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PROJECT MANUAL

VOLUME 2 OF 2
DIVISIONS 21 -33



River Road Elementary School Building & Site

Eugene School District 4j

120 Hilliard Lane
Eugene, OR 97404

Date: February 12, 2016

Owner: Eugene School District 4j

CIP#: 410.307.001

Architect: PIVOT Architecture, PC
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Architect's Project: 1337

**SECTION 00 0110
TABLE OF CONTENTS**

PROCUREMENT AND CONTRACTING REQUIREMENTS

DIVISION 00 -- PROCUREMENT AND CONTRACTING REQUIREMENTS

- 00 0101 - Project Title Page
- 00 0110 - Table of Contents
- 00 0115 - List of Drawing Sheets
- 00 1113 - Invitation To Bid
- 00 2113 - Instructions to Bidders, AIA Document A701
- 00 2213 - Supplementary Instructions to Bidders
- 00 3100 - Information Available to Bidders
Geotechnical Report
- 00 4113 - Bid Form
- 00 4522 - First Tier Subcontractor Disclosure Form
- 00 5213 - Form of Agreement
- 00 7213 - General Conditions, AIA Document A201
- 00 7300 - Supplementary Conditions
- 00 7343 - Prevailing Wage Rates for Public Contracts in Oregon

SPECIFICATIONS

DIVISION 01 -- GENERAL REQUIREMENTS

- 01 1100 - Summary of Work
- 01 1100 C - Full Time Superintendent Disclosure Statement
- 01 2100 - Allowances
- 01 2300 - Alternates
- 01 2500 - Contract Modification Procedures
- 01 2501 - CR/PO Form
- 01 2900 - Payment Procedures
- 01 3100 - Project Management and Coordination
- 01 3200 - Construction Progress Documentation
- 01 3300 - Submittal Procedures
- 01 4000 - Quality Requirements
- 01 5000 - Temporary Facilities and Controls
- 01 6000 - Product Requirements
- 01 6023 - Substitution Request Form Prior to Bidding
- 01 6024 - Substitution Request Form After Bidding
- 01 7300 - Execution Requirements
- 01 7329 - Cutting and Patching
- 01 7700 - Closeout Procedures
- 01 7823 - Operations and Maintenance Data
- 01 7839 - Project Record Documents
- 01 7900 - Demonstration and Training
- 01 9113 - General Commissioning Requirements

DIVISION 02 -- EXISTING CONDITIONS

02 4100 - Demolition

DIVISION 03 -- CONCRETE

03 1000 - Concrete Forming and Accessories

03 2000 - Concrete Reinforcing

03 3000 - Cast-in-Place Concrete

03 3511 - Concrete Floor Finishes

03 3543 - Polished Concrete Finishing

03 4500 - Precast Architectural Concrete

DIVISION 04 -- MASONRY

04 2000 - Unit Masonry

DIVISION 05 -- METALS

05 1200 - Structural Steel Framing

05 2100 - Steel Joist Framing

05 3100 - Steel Decking

05 4000 - Cold-Formed Metal Framing

05 5000 - Metal Fabrications

05 5100 - Metal Stairs and Railings

DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

06 1000 - Rough Carpentry

06 2000 - Finish Carpentry

06 4100 - Architectural Wood Casework

DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

07 1300 - Sheet Waterproofing

07 1900 - Water Repellents

07 2100 - Thermal Insulation

07 2500 - Weather Barriers

07 4113 - Metal Roof Panels

07 4213 - Metal Wall Panels

07 4264 - Metal Composite Material Wall Panels

07 5400 - Thermoplastic Membrane Roofing

07 6200 - Sheet Metal Flashing and Trim

07 7200 - Roof Accessories

07 7273 - Fall Arrest Roof Anchors

07 8400 - Firestopping

07 9005 - Joint Sealers

07 9513 - Expansion Joint Cover Assemblies

DIVISION 08 -- OPENINGS

08 1113 - Hollow Metal Doors and Frames

08 1416 - Flush Wood Doors

08 3100 - Access Doors and Panels

- 08 3223 - Security Grilles
- 08 4229 - Automatic Entrances
- 08 4313 - Aluminum-Framed Storefronts
- 08 4413 - Glazed Aluminum Curtain Walls
- 08 5113 - Transaction Window
- 08 6300 - Metal-Framed Skylights
- 08 7100 - Door Hardware
- 08 7111 - Door Hardware Schedule
- 08 8000 - Glazing
- 08 8723 - Decorative Glazing Films
- 08 9100 - Louvers

DIVISION 09 -- FINISHES

- 09 2116 - Gypsum Board Assemblies
- 09 3000 - Tiling
- 09 5100 - Acoustical Ceilings
- 09 5426 - Wood Ceilings
- 09 6466 - Wood Athletic Flooring
- 09 6500 - Resilient Flooring
- 09 6813 - Tile Carpeting
- 09 7733 - Glass Fiber Reinforced Plastic Panels
- 09 8405 - Acoustical Wall Panels
- 09 9000 - Painting and Coating
- 09 9600 - High-Performance Coatings
- 09 9657 - Electrostatic Epoxy Coating

DIVISION 10 -- SPECIALTIES

- 10 1101 - Visual Display Boards
- 10 1400 - Signage
- 10 2113.19 - Plastic Toilet Compartments
- 10 2123 - Cubicles
- 10 2226 - Folding Panel Partitions
- 10 2601 - Wall and Corner Guards
- 10 2800 - Toilet, Bath, and Laundry Accessories
- 10 4400 - Fire Protection Specialties
- 10 5100 - Lockers
- 10 7500 - Flagpoles

DIVISION 11 -- EQUIPMENT

- 11 4000 - Foodservice Equipment
- 11 5213 - Projection Screens
- 11 6143 - Stage Curtains and Rigging
- 11 6623 - Gymnasium Equipment
- 11 8227 - Waste Compactors

DIVISION 12 -- FURNISHINGS

- 12 2400 - Window Shades
- 12 5210 - Upholstered Seating
- 12 9300 - Site Furnishings
- 12 9313 - Bicycle Racks

DIVISION 13 -- SPECIAL CONSTRUCTION

DIVISION 14 -- CONVEYING EQUIPMENT

- 14 2010 - Passenger Elevators
- 14 4200 - Wheelchair Lifts

DIVISION 15 -- RESERVED (NOT USED) (FOR MECHANICAL, SEE DIVISIONS 21, 22, AND 23)

DIVISION 16 -- RESERVED (NOT USED) (FOR ELECTRICAL, SEE DIVISIONS 25, 26, 27, 28, AND 29)

DIVISION 17 -- RESERVED (NOT USED)

DIVISION 18 -- RESERVED (NOT USED)

DIVISION 19 -- RESERVED (NOT USED)

DIVISION 20 -- RESERVED (NOT USED)

DIVISION 21 -- FIRE SUPPRESSION

- 21 0500 - Common Work Results for Fire Suppression
- 21 1000 - Water Based Fire Suppression Systems

DIVISION 22 -- PLUMBING

- 22 0500 - Common Work Results for Plumbing
- 22 0514 - Variable Frequency Drives for Plumbing Equipment
- 22 0519 - Meters and Gages for Plumbing
- 22 0523 - General Duty Valves and Specialties for Plumbing
- 22 0529 - Hangers Supports and Anchors for Plumbing
- 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment
- 22 0553 - Identification for Plumbing Piping and Equipment
- 22 0590 - Pressure Testing for Plumbing Systems
- 22 0593 - Testing, Adjusting and Balancing for Plumbing
- 22 0700 - Insulation for Plumbing
- 22 0800 - Commissioning for Plumbing
- 22 1415 - Rainwater Reclamation System
- 22 2113 - Pipe and Pipe Fittings Plumbing
- 22 2123 - Pumps for Plumbing
- 22 2500 - Plumbing Water Treatment
- 22 3000 - Plumbing Equipment
- 22 4000 - Plumbing Fixtures

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

- 23 0500 - Common Work Results for HVAC
- 23 0514 - Variable Frequency Drives for HVAC Equipment
- 23 0518 - HVAC Expansion Compensation

- 23 0519 - Meters and Gages for HVAC Piping
- 23 0523 - General Duty Valves and Specialties for HVAC
- 23 0529 - Hangers, Supports and Anchors for HVAC
- 23 0548 - Vibration and Seismic Controls for HVAC Piping and Equipment
- 23 0553 - Identification for HVAC Piping and Equipment
- 23 0590 - Pressure Testing for HVAC Systems
- 23 0593 - Testing, Adjusting, and Balancing for HVAC
- 23 0700 - Insulation for HVAC
- 23 0800 - Commissioning of HVAC
- 23 0900 - Controls
- 23 2014 - Prefabricated Piping Systems for HVAC
- 23 2113 - Pipe and Pipe Fittings HVAC
- 23 2123 - Pumps for HVAC Systems
- 23 2500 - HVAC Water Treatment
- 23 3101 - HVAC Ducts and Casing-Low Pressure
- 23 3300 - Air Duct Accessories
- 23 3319 - Duct Silencers
- 23 3400 - HVAC Fans
- 23 3600 - Air Terminal Units
- 23 3700 - Air Outlets and Inlets
- 23 4000 - HVAC Air Cleaning Devices
- 23 5100 - Breechings, Chimneys, and Stacks
- 23 5200 - Heating Boilers
- 23 6400 - Packaged Water Chillers
- 23 7000 - Central HVAC Equipment
- 23 8100 - Decentralized Unitary HVAC Equipment
- 23 8200 - Convection Heating and Cooling Units
- 23 8410 - Electric Heating Equipment

DIVISION 24 -- RESERVED (NOT USED)

DIVISION 25 -- INTEGRATED AUTOMATION (NOT USED)

DIVISION 26 -- ELECTRICAL

- 26 0500 - Common Work Results for Electrical
- 26 0519 - Low-Voltage Electrical Power Conductors and Cables
- 26 0526 - Grounding and Bonding for Electrical Systems
- 26 0529 - Hangers and Supports for Electrical Systems
- 26 0533 - Raceways and Boxes for Electrical Systems
- 26 0535 - Sound System Raceway
- 26 0536 - Cable Trays for Electrical Systems
- 26 0543 - Underground Ducts and Raceways for Electrical Systems
- 26 0553 - Identification for Electrical Systems
- 26 0573 - Overcurrent Protection Device Coordination Study

26 0580 - Electrical Testing
26 0630 - Photovoltaic System
26 0800 - Commissioning for Electrical
26 0923 - Lighting Control Devices
26 2200 - Low-Voltage Transformers
26 2413 - Switchboards
26 2416 - Panelboards
26 2726 - Wiring Devices
26 2900 - Motor Controllers
26 3213 - Engine Generators
26 3623 - Automatic Transfer Switches
26 4313 - Surge Protective Devices
26 5000 - Lighting

DIVISION 27 -- COMMUNICATIONS

27 0000 - Communications
27 4116 - Integrated Audio-Video Systems and Equipment
27 0500 - Common Results for Communications
27 0513 - Communications Services
27 0526 - Grounding and Bonding for Communications Systems
27 0528 - Pathways for Communications Systems
27 0528.29 - Hangers and Supports for Communications Systems
27 0528.33 - Conduits and Backboxes for Communications Systems
27 0528.36 - Cable Trays for Communications Systems
27 0528.39 - Surface Raceways for Communications Systems
27 0553 - Identification for Communications Systems
27 0800 - Commissioning of Communications Systems
27 1100 - Communications Equipment Room Fittings
27 1116 - Communications Cabinets, Racks, Frames, and Enclosures
27 1119 - Communications Terminations Blocks and Patch Panels
27 1123 - Communications Cable Management and Ladder Rack
27 1126 - Communications Rack Mounted Power Protection and Power Strips
27 1313 - Communications Copper Backbone Cabling
27 1323 - Communications Optical Fiber Backbone Cabling
27 1513 - Communications Copper Horizontal Cabling
27 1543 - Communications Faceplates and Connectors
27 1619 - Communications Patch and Station Cords
27 2133 - Data Communications Wireless Access Points
27 4100 - Audio-Video Systems
27 4116 - Music Room Sound System
27 4119 - Integrated Audio Video Systems
27 5113 - Paging Systems
27 5313 - Clock Systems

DIVISION 28 -- ELECTRONIC SAFETY AND SECURITY

- 28 0500 - Common Work Results for CCTV and Security
- 28 0800 - Commissioning for Fire Alarm and Security
- 28 1313 - Access Control Applications
- 28 1316 - Access Control System and Database Management
- 28 1319 - Access Control Infrastructure
- 28 1326 - Access Control Remote Devices
- 28 1333 - Access Control Interfaces
- 28 1343 - Access Control Identification Management
- 28 1613 - Intrusion Detection Control Systems
- 28 1619 - Intrusion Detection Remote Devices
- 28 1633 - Intrusion Detection Interfaces
- 28 3001 - Fire Detection and Communication

DIVISION 29 -- RESERVED (NOT USED)

DIVISION 30 -- RESERVED (NOT USED)

DIVISION 31 -- EARTHWORK

- 31 2000 - Earth Moving
- 31 2333 - Trenching and Backfill
- 31 2500 - Erosion Control

DIVISION 32 -- EXTERIOR IMPROVEMENTS

- 32 1200 - Flexible Paving
- 32 1313 - Concrete Paving
- 32 1600 - Concrete Curbs and Gutters
- 32 1610 - Concrete Sidewalks
- 32 1713 - Parking Bumpers
- 32 1723.13 - Painted Pavement Markings
- 32 3113 - Chain Link Fences and Gates
- 32 3119 - Decorative Metal Fences and Gates
- 32 8000 - Irrigation
- 32 9000 - Planting

DIVISION 33 -- UTILITIES

- 33 1000 - Water Utilities
- 33 3000 - Sanitary Sewerage Utilities
- 33 3913 - Sanitary Utility Sewerage Manhole, Frames and Covers
- 33 4000 - Storm Drainage Utilities
- 33 4913 - Storm Drainage Manholes, Frames, and Covers
- 33 4600 - Subdrainage
- 33 5100 - Natural Gas Distribution

END OF TABLE OF CONTENTS

SECTION 21 0500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section calls for design-build work. Provide a complete working automatic sprinkler and standpipe system for the entire building as shown, specified and required by applicable codes.
- B. Piping and sprinkler head locations shall meet the Architectural design intent for the building in addition to complying with specifications and applicable codes. The right is reserved to make any reasonable changes in sprinkler head location prior to roughing-in, without cost impact.
- C. Related Sections include Section 21 1000, Water Based Fire Suppression Systems.

1.03 QUALITY ASSURANCE

- A. All work and materials shall conform to the local and State codes, and all Federal, State and other applicable laws and regulations.
- B. Contractor shall obtain and pay for all permits, licenses and inspection.
- C. Materials and equipment shall be UL listed except for pipe that meets the requirements of Table 6.3.1.1, fittings that meet Table 6.4.1, and hangers that meet section 9.1 of NFPA 13.
- D. Materials and equipment shall be new. Work shall be of good quality, free of faults and defects and in conformance with the Contract Documents.
- E. Apparatus shall be built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- F. All equipment shall be installed level and true.
- G. Where two or more units of the same class of equipment are furnished, use products of the same manufacturer. Component parts of the entire system need not be products of same manufacturer.
- H. Follow manufacturer's installation directions.
- I. Cutting and Patching:
 - 1. Cutting, patching, and repairing for the proper installation and completion of the work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting shall be performed by skilled craftsmen of each respective trade in conformance with the appropriate Division.
 - 2. Additional openings required in building construction shall be made by drilling or cutting. Use of jackhammer is prohibited.
 - 3. Fill holes which are cut oversize so that a tight fit is obtained around the sleeves passing through.
 - 4. Beams or columns shall not be pierced without permission of Architect.
 - 5. All new or existing work cut or damaged shall be restored to its original condition. Where alterations disturb lawns, paving, walks or other landscaping, the surfaces shall be repaired, refinished, and left in condition existing prior to commencement of work.
- J. Regulatory Requirements:
 - 1. All products and equipment shall be prohibited from containing pentabrominated, octabrominated and decabrominated diphenyl ethers. Where products or equipments within this specification contain these banned substances, provide complying products and equipments from approved manufacturers with equal performance characteristics.

2. General: All work and materials shall conform to the local and State codes, and all Federal, State and other applicable laws and regulations.
3. Contractor responsible for obtaining and payment for all permits, licenses, and inspection certificates required in accordance with provisions of Contract Documents.
4. All fire protection system designs must bear the stamp and seal of the registered Professional Engineer who prepared the documents. The Engineer's stamp certifies that the work was done under the Engineer's supervision and control. Certification from NICET technicians, or other contractors, cannot replace the certification by the Engineer. Verify/coordinate with local building department for their specific requirements

1.04 SUBMITTALS

A. Shop Drawings:

1. Prepare fire protection system shop drawings showing locations and types of head or outlets, alarm valves and devices, pipe sizes and cutting lengths, test tees and valves, drain valves, and other related items. Shop drawings shall be new drawings prepared by Contractor. Overlay drawings with shop drawings of other trades and check for conflicts. Drawings shall be same size as Architect's Drawings with similar title block. Drawings shall be fully dimensioned including both plan and elevation dimensions.
2. Shop drawings shall include:
 - a. Sprinkler head layout drawings overlaid with ceiling and floor plans.
 - b. Sprinkler floor plans, including all piping, equipment and heads to a minimum scale of 1/8-inch equals 1-foot or same as plans, whichever is greater.
 - c. Beam penetration drawings indicating beam penetrations at a minimum scale of 1/4-inch = 1-foot.
 - d. Fabrication drawings of architectural wooden ceilings and skylight areas, including panel penetrations for lighting, sprinkler heads, fire alarm devices, and any other penetrations.
 - e. Hydraulic calculation information may be included.
3. Submit shop drawings to Architect for review and approval prior to submittal to Authority Having Jurisdiction. Contractor may request a design coordination meeting with Architect prior to submitting shop drawings.
4. Additional shop drawings may be requested if it appears that coordination issues are not being resolved in the field.

B. Product Data: Submit product data for all equipment. Include manufacturer's detailed shop drawings, specifications, and data sheets. Data sheets shall include capacities, pressure drop, design and operating pressures, installation procedures and similar data.

C. Submit certificates and test reports as required by NFPA 13.

D. Submission Requirements:

1. Refer to Division 1 for additional requirements related to submittals.
2. Shop Drawings:
 - a. Provide three sets of shop drawings, hydraulic calculations, and product data to Architect for review.
 - b. Submit six sets of Authority Having Jurisdiction-approved drawings to Architect.
3. Product Data:
 - a. Submit electronic copies of product data in PDF format with each item filed labeled with its respective specification section number, article and paragraph and mark, if applicable.
 - b. Include a complete index in the submittal.

- c. All product data shall be submitted in a single submittal. Partial submittals will not be accepted.
- E. It shall be the Contractor's responsibility to:
 - 1. See that all submittals are submitted at one time and are in proper order.
 - 2. Ensure that all equipment will fit in the space provided.
 - 3. Assure that all deviations from Drawings and Specifications are specifically noted in the submittals. Failure to comply will void review automatically.

1.05 OPERATING AND MAINTENANCE MANUAL, PARTS LISTS, AND OWNERS INSTRUCTIONS

- A. Refer to Section 01 7823 – Operation and Maintenance Data for additional requirements.
- B. Instruct Owner thoroughly in proper operation of equipment and systems, in accordance with manufacturer's instruction manuals. Operating instructions shall cover all phases of control.
- C. Furnish competent engineer knowledgeable in this building system for minimum of one 8-hour day to instruct Owner in operation and maintenance of systems and equipment. Contractor shall keep a log of this instruction including dates, times, subjects, and those present and shall present such log when requested by Architect.

1.06 PROJECT CONDITIONS

- A. Prior to bidding, become familiar with existing conditions by visiting the site.
- B. Coordinate exact requirements governed by actual job conditions. Check all information and report any discrepancies before fabricating work.
- C. Coordinate shutdown and start-up of existing, temporary, and new systems and utilities with Owner.

1.07 TEST REPORTS AND CERTIFICATES

- A. Submit one copy of test reports and certificates to the Architect.

1.08 SUBSTITUTIONS

- A. Submit any requests for product substitutions in accordance with the Instructions to Bidders and the General and Supplemental Conditions.

PART 2 PRODUCTS

2.01 ACCESS PANELS

- A. Provide as specified in Architectural Divisions.

2.02 PIPE SLEEVES

- A. Interior Wall and Floor Sleeves: 18 gauge galvanized steel or pre-approved water tight system.
- B. Interior Wall and Floor Sleeves (fire rated): Fire rated and water tight system approved by Authority Having Jurisdiction.
- C. Exterior Wall and On Grade Floor Sleeves: Cast iron.

2.03 FLOOR, WALL AND CEILING PLATES

- A. Furnish stamped split type plates as follows:
 - 1. Floor Plates: Cast brass, chromium plated.
 - 2. Wall and Ceiling Plates: Spun aluminum.

PART 3 EXECUTION

3.01 COORDINATION

- A. Coordinate fire protection piping and appurtenances with ducts, other piping, electrical conduit, and other equipment.
- B. All fire protection piping and equipment shall be concealed except in area without ceilings.

- C. In general, sprinklers shall be located in the center of ceiling panels and symmetrically within rooms and down corridors, coordinated with and in pattern with lights and grilles. Deviations must be approved by the Architect.

3.02 SLEEVES

- A. Interior Floor and Wall Sleeves: Provide sleeves large enough to provide clearances around pipe outside diameter as required by NFPA. Make watertight by packing with safing insulation and sealing.
- B. Sleeves through Rated Floors and Walls: Similar to interior sleeves except install fire-rated system approved by Authority Having Jurisdiction.
- C. Exterior Wall Sleeves Below Grade: Make watertight with using link-seal modular wall and casing seal or lead and oakum. Caulk from outside.
- D. On Grade Floor Sleeves: Same as below grade exterior wall sleeves, except caulk from inside.
- E. Exterior Wall Sleeves Above Grade: Same as interior wall sleeves, except caulk from outside.
- F. All floor sleeves shall maintain a water barrier by providing a water tight seal or they shall extend 1 inch above finished floor except through mechanical equipment room floors and shafts where sleeves shall extend 2 inches above finished floor level. Sleeves through roof shall extend 8 inches above roof. Wall sleeves shall be flush with face of wall unless otherwise indicated. Sleeves through planters shall extend 8 inches above planter base.

3.03 FLOOR, WALL AND CEILING PLATES

- A. Install on piping passing through finished walls, floors, ceilings, partitions and plaster furrings. Plates shall completely cover opening around pipe and duct.
- B. Secure wall and ceiling plates to pipe or structure.
- C. Plates are not required in mechanical rooms or unfinished spaces.

3.04 CLEANING

- A. Clean equipment and piping of stampings and markings (except those required by codes), iron cuttings, and other refuse.
- B. Clean scratched or marred painted surfaces of rust or other foreign matter and paint with matching color industrial enamel.

3.05 EQUIPMENT PROTECTION

- A. Keep pipe and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect piping, conduit, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore damaged or contaminated equipment or apparatus to original conditions or replace at no cost to Owner.
- B. No rusted material is permitted.
- C. Cover or otherwise suitably protect equipment and materials stored on the job site.

3.06 ACCESSIBILITY

- A. Locate valves, indicating equipment or specialties requiring frequent reading, adjustments or inspection conveniently and accessibly.
- B. Install gauges so as to be easily read from the floors.

3.07 PAINTING

- A. Exposed to View:
 - 1. Hangers: One coat rust inhibiting primer and final coat of black enamel.
 - 2. Sprinkler Piping: One coat rust inhibiting primer and final coat of black enamel.
 - 3. Steel Valve Bodies and Bonnets: One coat of black enamel.
 - 4. Brass Valve Bodies: Not painted.
 - 5. Sprinkler Heads: Not painted.

B. Concealed from View (above ceilings, not visible):

1. Not painted.

3.08 CLEANING

A. Clean interior of all piping before installation.

B. Before operating any equipment or systems, make thorough check to determine that systems have been flushed and cleaned as required and equipment has been properly installed in accordance with manufacturer's instructions.

3.09 ELECTRICAL EQUIPMENT

A. Fire Suppression systems shall not pass over switchboards or electrical panelboards.

END OF SECTION

SECTION 21 1000
WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section, 21 0500, Common Work Results for Fire Suppression apply to work specified in this Section.

1.02 SUMMARY

- A. This Section calls for design-build work. Provide a complete working automatic fire sprinkler/standpipe system with zoning layout as shown, specified and required by applicable codes.

1.03 QUALITY ASSURANCE

- A. All work and materials shall conform to the local and State codes, and all Federal, State and other applicable laws and regulations, including in particular NFPA 13 and 14.
- B. NFPA 13 (without the use of exceptions found in NFPA 13 systems minimum guideline) shall be used for the location, sizing, and installation of piping and sprinkler systems unless local fire marshal or owner's insurance underwriter requirements are more stringent. Exceptions must be approved by the Engineer prior to usage.
- C. Water Service Pressure Basis of Design: Coordination was done to determine fire service water pressure used to develop the fire sprinkler system design information included herein. The Contractor shall be required to obtain current flow test information prior to starting their design of the fire sprinkler system.

1.04 SUBMITTALS

- A. Provide submittal in accordance with Section 21 0500, Common Work Results for Fire Suppression.

PART 2 PRODUCTS

2.01 SPRINKLER HEADS

- A. Fire sprinklers shall be of one manufacturer throughout building.
- B. Sprinklers Installed in Finished Ceilings: Quick response, recessed, bulb type, [chrome] [white] finish, 165 degrees F unless required otherwise.
- C. Sprinklers Installed in Finished Ceilings: Quick response, concealed pendant with [chrome] [white] drop-off cover plate, rough bronze finish, 155 degrees F unless required otherwise.
- D. Sprinklers Installed in Unfinished Ceiling Areas (or Above Finished Ceilings Where Required): Pendant or up-right fusible solder type, rough bronze finish and shall be of adequate temperature for the hazard.
- E. Sprinklers Installed in Exterior Covered Areas: Quick response, dry pendant fusible solder type, chrome finish, 165°F unless required otherwise.

2.02 UTILITY MARKERS

- A. Provide plastic tape utility markers over all buried piping. Provide identification on tape.
- B. Material to be Brady Identoline plastic tape, 6-inch, Seton, or approved equal.

2.03 VALVE IDENTIFICATION

- A. Valve Tags:
 - 1. General: Identify valves with metal tags or plastic signs, legends to be stamped or embossed. It shall indicate the function of the valve and its normal operating position, and area served; i.e.,
 - a. GRD LVL Area Served

- b. ISOLATION Valve Function
 - c. NO Normal Operation Position
2. Size: Valve tags 2-inch diameter with 1/4-inch high letters.
 3. Material: Use 0.050 or 0.064-inch brass tags.
 4. Control Valves: Use 1/16-inch thick laminated 3-ply plastic, center ply white, outer ply red, "lamicoid" or equal. Form letters by exposing center ply.
- B. Valve Tag Directory: Include tag number, location, exposed or concealed, area served, valve size, valve manufacturer, valve model number, and normal operating position of valve.

2.04 PIPING MARKERS

- A. Pipe not visible from occupied space shall be labeled with all-vinyl, self-sticking labels or letters. For pipe covering sizes up to and including 3/4-inch outside diameter, use labels with 1/2-inch letters. For sizes from 3/4 to 2-inch outside diameter, 3/4-inch letters; above 2-inches outside diameter, 2-inch letters. The pipe markers shall have a red background with black letters saying FIRE PROTECTION WATER with black directional arrows.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all items in accordance with manufacturers' instructions.
- B. Drain all piping per NFPA 13. If drain piping is discharged to outside, provide splash plate in a location approved by the architect.

3.02 EXTRA STOCK

- A. Provide additional number of heads of each type and temperature rating installed as required to meet NFPA 13 requirements.
- B. Provide storage cabinet or cabinets as required to receive reserve sprinkler heads and special installation tools required.
- C. Provide index label for each head indicating manufacturer, model, orifice size of K-factor, and temperature rating.
- D. Provide, inside cabinet, a list of heads stored within and brief description of where installed.
- E. Locate cabinet in a location approved by the architect.

3.03 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Perform all tests and arrange for required inspections of installed system as required.
 2. Notify the Owner and Architect 48 hours prior to any test or inspection.

END OF SECTION

SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of This Section, Common Work Results for Plumbing, apply to all sections in Division 22.
- C. All Sections of Division 22 are interrelated. When interpreting any direction, material, and method specified in any section of Division 22 consider it within the entirety of Work in Division 22.

1.02 SUMMARY

- A. The intent of Division 22 Specifications and the accompanying Drawings is to provide a complete and workable facility with complete systems as shown, specified and required by applicable codes. Include all work specified in Division 22 and shown on the accompanying Drawings, including appurtenances, connections, etc., in the finished job.
- B. The Division 22 Specifications and the accompanying Drawings are complementary and what is called for by one shall be as binding as if called for by both. Items shown on the Drawings are not necessarily included in the Specifications and vice versa. Specifications shall supersede drawings in case of conflict.
- C. Imperative language is frequently used in Division 22 Specifications. Except as otherwise specified, requirements expressed imperatively are to be performed by the Contractor.
- D. The Drawings that accompany the Division 22 Specifications are diagrammatic. They do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts. Offsets and transitions shall be assumed at a minimum at each duct crossing, structural penetrations through shear walls or beams, structural grids where ceiling heights are restricted, and at piping mains. Follow the Drawing as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the Building, subject to approval, and without additional cost to the Owner. The right is reserved to make any reasonable changes in fixture location prior to roughing-in, without cost impact.

1.03 RELATED WORK

- A. The General and Supplemental Conditions apply to this Division, including but not limited to:
 - 1. Drawings and specifications.
 - 2. Public ordinances, permits.
 - 3. Include payments and fees required by governing authorities for work of this Division.
- B. Division 1, General Requirements, applies to this Division.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. All products and equipments shall comply with Oregon Revised Statute (ORS) 453.005(7)(e) prohibiting pentabrominated, octabrominated and decabrominated diphenyl ethers. Where products or equipments within this specification contain these banned substances, provide complying products and equipments from approved manufacturers with equal performance characteristics.
 - 2. General: All work and materials shall conform to the local and State codes, and all Federal, State and other applicable laws and regulations.
 - 3. Contractor responsible for obtaining and payment for all permits, licenses, and inspection certificates required in accordance with provisions of Contract Documents.

- B. Materials and equipment shall be new. Work shall be of good quality, free of faults and defects and in conformance with the Contract Documents.
- C. Apparatus shall be built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- D. The entire plumbing system and apparatus shall operate at full capacity without objectionable noise or vibration.
- E. All equipment shall be installed level and true. Housekeeping pads and curbs shall account for floor or roof slope.
- F. Materials and Equipment:
 - 1. 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 along with other manufacturers.
 - 2. Where two or more units of the same class of equipment are furnished, use products of the same manufacturer. Component parts of the entire system need not be products of same manufacturer.
 - 3. Furnish all materials and equipment of size, make, type, and quality herein specified.
 - 4. Equipment scheduled by performance or model number shall be considered the basis of the design. If other specified manufacturer's equipment is provided in lieu of the basis of design equipment the contractor is responsible for all changes and costs which may be necessary to accommodate this equipment, including different sizes and locations for connections, different electrical characteristics, different dimensions, different access requirements or any other differences which impact the project.
- G. Workmanship:
 - 1. General: All materials shall be installed in a neat and professional manner.
 - 2. Manufacturer's Instructions: Follow manufacturer's directions where they cover points not specifically indicated. If they are in conflict with the Drawings and Division 22 Specifications, obtain clarification before starting work.
- H. Cutting and Patching:
 - 1. Cutting, patching, and repairing for the proper installation and completion of the work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting shall be performed by skilled craftsmen of each respective trade in conformance with the appropriate Division of Work.
 - 2. Additional openings required in building construction shall be made by drilling or cutting. Use of jackhammer is specifically prohibited.
 - 3. Fill holes which are cut oversize so that a tight fit is obtained around the sleeves passing through.
 - 4. Beams or columns shall not be pierced without permission of Architect and then only as directed.
 - 5. All new or existing work cut or damaged shall be restored to its original condition. Where alterations disturb lawns, paving, walks, etc., the surfaces shall be repaired, refinished, and left in condition existing prior to commencement of work.

1.05 SUBMITTALS

- A. Submit in accordance with Division 01.

B. Shop Drawings:

1. The Contract Drawings indicate the general layout of the piping, and various items of equipment. Coordination with other trades and with field conditions will be required. For this purpose, prepare Shop Drawings of all piping, and equipment installations. Shop Drawings shall be new drawings prepared by Contractor and not reproductions or tracings of Architect's Drawings. Overlay drawings with shop drawings of other trades and check for conflicts. All drawings shall be same size as Architect's Drawings with title block similar to Contract Drawings and identifying Architect's Drawing number or any reference drawings. All drawings shall be fully dimensioned including both plan and elevation dimensions. Shop drawings cannot be used to make scope changes.
2. Shop drawings shall be prepared in two-dimensional format.
3. Shop drawings shall include but are not limited to:
 - a. Plumbing site plan drawn to same scale as Site Plan.
 - b. Complete floor plans with plumbing to a minimum of 1/4-inch equals 1'-0" scale.
 - c. Plumbing in mechanical rooms to a minimum of 1/2-inch equal 1'-0" scale.
 - d. Sections of congested areas to a minimum of 1/2-inch = 1'-0" scale.
 - e. Fabricated Equipment: Scale and drawing sizes to suit contractor except equipment shall not be less than 1/2-inch equals 1'-0" scale.
 - f. Superplot plans of above ground work with a colored overlay of all trades including, but not limited to, HVAC piping, HVAC equipment, plumbing piping and equipment, sprinklers, lighting, lighting controls, cable tray, fire alarm devices, electrical power conduit, and ceiling system to a minimum of 1/2" = 1'-0" scale.
 - g. Superplot plans of below ground work with a colored overlay of all trades including, but not limited to, structural footings and foundation, HVAC piping, civil piping, plumbing piping, and power conduit to a minimum of 1/2" = 1'-0" scale.
 - h. Beam penetration drawings indicating beam penetrations meeting the requirements indicated on the floor plans and on the structural drawings to a minimum of 1/4" = 1'-0" scale.
 - i. Slab penetration drawings of HVAC, plumbing, sprinklers, lighting and electrical to a minimum of 1/4-inch equals 1'-0" scale.
4. Submit shop drawings for review prior to beginning fabrication. Additional shop drawings may be requested when it appears that coordination issues are not being resolved in the field or when there is a question as to whether contract documents are being complied with or the design intent is being met.

C. Product Data:

1. In general, submit product data for review on all scheduled pieces of equipment, on all equipment requiring electrical connections or connections by other trades, and as required by each specification section or by Drawing notes. Include manufacturer's detailed shop drawings, specifications and data sheets. Data sheets shall include capacities, RPM, BHP, pressure drop, design and operating pressures, temperatures, and similar data. Manufacturer's abbreviations or codes are not acceptable.
2. List the name of the motor manufacturer and service factor for each piece of equipment.
3. Indicate equipment operating weights including bases and weight distribution at support points.
4. In the case of equipment such as wiring devices, time switches, valves, etc., specified by specific catalog number, a statement of conformance will suffice.

D. Submission Requirements:

1. Shop Drawings and Product Data:
 - a. Refer to Division 1 for additional requirements related to submittals.

- b. Submit electronic copies of shop drawings and product data for Work of Division 22 in PDF format with each item filed under a folder and labeled with its respective specification section number, article, and paragraph and mark, if applicable.
 - c. Include a complete index in the original submittal. Indicate both original items submitted and note stragglers that will be submitted at a later date to avoid delay in submitting.
 - d. The bulk of the shop drawings and product data, excepting Controls and Instrumentation, shall be included with the original submittal. Controls and Instrumentation submittals may lag but shall be complete when submitted. Partial submittals will not be accepted. Other stragglers submitted after return of the original binder shall include a tab similar to that originally submitted. Upon receipt of the returned late submittal, insert them in the previously submitted binder.
- E. Contractor Responsibilities: It shall be the Contractor's responsibility to:
- 1. See that all submittals are submitted at one time and are in proper order.
 - 2. Ensure that all equipment will fit in the space provided.
 - 3. Assure that all deviations from Drawings and Specifications are specifically noted in the submittals. Failure to comply will void review automatically.

1.06 OPERATING AND MAINTENANCE MANUAL, PARTS LISTS, AND OWNERS INSTRUCTIONS

- A. Refer to Division 1 for additional requirements.
- B. Submit three bound copies of manufacturer's operation and maintenance instruction manuals and parts lists for each piece of equipment or item requiring servicing. Literature shall be on 8-1/2"x11" sheets or catalogs suitable for side binding. Submit data when the work is substantially complete, packaged separately, and clearly identified in durable 3-ring binder. Include name and contact information for location of source parts and service for each piece of equipment. Clearly mark and label in each submittal, the piece of equipment provided with the proper nameplate and model number identified. Provide wiring diagrams for all electrically powered equipment.
- C. Instruct Owner thoroughly in proper operation of equipment and systems, in accordance with manufacturer's instruction manuals. Operating instructions shall cover all phases of control.
- D. Furnish competent engineer knowledgeable in this building system for minimum of five 8-hour days to instruct Owner in operation and maintenance of systems and equipment. Contractor shall keep a log of this instruction including dates, times, subjects, and those present and shall present such log when requested by Architect.

1.07 PROJECT CONDITIONS

- A. Existing Conditions: Prior to bidding, verify and become familiar with all existing conditions by visiting the site, and include all factors which may affect the execution of this Work. Include all related costs in the initial bid proposal.
- B. Coordinate exact requirements governed by actual job conditions. Check all information and report any discrepancies before fabricating work. Report changes in time to avoid unnecessary work.
- C. Coordinate shutdown and start-up of existing, temporary, and new systems and utilities. Notify Owner, City and Utility Company.

1.08 WARRANTY

- A. Provide a written guaranty covering the work of this Division (for a period of one calendar year from the date of acceptance by the Owner) as required by the General Conditions.
- B. Provide manufacturer's written warranties for material and equipment furnished under this Division insuring parts and labor for a period of one year from the date of Owner acceptance of Work of this Division.
- C. Correct warranty items promptly upon notification.

1.09 PROVISIONS FOR LARGE EQUIPMENT

- A. Contractor shall make provisions for the necessary openings in building to allow for admittance of all equipment.

1.10 TEST REPORTS AND CERTIFICATES

- A. Contractor shall submit one copy of all test reports and certificates specified herein to the Architect.

1.11 SUBSTITUTIONS

- A. Contractor shall submit any requests for product substitutions in accordance with the Instructions to Bidders, section 01 6000 – Product Requirements and the General and Supplemental Conditions.

PART 2 PRODUCTS

2.01 ACCESS PANELS

- A. Furnish under this Division as specified in section 083100-Access Doors & Panels.

2.02 PIPE SLEEVES

- A. Interior Wall and Floor Sleeves: 18 gauge galvanized steel, or another pre-approved system.
- B. Interior Wall and Floor Sleeves (fire rated): Fire rated and water tight system approved by Authority Having Jurisdiction and Owners Insurance underwriter, with rating equal to floor or wall penetration, and designed specifically for the floor or wall construction, piping material, size and service.
- C. Exterior Wall Sleeves: Cast iron.
- D. On Grade Floor Sleeves: Same as exterior wall sleeves.
- E. Water Tight Sleeves: Combination steel pipe sleeves with water stop and anchor plate; Link Seal Model WS, mated with synthetic rubber links interlocked with bolts and nuts; Link Seal Model LS.

2.03 FLOOR, WALL AND CEILING PLATES

- A. Furnish stamped split type plates as follows:
 - 1. Floor Plates: Cast brass, chromium plated.
 - 2. Wall and Ceiling Plates: Spun aluminum.

2.04 MACHINERY GUARDS

- A. Furnish guards for protection on all rotating and moving parts of equipment. Provide guards for all metal fan drives and motor pulleys, regardless of being enclosed in a metal cabinet.
- B. Design guards so as not to restrict air flow at fan inlets resulting in reduced capacity.
- C. Provide shaft holes in guards for easy use of tachometers at pulley centers. Guards shall be easily removable for pulley adjustment or removal and changing of belts.
- D. All guards shall meet OSHA requirements including back plates.
- E. Provide inlet and outlet screens on all fans in plenums or where exposed to personnel.

2.05 ELECTRICAL EQUIPMENT

- A. General: All equipment and installed work shall be as specified under Division 26, Electrical.
- B. Coordinate with the electrical Drawings and electrical contractor for minimum electrical equipment bracing requirements based on the available interrupting current (AIC) rating at the bus of the panelboard or switchboard serving the piece of equipment. Provide equipment that meets the bracing requirement.

C. Motors:

1. Motors shall be furnished as integral part of driven equipment. They shall be drip-proof induction type with ball bearings unless noted otherwise. Motors 1 HP and above shall be premium energy efficient type, except for emergency equipment motors. Motors shall be built to NEMA Standards for the service intended. The motors shall be rated for the voltage specified, suitable for operation within the range of 10% above to 10% below the specified voltage.
2. Energy efficient motors shall be Baldor, Westinghouse, General Electric or approved equal. The motor shall meet the efficiency standards identified in the table below as determined using the IEEE Method B test at full load.

MINIMUM MOTOR EFFICIENCIES					
		RPM			
		IEEE 112B Efficiency			
HP	KW	900	1200	1800	3600
1	0.75	--	82.5	85.5	80.0
1.5	1.15	--	86.5	86.5	85.5
2	1.53	--	87.5	86.5	86.5
3	2.3	84.0	89.5	89.5	88.5
5	3.8	85.5	89.5	89.5	89.5
7.5	5.6	87.5	91.7	91.7	91.0

3. Refer to Equipment Schedules on the Drawings for motor horsepower, voltage and phase.
 4. Refer to individual product sections for additional motor requirements.
 5. Motors shall have built-in thermal overload protection, or be protected externally with separate thermal overload devices with low voltage release or lockout. Hermetically sealed motors shall have quick trip devices.
 6. All motors controlled by variable frequency drives shall be inverter duty rated and have Class F insulation or better. They shall also be able to withstand repeated voltage peaks of 1600 volts with rise times of 0.1 microseconds and greater in accordance with NEMA Standard MG1 Part 31.
 7. Motors served from variable frequency drives shall be equipped with shaft grounding system which shall provide a path for current to flow between the shaft and motor frame. SGS or equal.
- D. Starters: Provided under Division 26, Electrical, suitable for performing the control functions required, with the exception of self-contained equipment and where the starters are furnished as part of the control package.
- E. Equipment Wiring: Interconnecting wiring within or on a piece of mechanical equipment shall be provided with the equipment unless shown otherwise. This does not include the wiring of motors, starters and controllers provided under Division 26, Electrical.
- F. Control Wiring: All control wiring for plumbing equipment shall be provided herewith.
- G. Codes: All electrical equipment and products shall bear the Underwriters label as required by governing codes and ordinances.

PART 3 EXECUTION

3.01 ACCESS PANELS

- A. Install in accord with manufacturer's recommendations, coordinated with architectural features.
- B. Provide 1-hour and 2-hour fire rated doors where required bearing the U.L. label.
- C. Furnish 18-inch by 18-inch panels for ceilings and for access to equipment in soffits and shafts, and 12-inch by 12-inch for walls unless indicated otherwise.

- D. Furnish where indicated and where required to access valves, trap primers, shock arresters, and other appurtenances requiring operation, service or maintenance. Submit proposed locations for review prior to installation.

3.02 SLEEVES

- A. Interior Floor and Wall Sleeves: Provide sleeves large enough to provide 3/4-inch clearances around pipe or ductwork. Where pipe or ductwork is insulated, insulation shall pass continuously through sleeve with 3/4-inch clearance between insulation and sleeve. Penetrations through mechanical room and fan room floors shall be made watertight by packing with safing insulation and sealing with Tremco Dymeric Sealant or approved system.
- B. Sleeves Through Rated Floors and Walls: Similar to interior sleeves except install fire rated system approved by Authority Having Jurisdiction and Owners insurance underwriter, with rating equal to floor or wall penetration, and designed specifically for the floor or wall construction, piping material, size and service.
- C. Exterior Wall Sleeves Below Grade: Provide water tight sleeves. Install at pipes entering building below grade and where shown. Adjust to provide positive hydrostatic seal. Contractor shall be responsible for following manufacturer's procedure for installing and tightening seal. Secure sleeves against displacement.
- D. On Grade Floor Sleeves: Same as below grade exterior wall sleeves, caulked from inside.
- E. Exterior Wall Sleeves Above Grade: Similar to interior wall sleeves except caulk outside with Tremco Dymeric Sealant.
- F. Layout work prior to concrete forming. Do all cutting and patching required. Reinforce sleeves to prevent collapse during forming and pouring.
- G. All floor sleeves shall maintain a water barrier by providing a water tight seal or they shall extend 1-inch above finished floor except through mechanical equipment room floors and shafts where sleeves shall extend 2 inches above finished floor level. Sleeves through roof shall extend 8 inches above roof. Wall sleeves shall be flush with face of wall unless otherwise indicated. Waste stacks using carriers shall have sleeves flush with floor and sealed. Sleeves through planters shall extend 8 inches above planter base.
- H. Do not support pipes by resting pipe clamps on floor sleeves. Supplementary members shall be provided so pipes are floor supported.
- I. Special sleeves detailed on drawings shall take precedence over this section.

3.03 CLEANING

- A. General: Clean plumbing equipment, fixtures and piping of stampings and markings (except those required by codes), iron cuttings, and other refuse.
- B. Painted Surfaces: Clean scratched or marred painted surfaces of rust or other foreign matter and paint with matching color industrial enamel, except as otherwise noted.
- C. Additional requirements are specified under specific Sections of this Division.

3.04 EQUIPMENT PROTECTION

- A. Keep pipe and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect piping, conduit, fixtures, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore damaged or contaminated fixtures, equipment, or apparatus to original conditions or replace at no cost to the Owner.
- B. Protect bright finished shafts, bearing housings, and similar items until in service. No rust will be permitted.
- C. Cover or otherwise suitably protect equipment and materials stored on the job site.

3.05 ACCESSIBILITY

- A. General: Locate valves, thermometers, cleanout fittings and other indicating equipment or specialties requiring frequent reading, adjustments, inspection, repairs, and removal or replacement conveniently and accessibly with reference to the finished building.
- B. Thermometers and Gauges: Install thermometers and gauges so as to be easily read from the floors, platforms and walkways.

3.06 FLOOR, WALL AND CEILING PLATES

- A. Install on piping and ductwork passing through finished walls, floors, ceilings, partitions, and plaster furrings. Plates shall completely cover opening around pipe.
- B. Secure wall and ceiling plates to pipe, insulation, or structure.
- C. Plates shall not penetrate insulation vapor barriers.
- D. Plates not required in mechanical rooms or unfinished spaces.

3.07 PAINTING

- A. General: Coordinate painting of mechanical equipment and items with products and methods in conformance with the appropriate Division of Work, Painting. All exposed work under this division shall receive either a factory painted finish or a field prime coat finish, except:
 - 1. Exposed copper piping.
 - 2. Aluminum jacketed outdoor insulated piping.
- B. Equipment Rooms and Finished Areas:
 - 1. Insulation: Not painted.
 - 2. Hangers, Uninsulated Piping, Miscellaneous Iron Work, Structural Steel Stands, Uninsulated Tanks, and Equipment Bases: Paint one coat of black enamel.
 - 3. Steel Valve Bodies and Bonnets: One coat of black enamel.
 - 4. Brass Valve Bodies: Not painted.
 - 5. Equipment: One coat of grey machinery enamel. Do not paint nameplates.
- C. Concealed Spaces (above ceilings, not visible):
 - 1. Insulation: Not painted.
 - 2. Hangers, Uninsulated Piping, Miscellaneous Iron Work, Valve Bodies and Bonnets: Not painted.
- D. Exterior Steel: Wire brush and apply two coats of rust-inhibiting primer and one coat of grey exterior machinery enamel.
- E. Exterior Black Steel Pipe: Wire brush and apply two coats of rust-inhibiting primer and one coat of exterior enamel. Painting schemes shall comply with ANSI A13.1.

3.08 ADJUSTING AND CLEANING

- A. Before operating any equipment or systems, make thorough check to determine that systems have been flushed and cleaned as required and equipment has been properly installed, lubricated, and serviced. Check factory instructions to see that installations have been made accordingly and that recommended lubricants have been used.
- B. Use particular care in lubricating bearings to avoid damage by overlubrication and blowing out seals. Check equipment for damage that may have occurred during shipment, after delivery, or during installation. Repair damaged equipment as approved or replace with new equipment.

3.09 ELECTRICAL EQUIPMENT

- A. Piping for plumbing systems not serving electrical space shall not be installed in any switchgear room, transformer vault, telephone room, or electric closet except as indicated.
- B. Piping for plumbing systems shall not pass over switchboards or electrical panelboards. Where conflicts exist, bring to attention of Architect.

3.10 EQUIPMENT CONNECTIONS

- A. Make final connections to equipment specified in sections other than Division 22 of the specifications and Owner furnished equipment in accordance with manufacturer's instructions and shop drawings furnished and as indicated.
- B. Piping:
 - 1. Connections include hot and cold water, non-potable water, natural gas, sanitary waste and vent, and propane.
 - 2. Provide valves and specialties as specified and as detailed on the Drawings. Provide increasers, reducers, and any other fittings required for complete installation.
 - 3. All piping connections shall be independently supported to prevent undue strain on equipment.
- C. Refer to Specification Section 11 4000 Food Service Equipment.

END OF SECTION

SECTION 22 0514

VARIABLE FREQUENCY DRIVES FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Variable frequency drives.

1.03 SUBMITTALS

- A. Submit the following:
 1. Product data on variable frequency drives and related components.
 2. Startup log/check list showing successful operation.
 3. Operation and maintenance data.

PART 2 PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES

- A. Acceptable Manufacturers:
 1. Reliance, Toshiba, ABB, Emerson, Yaskawa, Square D, Siemens, Safronics, and Allen-Bradley.
 2. Other Manufacturers: Submit substitution request.
- B. General Description:
 1. Variable frequency AC motor drive (VFD) to be of pulse width modulated (PWM) inverter type. The VFD designed to convert 60 Hz input power to adjustable frequency output power to provide positive speed control to standard induction motors. The VFD to be dedicated variable torque design for specific use with centrifugal loads.
 2. Provide completely solid state variable frequency power and logic unit.
 3. Speed control to be step-less throughout the range under variable torque load on continuous basis. Speed controlled by remote building energy management system providing 4-20MA input signal to drive and remote start/stop signal. Coordinate with Section 23 0900.
 4. Provide adjustable frequency control with diode bridge/capacity input designed to provide high, constant power factor of 0.95 regardless of load or speed and eliminate SCR line noise.
 5. Equipment will be designed and manufactured in accordance with applicable current NEMA and IEEE recommendations and be designed for installation per NEC. Equipment will be UL listed and bear the UL label.
 6. Control shall be suitable for operation in ambient temperatures of 32 degrees F to 104 degrees F.
 7. Every VFD shall be factory tested with an AC induction motor 100 percent loaded and temperature cycled within an environmental chamber at 104 degrees F.
- C. Self Protection and Reliability Features:
 1. Adjustable current limit to 60 percent to 110 percent of drive rating.
 2. Adjustable instantaneous overcurrent trip.
 3. Under voltage trip.

4. Over temperature trip.
5. Short circuit protection phase to phase and phase to ground faults phase rotation insensitive.
6. Momentary power loss, more than 17 milliseconds.
7. Transient protection against all normal transients and surges in incoming power line.
8. Orderly shutdown in event of any of above conditions, drive shall be designed to shut down safely without component failure.
9. Provide visual indication and manual reset.

D. Standard Features:

1. Drive logic shall be microprocessor based. Control logic shall be isolated from power circuitry.
2. Stand alone operation to facilitate start up and troubleshooting procedures.
3. VFD shall be UL 508C listed for drives serving a single motor or UL 508A listed for drives serving multiple motors, for use on distribution systems with 22,000 AIC.
4. Output voltages shall be equal to applied input voltage.
5. Isolated signal inputs.
6. Frequency Stability. Output frequency will be held to +0.1% of maximum frequency regardless of load, +10% input voltage change or temperature changes within ambient specification.
7. Built-in digital display shall indicate output frequency, voltage and current and shall provide indication of over current, over voltage, current limit, ground fault, over temperature, input power on, minimum or maximum speed adjustment, power on, fault condition. Display shall be on panel face.
8. Start/Stop Control - Controlled decelerated stop.
9. Primary and secondary fused for a control circuit transformer.
10. Minimum and maximum speed control.
11. Adjustable Accel/Decel - independently adjustable 10-100 second.
12. Hand-Off auto switches.
13. Programmable Auto Restart - after power outage.
14. Provide fused disconnect, including auxiliary contacts to isolate control circuit when disconnect is in "off" position, except fused disconnects not required where packaged equipment is provided with a single point connection with single point disconnect and internal overcurrent protection for VFD and motors.
15. Remote contacts for fault, and on/off status.
16. Adjustable motor output voltage.
17. Analog output voltage of 0-10 VDC, -20 MA proportional to control output frequency.
18. Provide a NEMA 1 enclosure for indoor applications and NEMA 3R enclosure for outdoor applications to isolate each motor starter and control section with its associated disconnect switch.
19. Manual speed control for each motor.

E. Communications:

1. Provide factory installed communication chip for direct network connection to DDC Control System specified in Section 23 0993. Interface shall allow for all control and interface functions specified herein and in Section 23 0993. Interface control functions and information shall include, but not be limited to the following:
 - a. Start/Stop

- b. Change Directions
 - c. Drive Fault
 - d. Drive Fault Codes
 - e. Reset Drive
 - f. Percent Output
 - g. Speed
 - h. Power
 - i. Drive Temp
 - j. KWH
 - k. Run Time
- 2. Provide isolated analog output signals for volts, amps and frequency from each VFD for connection to the DDC Control System specified in Section 23 09 93.
 - 3. Provide RS485 communications port and programming software capability.

PART 3 EXECUTION

3.01 VARIABLE FREQUENCY DRIVE INSTALLATION

- A. Install VFD in accordance with manufacturer's written installation instructions.
- B. Install on strut support stand.
- C. Provide one drive for each motor as scheduled.

3.02 START UP

- A. General: Comply with manufacturer's instructions for startup.
- B. Startup provided under the direct supervision of the manufacturer's representative with factory trained personnel.

3.03 FIELD QUALITY CONTROL

- A. Prior to installation, manufacturer's representative shall coordinate variable speed drive control interface with the controls contractor and verify that intended installation (controls, wiring, etc.) complies with the manufacturer's recommendations.
- B. Field Test: Except where initial variable speed drive operation clearly shows the performance meets or exceeds the requirements, test to show compliance. Tests performed by the manufacturer's representative in the presence of the Engineer.

END OF SECTION

**SECTION 22 0519
METERS AND GAUGES FOR PLUMBING**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Thermometers, pressure gauges, water meters, water flow meters, vacuum gauges.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Products listed in this Section.
 - 2. Water flow meters, include graph of output signal vs. gpm for each device.
 - 3. Operating and Maintenance Data.

PART 2 PRODUCTS

2.01 THERMOMETERS, WATER

- A. Acceptable Manufacturers:
 - 1. Ashcroft, Weiss, Terrice, Marsh, Weksler, Tel-Tru.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Direct drive 5-inch dial type, stainless steel case, separable sockets, stem length to penetrate minimum of 1/2 pipe diameter, adjustable face, extension necks where required to clear insulation.

C. Range:

Plumbing Systems	Temperature	Graduations
Domestic Hot Water	30-180 degrees F	2 degrees F

2.02 PRESSURE GAUGES - GENERAL

- A. Acceptable Manufacturers:
 - 1. Marsh, Ashcroft, Weiss, Terrice, Weksler, Tel-Tru.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: 4-1/2-inch dial, molded black polypropylene turret case.

C. Range:

Plumbing Systems	Pressure	Graduations
Domestic Cold Water	0-160 psi	1 psi
Reclaimed Water	0-160 psi	1 psi
Industrial Cold Water	0-160 psi	1 psi
Other ranges may be listed on Drawings in which case they take precedence		

2.03 WATER METER

- A. Acceptable Manufacturers:
 - 1. Hersey Model HD, similar Badger, Sparling.
 - 2. Other Manufacturers: Submit Substitution Request.

B. Description:

1. Disc type meter, bronze split casing, magnetic drive.
2. Heavy duty gear train, completely sealed, circular meter, totalize in cubic feet with sweep hand.
3. Comply with AWWA performance standards.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Provide meters and gauges where shown on Drawings.
- B. Install all gauges and meters as required and as recommended by equipment manufacturer or their representative.
- C. Extend all connections, wells, cocks, or gauges to a minimum of 1-inch beyond insulation thickness of the various systems.
- D. Locate all gauges so that they may be conveniently read at eye level or easily viewed and read from the floor or from the most likely viewing area, i.e., platform, catwalk, etc.
- E. Install instruments over 6'-6" above floor, to be viewed from the floor, with face at 30 degrees to horizontal.

3.02 INSTALLATION - PRESSURE GAUGES

- A. Provide instrument gauge cock at inlets. Locate pressure gauge taps for measuring pressure drop or increase across pumps, etc., as close to the device as possible.

3.03 WATER METER

- A. Installed in accord with manufacturer's recommendations and as shown on the Drawings.

END OF SECTION

SECTION 22 0523

GENERAL DUTY VALVES AND SPECIALTIES FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing, apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Valves, general purpose gauge cocks, and balance fittings.

1.03 SUBMITTALS

- A. Submit product data.

1.04 DEFINITIONS

- A. CWP Cold Working Pressure
- B. EPDM Ethylene Propylene Copolymer Rubber
- C. NBR Acrylonitrile-Butadiene, Buna-N, or Nitrile Rubber
- D. NRS Nonrising Stem
- E. OS&Y Outside Screw and Yoke
- F. RS Rising Stem
- G. PTFE Polytetrafluoroethylene plastic.
- H. SWP Steam working pressure.
- I. Lead Free: Refers to the wetted surface of pipe, fittings, and fixtures in potable water systems that have a weighted average lead content ≤ 0.25 percent per Safe Drinking Water Act as amended January 4, 2011. Section 1417 *Add specific state requirements as needed.

1.05 QUALITY ASSURANCE

- A. ASME Compliance:
 - 1. ASME B16.10 for ferrous valve dimensions.
 - 2. ASME B31.9 for building services piping valves.
- B. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER VALVES

- A. General: Where only NIBCO INC. figure numbers are listed, equivalent products by those specified below are acceptable.
 - 1. Swing Check: Victaulic, Crane, Kennedy, Stockham, Milwaukee, Walworth and Hammond.
 - 2. Silent Check: Mueller, Metraflex, Victaulic, Bell and Gossett, Milwaukee and Gruvlok.
 - 3. Balancing: Bell and Gossett, Armstrong, Tour and Anderson, and NIBCO.
 - 4. Butterfly: Victaulic, Gruvlok, Crane, Walworth, Milwaukee and Metraflex.
 - 5. Ball: Gruvlok, Apollo, Crane, Hammond, Milwaukee and Victaulic.
- B. Other Manufacturers: Submit Substitution Request.
- C. All such valves shall be of one manufacturer.
- D. Valve ends may be threaded, flanged, soldered, or grooved, as applicable to piping system. Refer to Section 22 2113, Pipe and Pipe Fittings Plumbing for allowable fittings.

2.02 GLOBE VALVES

- A. Bronze Globe and Angle Globe: Bronze body, bronze mounted, renewable composition disc, 150 psi rating; NIBCO 235 or 335.
- B. Bronze Globe and Angle Globe High Pressure: Bronze body, stainless steel disc, union bonnet, 300 psi steam; NIBCO 276-AP or 376-AP.

2.03 CHECK VALVES

- A. Horizontal Bronze Swing Check: Bronze body, bronze mounted, regrinding bronze disc, 150 psi steam rating, 300 psi WOG; NIBCO 433-Y.
- B. Lead Free Horizontal Bronze Swing Check: Lead Free Silicon Bronze corrosion resistant body, and trim, PTFE renewable seat and disc, 300 psi CWP; NIBCO S/T 413-Y-LF.
- C. Horizontal Iron Swing Check: Iron body, bronze mounted, regrinding bronze disc and seat ring, 125 psi rating; NIBCO 918.
- D. Lead Free Horizontal Iron Swing Check: ASTM A 126 gray Iron body, Stainless steel or Lead Free silicon bronze corrosion resistant trim, 200 CWP psi rating; NIBCO F-918-LF.

2.04 BALL VALVES

- A. Bronze Ball: Bronze cast body, chrome-plated full port ball, with handle, Teflon seat, 600 psi WOG, 150 psi steam; NIBCO 585-80.
- B. Lead Free Bronze Ball: Two piece, full port, Lead Free silicon bronze body, Stainless steel or silicon bronze trim, Reinforced PTFE or TFE seats, 600 psi CWP NIBCO T/S-585-80-LF or T/S-585-66-LF.

2.05 BUTTERFLY VALVES

- A. Ductile iron body, nickel chrome plated disc and stainless steel shaft, with lever handle and locking feature on valves 6-inches and less, gear operator on valves 8-inches and over; stem neck length to accommodate insulation where applicable, EPDM liner, 200 psi water; NIBCO 2000, NIBCO 4765.
- B. Lead Free Butterfly Valve: Ductile iron body, Lead Free Aluminum Bronzedisc and stainless steel stem, with lever handle and locking feature on valves 6-inches and less, gear operator on valves 8-inches and over; stem neck length to accommodate insulation where applicable, EPDM liner, 200 psi water; NIBCO LD- 2000N-3/5,
- C. Copper Grooved Piping System Butterfly Valve: Brass body, Aluminum-bronze disc, Fluoroelastomer seat, lever handle, stem length to accommodate insulation, 300 psi water; Victaulic Series 608N.
 - 1. Grooved ends shall be manufactured to copper-tubing sizes. Flaring tube or fitting ends to accommodate alternate sized couplings is not permitted.

2.06 BALANCING VALVE

- A. Lead-Free Calibrated:
 - 1. Bronze, Ametal (copper-alloy), or ductile iron body, brass globe or ball, differential pressure readout valves with integral checks, calibrated plate, integral pointer, suitable for tight shutoff, memory stops, threaded, grooved or soldered ends, 250 psi water, NSF/ANSI 61 compliant, Bell and Gossett Lead-Free Circuit Setter Plus.

2.07 SPECIALTY VALVES

- A. Gas Cock: Forged brass body, hard chromium plated forged brass ball, with handle, rubber seats meeting ASTM D471, 175 psi WOG, entire unit tested to latest version of ANSI Z21.15, AGA and UL listed; Wooster, Parker, Watts, Jamesbury, PGL, ASCO.
- B. Emergency Gas Shutoff: Cast steel, normally closed, manually opened, electrically held open, automatic closing upon power interruption, Maxon Series CMM11. Provide manual gas cock upstream of emergency gas shut-off valve.

- C. Seismic Emergency Gas Shutoff Valve: Forged brass body, acceleration-sensitive triggering mechanism that is activated by a sudden motion, trip mechanism consisting of a steel ball resting on a tapered cup-shaped support with view port. Trip mechanism is factory set and sealed. Horizontal flow, see drawings for required size and capacity. Constructed to ANSI Z21.70, 1980 and ASCE 25-97 standards. UL listed and FM approved.
- D. Gauge Cocks: Brass, tee handle, male to female, 200 psi working pressure, 1/4 inch; Apollo 41 series.
- E. Drain Valves: Bronze globe valve or full port ball valve, garden hose end, cap and chain 3/4 inch size.
- F. Gas Pressure Regulator:
 - 1. Acceptable Manufacturers:
 - a. Actaris, Maxitrol, Fisher.
 - b. Other Manufacturers: Submit Substitution Request.
 - 2. Description: 0-500 SCFH capacity at 0-14 inches outlet pressure.
 - a. Body: Cast iron complying with ANSI 125 lb. construction standard.
 - b. Orifice: Aluminum.
 - c. Valve Seat: BUNA-N.
 - d. Diaphragm: BUNA-N.
 - e. Internal relief valve.
 - f. Maxitrol 325 series.
 - 3. Description: 501-3,000 SCFH capacity at 0-2 PSIG outlet pressure.
 - a. Body: Cast iron complying with ANSI 125 lb. construction standard.
 - b. Orifice: Brass.
 - c. Valve Seat: BUNA-N.
 - d. Diaphragm: BUNA-N.
 - e. Internal relief valve.
 - f. Actaris B38 series.
 - 4. Description: 3,001-10,000 SCFH capacity at 1-2 PSIG outlet pressure.
 - a. Body: Ductile iron.
 - b. Orifice: Stainless steel.
 - c. Valve Seat: Brass with vulcanized BUNA-N.
 - d. Diaphragm: BUNA-N
 - e. External relief valve.
 - f. Actaris RB1700 series.

2.08 WATER PRESSURE REDUCING VALVE ASSEMBLY

- A. Acceptable Manufacturers: Watts No. 223S, similar and equal Fisher, Armstrong Cash Acme.
- B. Description: Bronze body with inlet strainer, water tight cage assembly, 200 psi working pressure and suitable for 200 degrees F.

2.09 SYSTEM SPECIALTIES

- A. Manual Air Vents: Coin type; Dole No. 9 or approved equal.
- B. Pressure/Temperature Test Plug:
 - 1. Acceptable Manufacturers:
 - a. Peterson Engineering, Inc., Universal Lancaster, Sisco, Terlice.

- b. Other Manufacturers: Submit Substitution Request.
- 2. General: 1/2-inch NPT. fitting to receive either a temperature or pressure probe 1/8-inch O.D., fitted with a color coded and marked cap with gasket.
- 3. Material: Solid brass with valve core of Nordel.
- 4. Rating: Minimum 300 psig at 275 degrees F.
- 5. Gauges and Thermometers: Supply Owner with two pressure gauge adapters with 1/8-inch O.D. probe and two five-inch stem pocket test thermometers 25 degrees F to 125 degrees F for chilled water, 40 degrees F to 240 degrees F for heating water.

2.10 WATER RELIEF VALVES

- A. Acceptable Manufacturers:
 - 1. Consolidated, Kunkle, B&G, Armstrong, Cash Acme.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: Bronze or steel body, stainless steel or bronze, pressure settings to 160 psi at 250 degrees F, conforming to Section IV of ASME Code, size per manufacturer's recommendations based on Code, setting as indicated; Kunkle Model 537.

2.11 STRAINERS

- A. Acceptable Manufacturers:
 - 1. Armstrong, McAlear, Sarco, Steamflo, Mueller, R.P. & C. Company Titan Flow Control.
 - 2. For Grooved Coupling Systems: Gruvlok or Victaulic.
 - 3. Other Manufacturers: Submit Substitution Request.
- B. Wye Pattern:
 - 1. Bronze: Bronze body, 250 psi, 1/16-inch perforated type 304 stainless screen.
 - 2. Ductile Iron: Ductile iron body, 300 psi, 1/16 or 1/8-inch 304 stainless steel screen.
 - 3. Cast Iron: Cast iron body, 125 psi, 1/16-inch perforated type 304 stainless screen.
 - 4. Cast Iron, High Pressure: Cast iron body, 250 psi, 1/16-inch perforated type 304 stainless screen.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide valves at connections to equipment where shown or required for equipment isolation.
- B. Provide separate support for valves where necessary.
- C. Provide drain valves in all low points in the piping system, at coils and equipment, and as indicated.
- D. Coordinate gas pressure regulator selection with inlet pressure available at the regulator and the capacity and outlet pressure required by the equipment served. Install in accordance with manufacturer's recommendations. All gas cocks and gas regulator shall be located to be readily accessible for servicing. Provide approved gas cock immediately upstream of each gas pressure regulator. Provide separate vent to the outside for each regulator.

3.02 APPLIED LOCATIONS PLUMBING VALVES

A. In piping 2-inches and smaller:

System	Valve Types				
	Gate	Globe	Swing Check	Ball	Butterfly
Domestic Hot	Lead Free Bronze	Lead Free Bronze	Lead Free Bronze	Lead Free Bronze	Not Allowed
Domestic Cold	Lead Free Bronze	Lead Free Bronze	Lead Free Bronze	Lead Free Bronze	Not Allowed
Reclaimed Water	Bronze	Bronze	Bronze	Bronze	Not Allowed

B. In piping 2-1/2-inches and larger:

System	Valve Types				
	Gate	Globe	Swing Check	Ball	Butterfly
Domestic Hot	Lead Free Iron	Lead Free Iron	Lead Free Iron	Not Allowed	Lead Free Ductile Iron
Domestic Cold	Lead Free Iron	Lead Free Iron	Lead Free Iron	Not Allowed	Lead Free Ductile Iron
Reclaimed Water	Iron	Iron	Iron	Not Allowed	Ductile Iron

C. Calibrated balancing valves on domestic hot water. Size balancing valves based on the published performance curve characteristics for the scheduled flow rate for each location to ensure proper operation at design conditions.

D. Silent check valves on pump discharge for domestic cold water, reclaimed water, cold process water, process grey water.

E. Check valves on vertical discharge of sump pumps, iron swing check with outside weight and lever. Mount in piping at 45 degree angle.

F. In Natural Gas Piping:

1. Gas cock.
2. Gas pressure regulator.

G. Provide gauge cock for all pressure gauges.

3.03 VALVE IDENTIFICATION

A. General: Identify valves to indicate their function and system served.

B. Refer to Section 22 0553, Identification for Plumbing Piping and Equipment.

3.04 CHAIN OPERATORS

A. All valves in equipment rooms or fan rooms used for equipment or coil isolation and more than 8 feet above floor shall be installed with stem horizontal and equipped with chain wheels and chains extending to 6 feet above floor.

3.05 WATER PRESSURE REDUCING VALVE ASSEMBLY

A. Two valve assembly with smaller valve approximately 33 percent of the total larger valve approximately 66 percent of the total demand. See schedule on drawings for GPM flow rates and pressure settings of valves.

3.06 INSTALLATION

A. Manual Air Vents:

1. Install at all high points where automatic air vents are not used, where noted, and where required for proper venting of system.
2. Install in accordance with manufacturer's recommendations.

- B. Grooved joints shall be installed in accordance with the manufacturer's published installation instructions. Gaskets shall be molded and produced by the coupling manufacturer, and shall be suitable for the intended service. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the project site to ensure best practices in grooved installation are being followed. (A distributor's representative is not considered qualified to conduct the training of field visits.)
- C. Test Plugs: Install where indicated and in accordance with the manufacturer's recommendations.
- D. Pressure Reducing Valves:
 - 1. Install where indicated and in accordance with manufacturer's recommendations with three valve bypass.
- E. Water Relief Valves:
 - 1. Install where indicated, and in accordance with manufacturer's instructions. Pipe discharge to nearest floor sink where possible using Schedule 40 steel pipe.
- F. Strainer:
 - 1. Applied Locations Plumbing:
 - a. Bronze wye, in piping 2-inch and smaller; domestic water, solar hot water, reclaimed water, cold process water, process grey water.
 - b. Cast iron, in piping 2-1/2-inch and larger; solar hot water, reclaimed water, cold process water, process grey water
 - c. Cast iron, high pressure wye, in piping 2-1/2-inch and larger; domestic water.

END OF SECTION

SECTION 22 0529
HANGERS, SUPPORTS, AND ANCHORS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Supports and anchors for piping systems and equipment.
- B. Related Sections include:
 - 1. Section 22 0548, Vibration and Seismic Controls for Plumbing Piping and Equipment
 - 2. Section 22 0700, Insulation for Plumbing
 - 3. Section 22 2113, Pipe and Pipe Fittings Plumbing

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings of contractor fabricated piping support structures.
 - 2. No other submittals required under this Section.

PART 2 PRODUCTS

2.01 SUPPORTS, ANCHORAGE AND RESTRAINT

- A. General: Provide pipe and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports and seismic restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor shall be responsible for their design.
 - 2. Seismic restraints and anchorages shall resist seismic forces as specified in the latest edition of the International Building Code for the seismic zone in which the project is constructed.
 - 3. Seismic restraint shall not introduce excessive stresses in the piping caused by thermal expansion or contraction.
 - 4. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
 - 5. Seismic restraints shall be in accordance with the latest edition of the SMACNA "Seismic Restraint Manual - Guidelines for Mechanical Systems" for the Seismic Hazard Level corresponding to the seismic zone in which the project is constructed.
 - 6. Seismic restraints shall be in accordance with the applicable code.
 - 7. Seismic restraints shall follow the provisions described in Section 22 0548, Vibration and Seismic Controls for Plumbing Piping and Equipment.
- B. Engineered Support Systems: The following support systems shall be designed, detailed, and bear the seal of a professional engineer registered in the State having jurisdiction.
 - 1. Supports and seismic restraints for suspended piping and equipment.
 - 2. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
 - 3. Equipment and piping support frame anchorage to supporting slab or structure.

2.02 SUPPORTS, GENERAL

- A. Fabricate support members from welded standard structural shapes, pipe, and plate to carry the necessary rollers, hangers, and accessories as required. Support piping less than 4-inch pipe size from or by prefabricated roll-formed channels with necessary accessories to adequately support piping system.
- B. Acceptable Manufacturers: Unistrut, Superstrut, Powerstrut and Kinline, B-Line Systems, AnvilStrut.
- C. Supports and Accessories: Preformed roll-formed channels and accessories with matching compatible accessories as shown, as specified, and as required.
- D. Dissimilar Metal Protection: Hydra-Zorb cushions or Cush-a-strip.
- E. Clamps: Super Strut Series 700 through 702 or AnvilStrut Series 1000 through 1200.

2.03 PIPE ATTACHMENTS

- A. Acceptable Manufacturers: Anvil as noted or equivalent products by Superstrut, B-Line Systems, Tolco, Michigan Hanger.
- B. Uninsulated Horizontal Copper Piping:
 - 1. 2-inch and Smaller: Anvil CT-65, CT-69, CT-99C.
 - 2. Larger than 2-inch: Anvil 260 field or factory copper plated, plastic coated or other recognized industry methods. Electricians' tape is unacceptable.
- C. Insulated Horizontal Copper Pipe with Hangers Inside of Insulation: Same as Uninsulated Horizontal Copper Pipe.
- D. Insulated Horizontal Copper Pipe with Hangers Outside of Insulation:
 - 1. 2-inch and Smaller: Anvil 65, 70, 104 or 260.
 - 2. Larger than 2-inch: Anvil 260.
- E. Other Uninsulated Horizontal Pipe:
 - 1. 2-inch and Smaller: Anvil 65, 70, 104 or 260.
 - 2. Larger than 2-inch: Anvil 260.
- F. Other Insulated Horizontal Pipe With Hangers Inside of Insulation:
 - 1. 2-inch and Smaller: Anvil 65, 70, 104, 260 or 300.
 - 2. Larger than 2-inch: Anvil 260.
- G. Other Insulated Horizontal Pipe with Hangers Outside of Insulation:
 - 1. 2-inch and Smaller: Anvil 65, 70, 104 or 260.
 - 2. Larger than 2-inch: Anvil 260.
- H. Riser Clamps Copper Pipe:
 - 1. 4-inch and Smaller: Anvil CT-121, CT-121C or 261C.
 - 2. Larger than 4-inch: Anvil 261C.
- I. Riser Clamps Other Piping: Anvil 261.

2.04 PIPE ROLLERS, INSULATION PROTECTION SHIELDS AND INSULATION PROTECTION SADDLES

- A. Acceptable Manufacturers: Anvil as noted or equivalent Super Strut, B-Line Systems, Tolco, Michigan Hangers.
- B. Pipe Rollers: Anvil 174 or 274 as required. Size for pipe plus insulation for insulated pipe.
- C. Insulation Protection Shields: Anvil 167.
- D. Insulation Protection Saddles: Anvil 160 through 166A as required. Saddles for copper pipe, factory or field copper plated.

2.05 BUILDING ATTACHMENTS

- A. Acceptable Manufacturers: Anvil as listed or equivalent products by Elcen, Superstrut, B-Line Systems, Tolco, Michigan Hangers.
- B. Beam Hangers:
 - 1. On piping 6-inch and smaller: Anvil 86 with retaining clip Fig. 89.
 - 2. On piping larger than 6-inch: Anvil 228, or 292.
- C. Inserts: Anvil 152 malleable iron or 281 steel inserts. Inserts sized for required rod to support load being carried.
- D. Expansion Plugs: Similar and equal to Phillips "red-head" self-drilling flush shell selected for safety factor of 4.
- E. Powder actuated fasteners with silencers as approved by Architect.

PART 3 EXECUTION

3.01 HANGERS AND SUPPORTS

- A. General:
 - 1. Install all support systems as detailed and in accordance with manufacturer's recommendations. Provide pipe racks, pipe stands, trapeze hangers, etc., as required and as detailed on the Drawings.
 - 2. Provide adjustable hangers for all pipes complete with inserts, adjusters, bolts, nuts, swivels, all-thread rods, etc., except where specified otherwise.
 - 3. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping.
 - 4. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
 - 5. Install all cast iron piping in accordance with Cast Iron Soil Pipe Industry (CISPI) Standards.
 - 6. Support all piping within 2-feet of each change of direction on both sides of fitting.
 - 7. Support all piping within 2-feet of valves, meters, and other maintenance required items, on both sides of fitting.
- B. Insulated Piping Systems:
 - 1. See Section 22 0700 for insulation requirements.
 - 2. Insulated Piping Systems with Vapor Barrier Insulation:
 - a. Install hangers outside of insulation.
 - b. On piping 1-1/2-inch and larger, provide insulation protection shields at each support location.
 - 3. Insulated Piping Systems with Non-Vapor Barrier Insulation:
 - a. At the contractor's option, hangers may be installed inside or outside of insulation for piping 2-inch and smaller.
 - b. If hangers are installed outside of insulation, provide insulation protection shields at all support locations on piping 1-1/2-inch and larger.
 - c. On piping larger than 2-inch, provide insulation saddles at each support location.
- C. Vertical Piping:
 - 1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.

2. Riser clamps on steel pipe to be directly welded to pipe. Riser clamps on copper pipe to be installed directly under fitting.
3. Risers that are not subject to thermal change to be supported at each floor of penetration.
4. Risers that are subject to thermal change require engineered supports. Size supports to carry all forces exerted by piping system when in operation. Riser supports shall follow the provisions described in Section 22 0548, Vibration and Seismic Controls for Plumbing Piping and Equipment.

D. Horizontal Piping:

1. Trapeze Hangers: Multiple pipe runs where indicated shall be supported on channels with rust resistant finish. Provide all necessary rods and supporting steel.
2. Support Spacing: Provide support at minimum spacing per MSS SP-69-1996 Pipe Hangers and Supports - Selection and Application:
 - a. Support piping within 2 feet of each change in direction.
 - b. Steel Pipe, Copper Tubing:

Minimum Pipe Size	Maximum Span Steel	Maximum Span Copper	Rod Size
1-inch and smaller	7-feet	5-feet	1/4-inch
1-1/4-inch to 2-inch	8-feet	8-feet	3/8-inch
2-1/2-inch to 3-inch	11-feet	9-feet	1/2-inch
4-inch to 5-inch	14-feet	12-feet	1/2-inch
6-inch	17-feet	14-feet	1/2-inch
 - c. Fuel Gas Piping: Support in accordance with local code requirements.
 - d. Plumbing Piping: Support in accordance with local plumbing code.
 - e. Plastic Pipe: Supported a maximum of 3 feet on center for piping 1-inch and smaller and 4 feet on center for piping 1-1/4-inch and larger with rod sizes as recommended by the manufacturer.
 - f. Piping provided with acoustical lagging wrap shall be supported a maximum of 5 feet on center. Install hangers outside of acoustical lagging.

E. Building Attachments:

1. Fastening or attaching to steel deck (without concrete fill) is prohibited. It will be necessary to support all piping from structural members, beams, joists, or provide intermediate angle iron supporting members between joists. Supports may be attached to concrete filled steel deck with load limitations shown on the structural drawings or otherwise obtained from the structural engineer.
2. Provide horizontal bracing on all horizontal runs 1-1/2 inch and larger and exceeding 50-feet in length at 75 foot intervals and as required to provide stabilized piping systems.
3. Provide all additional structural steel angles, channels, or other members required to support piping where structures do not occur as required for proper support.
4. Arrange supports to prevent eccentric loading of joists and joist girders. Locate supports at joist panel points.

END OF SECTION

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Isolation of mechanical equipment as indicated on the Drawings and specified herein.
 - 2. Seismic restraint of equipment and piping.
- B. Related Sections include:
 - 1. Section 22 0529, Hangers, Supports and Anchors for Plumbing

1.03 QUALITY ASSURANCE

- A. A single manufacturer shall select and furnish all isolation required, except packaged equipment with integral isolators meeting all the isolation and seismic requirements of this specification.
- B. Isolation performance requirements are indicated in the specifications. All deflections indicated are nominal static deflections for specific equipment supported.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Submit Shop Drawings showing complete details of construction for steel and concrete bases including:
 - a. Equipment mounting holes.
 - b. Dimensions.
 - c. Isolation selected for each support point.
 - d. Details of mounting brackets for isolator.
 - e. Weight distribution for each isolator.
 - f. Code number assigned to each isolator.
- B. Installation report as specified in PART 3 of this section.
- C. Operation and maintenance data.

1.05 CONTRACTOR RESPONSIBILITY

- A. Adequately restrain all equipment and piping to resist seismic forces. Design and select restraint devices to meet seismic requirements as defined in the latest issue of the International Building Code under Earthquake Design and applicable state and local codes.
- B. In addition, the contractor shall have the following responsibilities:
 - 1. Provide Engineering drawings, details, supervision, and instruction to assure proper installation and performance.

PART 2 PRODUCTS

2.01 SEISMIC RESTRAINTS

- A. General Requirements:
 - 1. Seismic restraints shall be provided for all equipment and piping, both supported and suspended.

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

2. Bracing of piping shall be in accordance with the code and with the provisions set forth in the SMACNA seismic restraint manual.
3. The structural requirements for the restraints, including their attachment to the building structure, shall be reviewed and approved by the structural engineer.
4. Attachments to supported or suspended equipment must be coordinated with the equipment manufacturer.

B. Supported Equipment:

1. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene.
2. Bushing shall be replaceable and a minimum of 1/4-inch thick. Rated loadings shall not exceed 1000 psi.
3. An air gap of 1/4-inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces.
4. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to ensure no short circuits exist before systems are activated.
5. Snubber: Mason Industries, Inc., Type Z-1225.

C. Bracing of Pipes:

1. Provide seismic bracing of all piping as detailed below to meet the building code requirements:
 - a. Exception: Piping suspended by individual hanger's 12-inches or less in length, as measured from the top of the pipe to the bottom of the support where the hanger is attached, need not be braced where the following criteria are met.
 - 1) Seismic braces are not required on high deformability piping when the $I_p=1.0$ and provisions are made to avoid impact with larger pipe or mechanical components or to protect the pipe in the event of such impact and the nominal pipe size is 3-inches diameter or less.
 - 2) Seismic braces are not required on high deformability piping when the $I_p=1.5$ and provisions are made to avoid impact with larger pipe or mechanical components or to protect the pipe in the event of such impact and the nominal pipe size is 1-inch diameter or less.
2. Seismic braces for pipes on trapeze hangers may be used.
3. Provide flexibility in joints where pipes pass through building seismic joints or expansion joints, or where pipes connect to equipment.
4. Cast iron pipe of all types, glass pipe, and any other pipe jointed with a shield and clamp assembly, where the top of the pipe is 12-inches or more from the supporting structure, shall be braced on each side of a change in direction of 90 degrees or more. Riser joints on unsupported sections of piping shall be braced or stabilized between floors.
5. Vertical risers shall be laterally supported with a riser clamp at each floor. For buildings greater than six stories high or for piping subject to thermal change all risers shall be engineered individually.

D. Suspended Equipment and Piping:

1. Seismic cable restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.
2. Cable must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

3. Cable assemblies shall be type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc.
4. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall be type SRC or UC as manufactured by Mason Industries, Inc.
5. Pipe clevis cross-bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.

2.02 FLEXIBLE HOSE CONNECTOR

- A. Flexible stainless steel hoses shall be manufactured using Type 304 stainless steel hose and braid with one fixed and one floating raised face carbon steel plate flange.
- B. Sizes 2-1/2-inch and smaller may have threaded male nipples or copper sweat ends. Grooved ends are acceptable in all sizes in grooved piping systems. Weld ends are not acceptable. Copper sweat end hoses for water service shall be all copper or bronze construction.
- C. Hose shall have close pitch annular corrugations for maximum flexibility and low stiffness. Tested hose stiffness at various pressures must be included in the submittals.
- D. Hose shall be capable of continuous operation at 150 psi and system test pressure when installed in piping systems.
- E. Hose shall be the same size as the pipe it connects and have pipe thread connectors on both ends with male or female end adapters as required.
- F. Mason type BSS, FFL, MN, CPS or CPSB, similar HCi, Metraflex.

2.03 EXPANSION JOINT/SEISMIC CONNECTOR

- A. T304 stainless steel hose and braid, Schedule 40 radius elbows and 180 degree bend, flange or weld end Schedule 40 fittings. ASA certified when used for natural gas service. Metraflex Metaloop only.
- B. Connector shall accept differential support displacement without damaging pipe, equipment connections, or support connections.

PART 3 EXECUTION**3.01 GENERAL**

- A. Do not install any equipment or pipe which makes rigid contact with the building. "Building" includes slabs, beams, studs, walls, etc.
- B. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. The load shall not be transferred to the isolator until the installation is complete and under full operational load.
- C. Correct, at no additional cost, all installations which are defective in workmanship or materials.

3.02 INSTALLATION

- A. General:
 1. Rubber grommets and washers shall be provided to isolate the bolt from the building structure. Under no circumstances shall the isolation efficiency be destroyed when bolting the isolators to the building structure.
- B. Flexible Connectors:
 1. Flexible Sphere Connectors: Provide as indicated on the drawings.

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

2. Flexible Hose Connectors: Provide as indicated on the drawings.
3. Expansion Joint/Seismic Connector: Provide for all piping services where they cross expansion or seismic joints.

3.03 SEISMIC RESTRAINTS

A. General:

1. Install and adjust seismic restraints so that the equipment and piping support is not degraded by the restraints.
2. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.

B. Supported Equipment:

1. Each vibration isolation frame for supported equipment shall have a minimum of four seismic snubbers mounted as close as possible to the vibration isolators and/or the frame extremities.
2. Care must be taken so that the 1/4-inch air gap in the seismic restraint snubber is preserved on all sides in order that the vibration isolation potential of the isolator is not compromised. This requires that the final snubber adjustment be completed after the vibration isolators are properly installed and the installation approved.

C. Bracing of Pipes:

1. Branch lines may not be used to brace main lines.
2. Transverse bracing shall be at 40 feet maximum, except where a lesser spacing is indicated in the SMACNA tables for bracing of pipes
3. Longitudinal bracing shall be at 80 feet maximum except where a lesser spacing is indicated in the tables. In pipes where thermal expansion is a consideration, an anchor point may be used as the specified longitudinal brace provided that it has a capacity to resist both the seismic load and the additional force induced by expansion and contraction.
4. A rigid piping system shall not be braced to dissimilar parts of the building or to two dissimilar building systems that may respond differently during an earthquake.
5. Transverse bracing for one pipe section may also act as longitudinal bracing for a pipe section of the same size connected perpendicular to it if the bracing is installed within 24 inches of the elbow or tee.
6. Subject to confirmation by field inspection, seismic bracing is not required on piping when the piping is supported by rod hangers and the hangers in the entire run are 12-inches or less in length from the top of the pipe to the supporting structure, hangers are detailed to avoid bending of the hangers and their attachments and provisions are made for piping to accommodate expected deflections.

D. Suspended Equipment, Piping, Cable Method:

1. The cables shall be adjusted to a degree of slackness approved by the Structural Engineer.
2. The uplift and downward restraint nuts and Mason type RW neoprene covered steel rebound washers for the Type 6 hangers shall be adjusted so that there is a maximum 1/4-inch clearance.

3.04 FIELD QUALITY CONTROL

- A. Installation Report: Isolation manufacturer's representative shall confirm that all isolation is installed correctly and submit report stating that isolators are installed as shown on Shop Drawings, isolators are free to work properly, and that installed deflections are as scheduled and as specified.

END OF SECTION

SECTION 22 0553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Identify valves, piping and equipment components of the mechanical systems to indicate their function and system served.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Valve Tag Directory: Submit for approval prior to fabrication of valve tags.
 - 2. Equipment Nameplate Directory: Submit for approval prior to fabrication.
 - 3. Operating and Maintenance Data: Include a copy of valve tag and equipment nameplate directories in each set of Operating and Maintenance manuals.

PART 2 PRODUCTS

2.01 VALVE IDENTIFICATION

- A. Valve Tags:
 - 1. General: Identify valves with metal tags, legends to be stamped or embossed. It shall indicate the function of the valve and its normal operating position; i.e.,

56 HW	(NUMBER AND CONTENT OF PIPE)
ISOLATION	(VALVE FUNCTION)
NO	(NORMAL OPERATION POSITION)
 - 2. Size: Valve tags 2-inch diameter with 1/4-inch high letters.
 - 3. Material: Use 0.050 or 0.064-inch brass tags.
 - 4. Automatic Valves and Regulating Valves: Use 1/16-inch thick laminated 3-ply plastic, center ply white, outer ply red, "lamicoid" or equal. Form letters by exposing center ply.

2.02 VALVE TAG DIRECTORY: INCLUDE TAG NUMBER, LOCATION, EXPOSED OR CONCEALED, SERVICE, VALVE SIZE, VALVE MANUFACTURER, VALVE MODEL NUMBER, AND NORMAL OPERATING POSITION OF VALVE.PIPING MARKERS

- A. Acceptable Manufacturers:
 - 1. W.H. Brady, Seton, Marking Systems, Inc. (MSI).
 - 2. Other Manufacturers: Submit Substitution Request.

- B. Pipes shall be labeled with all-vinyl, self-sticking labels or letters. For pipe covering sizes up to and including 3/4-inch outside diameter, select labels with 1/2-inch letters. For sizes from 3/4 to 2-inch outside diameter, 3/4-inch letters; above 2-inches outside diameter, 2-inch letters. The pipe markers shall be identified and color coded as follows with black directional arrows.

PLUMBING SERVICE	BACKGROUND PIPE MARKER*	COLOR
COLD WATER	DOMESTIC COLD WATER	GREEN
HOT WATER	DOMESTIC HOT WATER SUPPLY	YELLOW
	DOM. HOT WATER RECIRC	YELLOW OR GREEN
SANITARY WASTE	SANITARY WASTE	GREEN
STORM DRAIN	STORM DRAIN	GREEN
OVERFLOW DRAIN	OVERFLOW DRAIN	GREEN
VENT	VENT	GREEN
NATURAL GAS	NATURAL GAS	YELLOW
NATURAL GAS VENT	NATURAL GAS VENT	YELLOW
RECLAIMED WATER	CAUTION: RECLAIMED WATER, DO NOT DRINK	PURPLE
* Directional arrow applied adjacent to pipe marker indicating direction of flow.		
** Provide custom marker labels for all piping for which no standard manufactured marker is available. Submit sample for approval.		

C. Reclaimed Water:

1. All reclaimed water pipe and fittings shall be continuously wrapped with purple-colored Mylar tape over insulation, with the words CAUTION: RECLAIMED WATER, DO NOT DRINK. Imprint lettering in two parallel lines, such that after wrapping the pipe with 1/2 width overlap, one full line of text shall be visible.
2. Wrapping tape is not required for buried PVC pipe manufactured with purple color integral to the plastic and marked on opposite sides to read CAUTION: RECLAIMED WATER, DO NOT DRINK in intervals not to exceed 3-feet,
3. Outlets and fixtures served with harvester rainwater shall be easily recognizable by color or symbol for non-potable water.
4. Reference local ruling for additional requirements.

2.03 EQUIPMENT IDENTIFICATION

A. Nameplates:

1. Tag all pumps, and miscellaneous items of mechanical equipment with engraved nameplates. Nameplates shall be 1/16-inch thick, 3-inch by x5-inch laminated 3-ply plastic, center ply white, outer ply black. Form letters by exposing center ply.
2. Identify unit with code number as shown on Drawings and area served.

- B. Equipment Nameplate Directory: List pumps, and other equipment nameplates. Include Owner and Contractor furnished equipment. List nameplate designation, manufacturer's model number, location of equipment, area served or function, disconnect location, and normal position of HOA switch.

2.04 CONCEALED EQUIPMENT IDENTIFICATION

A. Acceptable Manufacturers:

1. W.H. Brady, Seton.
2. Other Manufacturers: Submit Substitution Request.

B. Adhesive Laminated Tape:

1. 3/4-inch width transparent clear tape with black lettering.
2. Lettering in ALL CAPS Helvetica font 24 point.

PART 3 EXECUTION

3.01 VALVE IDENTIFICATION

A. Valve Tags:

1. Attach to valve with a brass chain.
2. Valve tag numbers shall be continuous throughout the building for each system. Contractor shall obtain a list for each system involved from the Owner.

B. Valve Tag Directory: Post final copy in Operation and Maintenance Manual.

3.02 PIPING MARKERS

A. Unless recommendations of ANSI A13.1, 1981 are more stringent, apply labels or letters after completion of pipe cleaning, insulation, painting, or other similar work, as follows:

1. Every 20-feet along continuous exposed lines.
2. Every 10-feet along continuous concealed lines.
3. Adjacent to each valve and stubout for future.
4. Where pipe passes through a wall, into and out of concealed spaces.
5. On each riser.
6. On each leg of a T.
7. Locate conspicuously where visible.
8. Provide pipe identification (over insulation) for all reclaimed water systems in accordance with current local codes and rulings.

B. Further, apply labels or letters to lower quarters of the pipe on horizontal runs where view is not obstructed, or on the upper quarters when pipe is normally viewed from above. Apply arrow labels indicating direction of flow. Arrows to be the same color and sizes as identification labels.

3.03 EQUIPMENT IDENTIFICATION

A. Nameplates: Attach to prominent area of equipment, either with sheet metal screws, brass chain, or contact cement as applicable.

B. Nameplate Directory: Post final copy in Operation and Maintenance Manual.

3.04 CONCEALED EQUIPMENT IDENTIFICATION

A. Where valves or equipment are located above ceilings or behind walls provide adhesive tape indicating the item (valve tag, equipment tag, etc.) at the access location (T-bar ceiling grid, access door, etc.).

B. Applicable equipment includes, but is not limited to, the following:

1. Isolation Valves
2. Control Valves

END OF SECTION

SECTION 22 0590
PRESSURE TESTING FOR PLUMBING SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Pressure testing of piping systems.

1.03 QUALITY ASSURANCE

- A. Code Compliance: Perform required tests in the presence of the authority having jurisdiction.
- B. Owner Witness: Perform all tests in the presence of the Owner's representative.
- C. Engineer Witness: The Engineer or Engineer's representative reserves the right to observe all tests or selected tests to assure compliance with the specifications.
- D. Simultaneous Testing: Test observations by the authority having jurisdiction, the Owner's representative, and the Engineer's representative need not occur simultaneously.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Test Reports:
 - a. Submit certificate of completion, inspection and test by authority having jurisdiction on required piping systems.
 - b. Submit certificate of test approval by Owner's representative on all systems.
 - c. The Engineer's representative will record witnessed tests.

PART 2 PRODUCTS – NOT APPLICABLE

PART 3 EXECUTION

3.01 GENERAL

- A. Piping: Test prior to concealment, insulation being applied, and connection to equipment, fixtures, or specialties. Conduct tests with all valves but those used to isolate the test section 10% closed.
- B. Leaks: Repair all leaks and retest until stipulated results are achieved.
- C. Notification: Advise the Architect 72 hours in advance of each test. Failure to so notify will require test to be rescheduled.
- D. Testing Equipment: Provide all necessary pumps, gauges, connections, and similar items required to perform the tests.

3.02 TESTING REQUIREMENTS

- A. Sanitary and Roof Drainage Systems: Test entire system or sections of system by closing all openings in piping except highest opening and filling system with water to point of overflow. If system is tested in sections, plug each opening except highest opening of section under test and fill each section with water, but none with less than 10-foot head of water. Keep water in system or in portions under test for at least 45 minutes before inspection starts. Test for two hours with no drop allowed. Locate and repair leaks.
- B. Domestic and Reclaimed Water Systems: Test per current State and local codes.

Section 22 0590
PRESSURE TESTING FOR PLUMBING SYSTEMS

C. Piping - General: Test all piping as noted below, with no leaks or loss in pressure for time indicated. Repair or replace defective piping until tests are completed successfully:

Plumbing Systems	Test Pressure	Test Medium	Test Duration
Industrial Water	150 psig	Water	4 hours
Natural Gas Piping	60 psig	Air	4 hours

END OF SECTION

SECTION 22 0593
TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Testing and balancing of domestic hot water recirculation systems.
 - 2. Testing and balancing of pumping systems.
- B. Related Sections include:
 - 1. Section 22 0800, Commissioning for Plumbing HVAC

1.03 QUALITY ASSURANCE

- A. Acceptable Testing and Balancing Firms:
 - 1. A.I.R., Inc.
 - 2. Air Balance Specialty, Inc.
 - 3. Neudorfer Engineers, Inc.
 - 4. Northwest Engineering Services.
 - 5. Pacific Coast Air Balance.
 - 6. Accurate Balancing Agency, Inc.
- B. Other Firms: Submit Substitution Requests prior to Bid Date.
- C. Industrial Standards: Testing and Balancing shall conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:
 - 1. NEBB: Comply with Procedural Standards for Testing, Adjusting Balancing of Environmental Systems.
 - 2. ASHRAE: Comply with recommendations pertaining to measurements, instruments, and testing, adjusting and balancing.
 - 3. ANSI:
 - a. S1.4 Specifications for sound level meters.
 - b. S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
- D. Instrument Certification: All instruments used shall be accurately calibrated and certified within six months of balancing and maintained in good working order.
- E. Test Observation: If requested, the tests shall be conducted in the presence of the Architect or the Architect's representative.
- F. Pre-Balancing Conference: Prior to starting balancing, general techniques shall be reviewed with the Engineer. This conference must occur prior to measuring existing conditions. Measuring of existing conditions must occur prior to any demolition or new work. The conference will review existing conditions and systems to be affected by the project

1.04 SUBMITTALS

A. Submit the following:

1. Balancing Log: Include all water outlets, actual field measured water volume, and percentage of design volumes. Provide drawings identifying location of all outlets.
2. Equipment Data Sheets: Indicate actual equipment performance, model numbers, bearing and belt data, motor nameplate data, and final balanced motor data.
3. Additional Data: Submit all additional data as provided by Associated Air Balance Council (AABC) Standard forms.
4. Number of Copies: Submit six copies of the above completed information to the Engineer for review and insertion into the Operating and Maintenance Data.
5. Instrument Certification: When requested, submit certificate of calibration for all equipment to be used.

B. Record data on NEBB forms or forms approved by the Architect.

1.05 PROJECT CONDITIONS

- A. Where existing systems are to be adjusted, establish flow rates in all branches prior to making any modifications to system. Submit preliminary report indicating existing conditions prior to making any modifications to existing systems. Adjust central equipment as required and restore all unmodified branches and outlets to original condition. Obtain existing system drawings from Owner and become familiar with extent and nature of existing systems.
- B. Do not perform final testing, adjusting, and balancing work until equipment has been completely installed and operating continuously as required.
- C. Conduct testing and balancing with clean strainers and filters in place. Clean strainers, etc., prior to performing hydronic testing and balancing.

1.06 WARRANTIES

- A. In addition to the Requirements of the Contract, include an extended warranty of six months after completion of test and balance work during which time the Architect at his discretion may request a recheck or resetting of any equipment or device listed in the test reports.

PART 2 PRODUCTS – NOT APPLICABLE

PART 3 EXECUTION

3.01 DOMESTIC HOT WATER RECIRCULATION SYSTEMS

- A. General: Make measurements in accordance with Industrial Standards specified above. Record on appropriate forms.
- B. Preliminary:
 1. List complete data of tested equipment and verify against Contract Documents.
 2. Open all line valves to full open position.
 3. Set master mixing valve as described by manufacturer's recommendations to achieve desired leaving water temperature.
 4. For each pump:
 - a. Verify rotation.
 - b. Test and record pump shut-off head.
 - c. Test and record pump wide-open head.
 5. Verify proper system pressures.
- C. Distribution:
 1. Read and adjust water flow for design conditions.
 2. Set all memory stops and mark position of adjuster on balancing valves.

3.02 DOMESTIC HOT WATER POINT OF USE MIXING VALVES

- A. General: Make measurements in accordance with Industrial Standards specified above. Record on appropriate forms.
- B. Preliminary:
 - 1. List complete data of tested equipment and verify against Contract Documents.
 - 2. Open all line valves to full open position.
- C. Distribution:
 - 1. Adjust water flow for design conditions.
 - 2. Set mixing valve to achieve desired leaving water temperature.
 - 3. Set all memory stops and mark position of adjuster on balancing valves.

3.03 COORDINATION

- A. Coordinate work with other trades to ensure rapid completion of the project.
- B. Deficiencies noted during the course of balancing in the mechanical installation shall be promptly reported to the Architect to allow corrective action to proceed.
- C. Periodic review of progress shall be provided as requested.

END OF SECTION

**SECTION 22 0700
INSULATION FOR PLUMBING**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Insulation for piping, and equipment.
- B. Related Sections include:
 - 1. Section 22 0529, Hangers, Supports and Anchors for Plumbing

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. All insulating products shall comply with the Oregon Revised Statute (ORS) 453.005(7)(e) prohibiting pentabrominated, octabrominated and decabrominated diphenyl ethers. Where products within this specification contain these banned substances, provide complying products from approved manufacturers with equal performance characteristics.
 - 2. Flame and Smoke Ratings: Installed composite flame spread not to exceed 25 and smoke developed not to exceed 50 as tested by UL 723.
 - 3. Energy Codes: Local Building and Energy Codes shall govern where insulation performance requirements for thickness exceeds thickness specified.
- B. Protection: Protect against dirt, water, chemical, or mechanical damage before, during, and after installation. Repair or replace damaged insulation at no additional cost.
- C. Source Quality Control:
 - 1. Service: Use insulation specifically manufactured for service specified.
 - 2. Labeling: Insulation labeled or stamped with brand name and number.
 - 3. Insulation and accessories shall not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin, shall not react corrosively with equipment, piping, or ductwork, and shall be asbestos free.

1.04 SUBMITTALS

- A. Submit the following.
 - 1. Product Data: For each type including density, conductivity, thickness, jacket, vapor barrier, and flame spread and smoke developed indices.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Equivalent products by Johns Manville, Knauf, Owens Corning, and CertainTeed are acceptable.
- B. All such insulation shall be of one manufacturer.
- C. Other Manufacturers: Submit Substitution Request.

2.02 PIPE INSULATION

- A. Fiberglass: Split sectional or snap-on type with 0.23 per inch maximum thermal conductivity (K-factor) at 75°F mean temperature, 850°F maximum service rating and white, vapor barrier jacket with pressure sensitive closure system. Johns Manville Microlok HP.

- B. Elastomeric: Expanded closed cell, 0.27 per inch maximum K-factor at 75°F mean temperature, 220°F maximum service rating with fitting covers and paintable surface. Armacell AP Armaflex, Rubatex.
- C. Polyolefin: Semi-rigid polyolefin form snap-on or slip over type with 0.24 per inch maximum thermal conductivity (K-factor) at 75°F mean temperature -165°F to 210°F service factor and paintable surface. End joints in insulation on piping with fluid temperatures normally below 65°F fuse sealed in accordance with the manufacturer's instructions. Joints longitudinal joints and other end joints made with manufacturer's approval contact adhesive in accordance with the manufacturer's instructions. Joints may be pre-glued or pre-coated with adhesive where applicable.

2.03 ACCESSORIES PIPING

- A. Adhesives:
 - 1. Fiberglass: Zeston Z-Glu.
 - 2. Elastomeric: Armacell 520.
 - 3. Polyolefin: As approved by the insulation manufacturer.
- B. Cements:
 - 1. Insulating: Ryder.
 - 2. Heat Transfer: Zeston Z-20.
- C. Wire Mesh: 1-inch mesh with 20 gauge annealed steel wire.
- D. Pipe Fitting Covers: One piece PVC insulated pipe fitting covers. Zeston, Ceel-Co.
- E. Grooved Coupling Insulation: One piece PVC insulated fitting cover, Zeston, Ceel-Co.
- F. Metal Pipe Jacket: 0.016-inch thick aluminum jacket with formed fitting covers, aluminum snap straps and sealant.
- G. Cloth Facing: Presized fiberglass cloth.
- H. Tapes: Pressure sensitive, weather resistant, and for temperatures up to 150°F. Zeston Z-tape.
- I. Paint: Ultraviolet resistant latex paint with special adherence capabilities to the PVC fitting covers, elastomeric, aluminum facing, Kraft paper, tapes, and adhesives.

PART 3 EXECUTION

3.01 GENERAL

- A. Workmanship:
 - 1. Installation: Insulation installed in first class, neat professional manner.
 - 2. Applicators: Applicators shall be employed by firm that specializes in insulation work.
- B. Preparation: Surfaces of piping and equipment clean, free of oil or dirt, and dry before insulation is applied.
- C. Stamps: ASME stamps, UL labels, and similar stamps and labels shall not be covered.

3.02 PLUMBING PIPE AND EQUIPMENT INSULATION APPLIED LOCATIONS

A. Insulation Applied Locations – Plumbing Piping:

System	Pipe Size	Insulation Type	Insulation Thickness	Notes
Domestic Cold Water, Above Grade	1 1/4-inch and smaller	Fiberglass, all-purpose jacket or Elastomeric or Polyolefin	1-inch	Note 1 Note 2
	Above 1 1/4-inch	Fiberglass, all-purpose jacket	1 1/2-inch	Note 1
Non-Potable Cold Water, Above Grade	1 1/4-inch and smaller	Fiberglass, all-purpose jacket or Elastomeric or Polyolefin	1-inch	Note 1 Note 2
	Above 1 1/4-inch	Fiberglass, all-purpose jacket	1 1/2-inch	Note 1
Domestic Hot Water Supply/Return, Above Grade	1 1/2-inch and smaller	Fiberglass, all-purpose jacket or Elastomeric or Polyolefin	1 1/2-inch	Note 1 Note 2
	Above 1 1/2-inch	Fiberglass, all-purpose jacket	2-inch	Note 1
Interior Storm Drain and Interior Overflow Drains	All	Fiberglass, all-purpose jacket	1/2-inch	Note 3
Traps and trap priming lines in unheated Spaces)	All	Fiberglass, all-purpose jacket	1-inch	Insulate over heat tape
Note 1: Cover with metal pipe jacket where exposed to weather, and over heat trace cable. Note 2: Elastomeric or polyolefin insulation not allowed over heat trace cable. Note 3: Drain bodies, insulate the first 10-feet connected to the drain body, and all horizontal piping. Do not insulate main vertical stack.				

B. The following piping is not insulated:

1. Waste and vent, except where heat traced.
2. Natural gas and propane.
3. Domestic cold water runouts to single fixture less than 12-inch long and exposed supplies.
4. Priming lines except where heat traced.

C. Insulation shall include all fittings, unions, flanges, mechanical couplings, valve bodies, valve bonnets, piping through sleeves, except valve bonnets, unions and flanges need not be insulated on the following systems: Domestic hot water, inside building.

D. Valves and irregular fittings shall be insulated with section of pipe insulation and insulating cement, securely fastened, and finished with 6 oz. canvas and Foster 30-36 lagging adhesive. The contractor shall have the option on all flanges, valves, strainers, not requiring a vapor barrier to insulate with removable replaceable pads fabricated of 1-inch layer of Pittsburgh Corning Temp Mat sandwiched between inner and outer layer of 8 oz. glass cloth held together with stainless staples with sufficient stainless lacing hooks to hold pad firmly to flange or valve with minimum 3-inch overlap onto adjacent pipe insulation using 18 gauge S.S. lacing wire.

E. Expansion Joints and Flexible Connectors: Pipe insulation or block of same material and thickness as adjacent piping.

3.03 PIPING INSTALLATION

A. General:

1. Joints: Coat both sides of complete joining area with applicable adhesive.
 - a. Longitudinal Joints: Make joints on top or back of pipe to minimize visibility. Except foam plastic, seal with closure system or 3-inch wide tape.
 - b. Butt Joints: Butt lightly together and, except for foam plastic, seal with 3-inch wide tape or butt straps.
 - c. Multiple Layered Insulation: Joints staggered.
2. Access: Strainer and other items requiring service or maintenance with easily removable and replaceable section of insulation to provide access.
3. Voids: Fill all voids, chipped corners and other openings with insulating cement or material compatible with insulating material. In insulation with Heat Tracing: Where piping is shown or specified to be heat traced, bed heat tape into heat transfer cement with insulation over heat tape and cement.
4. Seal joints, seams and fittings of metal watertight jackets at exterior locations.

B. Fiberglass Insulation: Exterior insulation encased in metal jacket.

C. Elastomeric and Polyolefin Insulation:

1. Slit full length and snap around pipe.
2. Make cuts perpendicular to insulating surface leaving no cut section exposed.
3. Do not stretch insulation to cover joints or fittings.
4. Seal joints in elastomeric insulation with adhesive.
5. Seal joints in polyolefin as specified hereinbefore.
6. Exterior insulation painted with two coats of specified paint in accordance with the manufacturer's instructions and encase in metal jacket.
7. Sealing joints with tape will not be allowed.

D. Fittings: Insulation specified with continuous vapor barrier, the vapor barrier must not be violated.

1. On Elastomeric and Polyolefin Insulation: Fittings covered with covers made up of mitered sections of insulation or with formed pipe fitting covers.
2. In Other Insulation: Fittings covered with insulation to the same level of the adjoining insulation or fill with insulating cement. Finish with pipe fitting covers or cloth facing and tape.

E. Unions, Mechanical Joints, Valves, Etc.:

1. General:
 - a. As specified for fittings.
 - b. Minimum thickness same as specified for piping.
2. Unions: Build up insulation at least 1/2-inch beyond adjoining insulation.
3. Flanges: With square corners. Where flanges are not insulated, terminate adjacent insulation so flange bolts can be removed.
4. Flanged Valves: Insulation with square corners.

F. Vapor Barrier Insulation:

1. Refer to Section 22 0529, Hangers, Supports, and Anchors for Plumbing for support requirements.

2. Piping which requires vapor barrier protection shall have a continuous vapor barrier, which may not be pierced or broken. The following piping systems require vapor barrier protection:
 - a. Domestic cold water.
 - b. Industrial cold water.
 - c. Non-potable cold water.
 - d. All other piping systems with a nominal operating temperature below 65°F.
3. Vapor Barrier Insulation:
 - a. Insulation for pipe requiring vapor barrier protection 1-1/4-inch or smaller, insulation continuous through pipe hangers and rollers.
 - b. For pipe 1-1/2-inch and larger, 18-inch section of calcium silicate, same thickness as pipe insulation with continuous vapor barrier jacket at each hanger or roller. Provide pipe shield specified in Section 22 0529, Hangers, Supports, and Anchors for Plumbing.
- G. Non-Vapor Barrier Insulation:
 1. Refer to Section 22 0529, Hangers, Supports, and Anchors for Plumbing for support requirements.
 2. At contractor's option, insulation may be interrupted at supports. Butt insulation tight to support.
 3. If contractor elects to continue insulation at supports, installation as specified for piping systems with vapor barrier installation.
 4. Void between saddle and pipe filled with insulation.

3.04 FIELD QUALITY CONTROL

- A. Field Test: All systems shall be tested and approved prior to installation of insulation.

END OF SECTION

SECTION 22 0800
COMMISSIONING FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.
- C. The Work of this Section is supplemental to and does not supersede any other requirements of the Contract Documents.

1.02 SUMMARY

- A. The commissioning process is described in Section 01 9113, General Commissioning Requirements.
- B. Provide all labor and materials required to complete the commissioning of those Division 22 systems and equipment identified as Commissioned Systems and Equipment in Section 01 9113, General Commissioning .
- C. Related Sections include:
 - 1. Section 01 9113, General Commissioning Requirements.
 - 2. All Sections of Division 22.

1.03 SUBMITTALS

- A. Refer to Section 01 9113, General Commissioning Requirements.

1.04 COMMISSIONING SCOPE OF WORK - COMMISSIONING AGENT

- A. Refer to Section 01 9113, General Commissioning Requirements.

1.05 COMMISSIONING SCOPE OF WORK - CONTRACTOR

- A. Refer to Section 01 9113, General Commissioning Requirements.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Refer to Section 01 9113, General Commissioning Requirements.

PART 3 EXECUTION

3.01 MEETINGS

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.02 INSTALLATION, CHECK-OUT, START-UP AND PREFUNCTIONAL CHECKS

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.03 FUNCTIONAL TESTING

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.04 TRAINING OF FACILITY OPERATING STAFF AND BUILDING OCCUPANTS

- A. Refer to Section 01 9113, General Commissioning Requirements.

END OF SECTION

SECTION 22 1415
RAINWATER RECLAMATION SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing, apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes a skid-mounted, reclaimed rainwater treatment and delivery package including, but not limited to the following: sensors and controls for treatment, chemical recirculation and injection pumps, chemical drum, chemical containment pallet, rainwater day tank and fittings, sensors and controls for day tank level management, sensors and controls for cistern water transfer, remote cistern transfer pump (CTP), sensors and controls for delivery/source pump(s), delivery/source pump(s), hydro-pneumatic tank, well water makeup valve, water meters, bag filters, flexible connectors, valves, fittings, and gauges as indicated on the Drawings.
- B. The submersible CTP and cistern ultrasonic level sensor shall be provided by package manufacturer and shipped loose for contractor installation and wiring back to the skid-mounted package.
- C. Treatment equipment in this Section requires the reclaimed rainwater supply to have a gross filtration method prior to transfer from the rainwater cistern. The cistern; cistern connections, and vents shall be supplied and coordinated per civil engineer's instructions. Refer to Execution Part of this Section for additional installation and coordination requirements.
- D. This Section includes performance based work. The intent of Division 22 Specifications and the accompanying Drawings is to provide a complete and workable system as shown and specified. Include all work specified in this Section and shown on the accompanying Drawings, including appurtenances, connections, etc., in the finished job.
- E. Related Sections Include:
 - 1. Section 22 0523, General Duty Valves and Specialties for Plumbing
 - 2. Section 22 0529, Hangers, Supports and Anchors for Plumbing
 - 3. Section 22 0553, Identification for Plumbing Piping and Equipment
 - 4. Section 22 0590, Pressure Testing for Plumbing Systems
 - 5. Section 22 0700, Insulation for Plumbing
 - 6. Section 22 2113, Pipe and Pipe Fittings Plumbing

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. State of Oregon, Building Codes Division, Alternate Method Ruling OPSC 08-03 or latest edition.
 - 2. Inspection Certifications & Approvals: Skid-mounted package shall be UL Listed under Packaged Pumping Systems.
 - 3. Output Water Quality: Meets basic Urban Reuse reclaimed water quality levels as defined in 2012 USEPA document, "Guidelines for Water Reuse," Table 4-4.
- B. All equipment or components of this Section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the Drawings.
- C. Ensure package's pressure and temperature ratings are at least equal to system's maximum operating pressure and temperature at point where installed, but not less than specified.

- D. Pumps shall operate at specified system fluid temperatures and pressures without vapor binding or cavitation, and with non-overloading motors.
- E. Ensure pump materials and mechanical seals are appropriate for use with reclaimed rainwater and treatment chemicals.
- F. The dimensions of the rainwater packaged skid shall not exceed those indicated on the Drawings.

1.04 SUBMITTALS

- A. Submit The Following:
 - 1. Product data for each item specified, including rated operating characteristics, furnished specialties and accessories.
 - 2. Shop Drawings: Include plans, sections, details (i.e. dimensions and connection sizes) and attachments to other work. For wiring diagrams include power and internal control wiring.
 - 3. Three dimensional drawings of entire skid package.
 - 4. Operation and maintenance data.
 - 5. Limited Warranty specified in this Section.

1.05 PRODUCT HANDLING

- A. Use all means to protect equipment before, during and after installation. Store materials in a clean, dry place and protect from weather and construction traffic.
- B. Skid-mounted package shall be provided with lifting chairs/lugs for lifting and securing to the housekeeping pad at the jobsite by the installing contractor.
- C. Items described as "shipped loose" are to be protected from probable damage during shipment, or to accommodate remote field installation locations as shown on the Drawings.
- D. Ideal system operating temperatures shall be 50 degrees F- 75 degrees F. Minimum operating temperature shall be 35 degrees F. Maximum operating temperature shall be 100 degrees F. System shall not be subjected to freezing temperatures.

1.06 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace equipment that fails in original materials or workmanship within specified warranty period with new equipment.
 - 1. Limited Warranty Period: 12 months from the date of installation, or 18 months from shipment, whichever occurs first. Consult operations manual for full details.

PART 2 PRODUCTS

2.01 RECLAIMED RAINWATER TREATMENT & DELIVERY PACKAGE

- A. Acceptable Manufacturers:
 - 1. The entire skid package shall be provided by one package system manufacturer, CHC FlowTherm Systems, as a UL Listed, pre-assembled, pre-piped and pre-wired pumping system.
 - 2. The package system manufacturer shall have at least three years experience with rainwater treatment, and at least 10 years experience with pressure boosting pumping systems.
 - 3. Other Manufacturers: Submit Substitution Request.
- B. The specifying engineer reserves the right to specify a primary manufacturer for the bid documents. The contractor may choose to supply equivalent equipment, as submitted by alternatively specified manufacturers with an approved substitution request. This alternatively specified equipment shall be supplied on a deduct-alternate basis and based on the approval of the supplied alternate manufacturer's submittals. This protects the specifying engineer's design concept, but allows for a check-and-balanced system to protect the post-commissioning owner.

- C. Skid Package Description: Furnish and install a skid-mounted, commercial reclaimed rainwater treatment and delivery package with plumbing and electrical system points of connection shown on the Drawings. This system sends either treated & pressurized rainwater or well water to the facility for non-potable usage.
1. Refer to scheduled equipment on Drawings for capacities and specific ratings of pumps and motors, as well as any other listed components.
 2. Interconnecting piping shall be Schedule 80 PVC; well water makeup piping may be minimum Type L or M copper.
 3. Unions or flanges shall be installed wherever necessary for ease of access, or wherever shown on the Drawings.
 4. All skid components shall be shipped mounted on a heavy duty, welded structural steel base plate, covered with at least 3/16" steel decking. The frame shall be built in accordance with AWS D1.1 standards. The WCC treatment equipment shall have an aluminum, powder coated frame secured to the skid's steel decking.

2.02 RAINWATER TREATMENT & DELIVERY SYSTEM

A. Treatment & Delivery System:

1. Acceptable Manufacturers:
 - a. Water Control Corporation (WCC).
2. Other Manufacturers: Submit Substitution Request.
3. Description: The submersible cistern transfer pump (CTP) sends water from the cistern to the day tank for treatment. The ETL Listed treatment system then periodically circulates water in the day tank through a chemical injection node using a recirculation pump in order to maintain adequate oxidation reduction potential (ORP) conditions. The delivery/source pump(s) in the system deliver pressurized treated rainwater, or bypassed well water for supply to the building load for non-potable use as required.

B. Recirculation Pump:

1. Acceptable Manufacturers:
 - a. Xylem, Grundfos, STA-RITE.
2. Other Manufacturers: Submit Substitution Request.
3. Description: Non self-priming, horizontal, end-suction centrifugal pump, AISI 304/316L stainless steel liquid handling components, easily accessible vent/prime/drain connections, internal mechanical seal with carbon versus silicon-carbide faces and viton elastomers, and NEMA open drip-proof or totally enclosed fan cooled motor.

C. Chemical Injection Pumps and Chemical Drum Suction Lance:

1. Acceptable Manufacturers:
 - a. EMEC.
2. Other Manufacturers: Submit Substitution Request.
3. Description: Self-venting, constant metering pump attached to the aluminum treatment equipment frame that injects adjustable amounts of 12.5 percent Sodium Hypochlorite (NaOCl) solution at the chemical mixing point downstream of the recirculation pump based on a local timer set point and ORP level.
4. Chemical Injection Pump Controller: Detached from WCP, but includes ON/OFF button and display for programmable injection (stroke) rate controls. Controller display shall illuminate during injection pump operation.
5. Chemical Drum Suction Lance: 35-inch PVC lance contains integral suction filter screen, mechanical float, adjustable depth adaptor, air vent, suction connection, level sensor cable and connector cable to the WCP.

6. Standby Equipment: A standby pump, controller, tubing and suction lance shall be provided should the primary equipment fail, or if the owner prefers a different chemical treatment agent that requires an activator, such as 5 percent chlorine dioxide with 35 percent phosphoric acid activator.

D. Polishing and WCC Bag Filters:

1. Acceptable Manufacturers:
 - a. PEP, FSI, Rosedale.
2. Other Manufacturers: Submit Substitution Request.
3. Description: The two WCC bag filters are located in series on the aluminum treatment equipment frame and the polishing filter is located at the discharge of the source pump(s). The polishing filter shall have a 25 micron rating; the first-stage WCC bag filter shall have a 25 micron rating and second-stage WCC bag filter shall have a 10 micron rating. Filters shall have 304 stainless steel, permanently piped housing compatible with the filter bag basket, and BUNA-N o-ring cover seals. Housing shall be rated for 125 psi and have a quick opening cover. Polishing filter shall be supported with adjustable-height legs and bolt tightening assembly. WCC filters shall be secured with wall mounting brackets attached to the aluminum treatment equipment frame.
4. The WCC filter bank and polishing filter shall be provided with differential pressure indicators and a switch for digital monitoring of the filter bank status by the Water Control Panel (WCP) and Cistern Transfer Pump Panel (CTPP). Indicator shall have a color display to show when the filter is clean and dirty.

E. Water Control Panel (WCP):

1. Description: The WCP coordinates all treatment intervals, chemical concentrations and alarms with ON/OFF control of the recirculation pump and chemical injection pumps. Control panel shall be in a NEMA 3R enclosure with hinged lockable cover, and house the recirculation pump motor starter and overload protection.
2. Normal Operations: The recirculation pump will be activated by an adjustable timer to sample the ORP from once every minute up to once every 60 hours, or the recirculation pump can run continuously; this period is referred to as sampling. If at any time during a sample, the ORP is below a pre-set level, the chemical injection pumps will activate and both the recirculation and chemical injection pumps will run until the adjustable High ORP set point is satisfied.
3. Well Water Makeup: A condition that exists such that well water bypasses the treatment equipment in order to satisfy demand. This condition shall be announced by a "Fresh Water ON" light at the Cistern Transfer Pump Panel (CTPP). Any of the following conditions shall initiate a well water makeup condition:
 - a. WCP General Alarm
4. WCP General Alarm: Light on the WCP that illuminates in the event of a treatment fault. This light can be accompanied by an audible chirp. The WCP shall shutdown treatment equipment, and initiate well water makeup for any of the following conditions:
 - a. High WCC Filter Bank Differential Pressure (adjustable)
 - b. Low Day Tank Water Level (adjustable): Set point should allow for adequate suction conditions at recirculation and delivery/source pump(s) to prevent cavitation and/or vortexing.
 - c. Low ORP (adjustable):
 - 1) Exception: If the ORP level falls below an adjustable Low ORP set point, the recirculation and chemical injection pumps shall start and/or remain online until the High ORP set point is satisfied.
 - d. Low Level In Chemical Drum A

- e. Recirculation Pump Over-Temperature: Alarms when recirculation pump temperature exceeds a pre-determined temperature (170 degrees F). If this condition occurs, the pump and chemical injection pumps will not turn on. When the pump temperature cools to 150 degrees F, normal system operation will resume.
 - f. Leak Detected Alarm
5. Local Control:
- a. ORP Calibration and Set point Adjustment
 - b. Treatment Length and Interval Adjustment
 - c. Recirculation Pump Test-Off-Auto Switch
 - d. Injector Pumps A Only-A&B-Off Switch
 - e. Recirculation Pump Power Disconnect Switch
6. Local Status Indicators: All alarm status lights, except the WCP General Alarm, shall flash repeatedly when activated and start a delay timer. Once the delay timer expires, the WCP General Alarm light shall illuminate.
- a. WCP General Alarm
 - b. Specific Alarm Status Lights:
 - 1) Day Tank Level – Low (adjustable)
 - 2) Chemical Drum A Level – Low
 - 3) WCC Filter Bank Differential Pressure – High (adjustable)
 - 4) ORP – Low (adjustable)
 - 5) Recirculation Pump – Over-Temperature
 - 6) Leak Detected Alarm
 - c. Injection Pump Power – ON
 - d. Recirculation Pump – ON
 - e. Timer – ON
 - f. System Elapsed Runtime Meter (hours)
 - g. Filter Bank Differential Pressure Indicator
 - h. Treatment Equipment Input and Output Pressure Gauges
 - i. ORP Control Section:
 - 1) ORP Concentration Status – Low (adjustable)
 - 2) ORP Concentration Status – Normal (adjustable)
 - 3) ORP Concentration Status – High (adjustable)
 - 4) ORP Readout (mV)
7. Building Management System (BMS) Interface: Dry contacts shall be provided for remote monitoring of the following:
- a. WCP General Alarm
 - b. High WCC Filter Bank Differential Pressure
 - c. Recirculation Pump Status (ON/OFF)
 - d. Leak Detected Alarm
- F. Vertical Storage Day Tank:
- 1. Acceptable Manufacturers:
 - a. Snyder, Norwesco, PolyProcessing.
 - 2. Other Manufacturers: Submit Substitution Request.

3. Description: Tank shall be constructed of high-density polyethylene (HDLPE) or cross-linked polyethylene (XLPE) with natural color, rated for indoor installation, specific gravity rating of 1.9, and certified for storage of up to 15 percent Sodium Hypochlorite. Tanks shall include top threaded manway with minimum 15 inch access, seismic restraint clips, as well as adequate fittings for connections shown on the Drawings. Bulkhead fitting material shall be PVC, with EPDM or viton gaskets.
4. Provide internal PVC drop-pipe/dip-tubes at tank inlets for adequate water recirculation and noise dampening inside the tank. Dip-tubes shall terminate no less than 6" from the bottom of the tank with an upturned elbow or bulkhead tee fitting. The manway shall provide the entry point for the well water makeup with air gap for backflow prevention.

G. Flexible Connectors:

1. Acceptable Manufacturers:
 - a. Metraflex, PolyProcessing, Flexmaster.
2. Other Manufacturers: Submit Substitution Request.
3. Description: Flexible expansion joints allow for lateral and vertical expansion and contraction on the lower third of the day tank's sidewall. Flexible connectors shall be constructed of PTFE resin or Viton tube and cover materials, and shall be rated for no less than the following: axial compression 0.67-inch, axial extension 0.67-inch, lateral deflection 0.51-inch, and angular deflection 14 degrees. Connectors shall be rated for system temperature, pressure and chemical concentration.

H. Ultrasonic Level Transmitter (cistern sensor shipped loose):

1. Acceptable Manufacturers:
 - a. Catec, FlowLine.
2. Other Manufacturers: Submit Substitution Request.
3. Description: System shall include ultrasonic tank level sensors to monitor day tank and cistern water levels. Sensors shall include at least one 4-20ma signal output for continuous tank level monitoring and four programmable SPST relays. Sensor shall be rated at depths equal to or greater than the full height of the tank with +/- 0.2 percent accuracy. The sensor shall use a PVDF transducer and Type 6P polycarbonate enclosure for corrosive liquids. The cistern sensor shall be shipped loose with skid package for field installation and wiring by contractor.
4. Building Management System Interface: BMS to monitor day tank and cistern water levels via 4-20mA output from ultrasonic transmitters, and alarm at graphical user interface at adjustable high and low set points.

I. Cistern Transfer Pump (shipped loose):

1. Acceptable Manufacturers:
 - a. Xylem, Grundfos, Weil.
2. Other Manufacturers: Submit Substitution Request.
3. Description: Submersible, floor-mounted style pump and air or oil-filled motor, internal mechanical seal with carbon versus ceramic faces and BUNA-N elastomers, cast iron volute and impeller, stainless steel shaft, vertical discharge, and capable of passing at least 1/2-inch solids. Pump is shipped loose with skid package for field installation and wiring by contractor.
4. Pump Stand: Pump assembly shall be mounted on a 6-inches to 18-inches tall, lightweight, corrosion resistant stand that rests on flat section at the bottom of the cistern. This feature is considered an equivalent to a floating suction inlet, which is intended to prevent settled debris on the bottom of the cistern from reaching the pump's suction inlet. Installing contractor shall attach the CTP to the stand with corrosion-resistant all-thread-rod in the field.

5. Controls: The CTP operates when the cistern low level and day tank operating levels allow for operation. This pump shall be controlled from the CTPP. This operation ensures proper day tank level management and suitable building water supply for non-potable applications.

J. Water Meters:

1. Acceptable Manufacturers:
 - a. Mueller Systems, Hersey Meters.
2. Other Manufacturers: Submit Substitution Request.
3. Description: Provide magnetic drive vertical turbine meters equipped with translator registers and frequency transmitter. The main-case and bottom cover shall be constructed of bronze, the rotor assembly thermoplastic, the strainer stainless steel, and casing bolts stainless steel ANSI B18.
4. Meter shall interface with a totalizing transmitter that converts the pulse signals into a dry contact switch closure or voltage increase of a specific duration for remote water usage trending and monitoring by the BMS.

K. Hydro-Pneumatic Tank:

1. Acceptable Manufacturers:
 - a. Wessels, Bell & Gossett, Flexcon Industries.
2. Other Manufacturers: Submit Substitution Request.
3. Description: 125 ASME construction, pre-charged, replaceable heavy-duty butyl bladder tank with steel shell, NPT system connections and .302-inch – 32 charging valve (standard tire valve) to facilitate on-site charging of the tank to meet system requirements. Tank to come skid mounted and piped.

L. Well Makeup Valve:

1. Acceptable Manufacturers:
 - a. Georg Fischer, Belimo.
2. Other Manufacturers: Submit Substitution Request.
3. Description: Two-way, electrically actuated, PVC ball valve with PTFE seat, EPDM seals, integrated emergency manual override, integrated optical position indicator, and end switch for position feedback.

M. Cistern Transfer Pump Panel (CTPP) Description: UL 508A Listed panel shall have a NEMA 1 enclosure, single point power connection for all skid components, and all necessary equipment and controls to allow for automatic operation and monitoring of the CTP, polishing filter differential pressure, and cistern low level alarm.

1. Rainwater Cistern Level, Cistern Transfer Pump (CTP), Filter, and Well Makeup Valve Monitoring and Control:
 - a. Cistern Low Level and CTP Failure Alarms: Alarm light shall illuminate at the CTPP upon a low-level condition in the cistern or CTP failure and lockout the CTP; normal treatment and delivery operations may continue. In this state, the CTP will not energize if called upon by the CTPP to replenish the day tank. When level in the day tank reaches the CTP ON set point, the treatment equipment shall disable and the well makeup valve shall open. Once level in the day tank reaches the "CTP OFF" set point, the well makeup valve shall close. Normal treatment of the day tank and CTP operation shall resume when the CTP failure and/or low cistern level alarms clear.
 - b. High Polishing Filter Differential Pressure: CTPP shall monitor the polishing filter's differential pressure and alarm when the high set point is reached. Normal transfer, treatment and delivery/boosting operations may continue during this condition.

- c. Well Makeup Valve: CTPP shall monitor the well makeup valve's position and illuminate a light when the valve is OPEN. The "Manual ON" position of the valve's control switch will override any control signals and open the valve; otherwise, normal operations as previously described will ensue with the valve's control switch in the AUTO position.
 2. Rainwater Day Tank Level Monitoring & Control:
 - a. CTP ON Level: This tank level is what the CTPP uses to enable the CTP or well makeup valve to replenish the day tank.
 - b. CTP OFF Level: This tank level is what the CTPP uses to disable the CTP or well makeup valve to prevent an overflow condition.
 3. Local Control:
 - a. CTP "HAND-OFF-AUTO" Switch
 - b. Well Makeup Valve "AUTO-Manual ON" Switch
 - c. Main Power Lockable Panel Disconnect Switch
 4. Local Display:
 - a. CTP Failure
 - b. CTP Run Pilot
 - c. Cistern Tank Level – Low (adjustable)
 - d. Polishing Filter Differential Pressure – High (adjustable)
 - e. Well Makeup Valve -- Open
 5. Materials and Components:
 - a. CTP Motor Starter with Overload and Short Circuit Protection
 - b. Control Circuit Transformer with Protected Primary and Secondary
 - c. Lockable Pump Disconnect
 6. Building Management System Interface: BMS to monitor CTP status (ON/OFF/Failure), Well Makeup Valve Position (Open/Closed), and polishing filter differential pressure status (High) with dry contact outputs from CTPP.
- N. Delivery/Boosting System and Controls:
 1. Acceptable Manufacturers:
 - a. CHC FlowTherm Systems.
 2. Other Manufacturers: Submit Substitution Request.
 3. Package Description: Booster pump package shall be UL Listed and have all components frame mounted, piped, painted, wired and factory tested. Package shall include duplex pumps, manifolds, and control panel. Pressure transducers shall be supplied on the suction and discharge manifold headers and factory wired to the unit's control panel.
 4. Delivery/Source Pump(s):
 - a. Acceptable Manufacturers: Xylem, Grundfos, STA-RITE.
 - b. Others Manufacturers: Submit Substitution Request.
 - c. Description: Non self-priming, vertical, inline, multi-stage centrifugal pump, AISI 304/316L stainless steel liquid handling components, easily accessible vent/prime/drain connections, internal mechanical seal with carbon versus silicon-carbide faces and viton elastomers.
 - d. Pump motor(s) shall be VFD-rated and shall meet the requirements of NEMA MG1, Section IV 31.4.4.2 for premium efficiency motors. Motor(s) shall have an open drip-proof or totally enclosed fan-cooled enclosure.

- e. Pump(s) to have a threaded, in-line, unleaded brass check valve, as well as ball or butterfly isolation valves at the inlet and outlet.
 - f. Pump manifold header piping shall be Schedule 10 welded, 304 stainless steel with header pipe size designed to not exceed 10 fps velocity. All pipe welds shall be performed by ASME Section IX certified welders and piping shall be welded to ASME/ANSI B31-9 specifications.
 - g. Each pump shall be fitted with a thermally activated purge valve to allow water to be purged to a remote drain in the event of a system overheating.
5. Delivery/Boosting System Control Panel:
- a. Description: UL 508A Listed, NEMA 1 enclosure with single point power connection and all the necessary components to allow for automatic operation of the variable speed pump(s). The panel shall include the following components:
- 6. Variable Frequency Drive for each motor
 - 7. Main power disconnect
 - 8. Through the door circuit breaker disconnect for each VFD
 - 9. HAND-OFF-AUTO selector switch for each pump
 - 10. Control circuit transformer with protected secondary
 - 11. Digital programmable logic controller (PLC) with door mounted color graphic touch screen display.
 - 12. Audio General Alarm – with push to silence button
 - 13. Pump operation and status lights
 - a. Door Mounted Status Lights shall include as a minimum:
 - 1) Pump Run
 - 2) Pump Out Of Service
 - 3) General Alarm
 - 14. The PLC shall provide a data log including a date and time stamp of past 20 system and VFD faults. These faults shall be displayed in English text on the door mounted supervisory controller (HMI).
 - 15. The micro-processor based supervisory controller (HMI) shall be a panel door mounted unit with color graphic touch screen display. The controller shall include PID control, floating point math with square root function and control the VFD's through a network interface. In addition to sending the run command and speed reference signal to the VFD's through the network interface, the HMI shall display line voltage, output frequency, output current and fault conditions for each VFD. The HMI shall provide an easy to use operator interface to all system parameters and display those parameters in plain English and engineering units. Monitoring functions shall be available to all users, but access to parameters shall be restricted by two levels of password protection.
 - 16. The controller shall provide data logging including a date and time stamp of the past 20 system fault conditions.
 - 17. Standard Variable Frequency Drive features shall include over current, earth fault, electronic motor overload protection, over temperature, over voltage, under voltage, phase failure, PID close-loop controller, and automatic energy saving mode, motor synchronization, and user macro storage, auto restart after power failure, electronic motor potentiometer, 16 mixed frequencies and min/max frequency limitation.

18. Control logic shall include an energy saving proof of No Demand Shutdown (NDS), which tests the system demand and then shuts off the lead pump if no demand is proven. The lag pumps shall shut off when it operates at its minimum speed for an adjustable elapsed time. The control logic shall also include the energy saving feature of dynamic set point adjustment (DSA), which automatically lowers or increases the system discharge operating pressure set point as the system demand changes. Alternative designs that do not utilize a built in software algorithm to compensate for the variable friction losses shall not be allowed to have their pressure transducer mounted on the discharge header; instead their transducer shall be provided loose and installed at the furthest remote location of the system to account for the variable friction losses within the piping system. The controls shall automatically stage the pumps and adjust the pump speed based on discharge pressure control. The lead and lag pumps shall be rotated after each system shutdown. The controls shall start a lag pump on lead pump failure. A high temperature safety shut down system shall be provided which uses a temperature sensor which measures the discharge water temperature and is directly connected to the PLC. If a high temperature occurs the system shall shut down and go into alarm. The pump water temperature monitoring must be used as a safety feature and cannot be used as an operating control. The controls shall include pump minimum run time and pump maximum run time adjustable set points.
19. The PLC shall be capable of connection to a Building Management System (BMS) using BACnet. Delivery/boosting system shall transmit a general fault for any of the following conditions:
 - a. Pump Fault
 - b. VFD Fault
 - c. PLC Fault
 - d. Transducer Failure
 - e. High System Pressure
 - f. Low Suction Pressure
 - g. Overload and Network Failure

PART 3 EXECUTION

3.01 RAINWATER TREATMENT AND DELIVERY PACKAGE INSTALLATION

- A. Install skid package in accordance with Drawings and the manufacturer's printed installation instructions. The installer shall be responsible for providing a functional system, installed in accordance with applicable national and local requirements.
- B. Install pipe and fittings in accordance with reference standards, manufacturers' recommendations and recognized industry practices.
- C. Reference Drawings for field piping connections and electrical connections performed by installing contractor and Division 26, respectively.
- D. Install and secure pump(s), ultrasonic sensor and stand per manufacturers' instructions. Consult cistern manufacturer to determine optimal inlet/outlet connection locations. Tank overflow(s) shall run to storm sewer/grade per civil engineer instructions.
- E. Install any vortex separator(s) below grade per manufacturer's instructions and as indicated. Direct vortex separator effluent to storm sewer per civil engineer's instructions.
- F. Install skid system on level concrete housekeeping pad in mechanical room or other location providing protection from freezing, UV radiation and other harmful elements.
- G. Manufacturer's authorized representative shall perform site visit after packaged system equipment delivery. Site inspection shall include validation of all included components received, equipment installation location, and clearances, and review all pre-installation questions from installing contractors.

3.02 PACKAGE TESTING

- A. The manufacturer shall hydro-pressure test pre-fabricated equipment prior to shipment with no decrease in pressure allowed. Test reports shall be included in the owner's manual. Defective work or material shall be replaced or repaired as necessary, and applicable inspections and tests repeated. Repairs shall be made with new materials.

3.03 EXTRA MATERIALS

- A. The Package Manufacturer shall provide the following extra materials for future replacement:
1. One Oxidation Reduction Potential sensor.
 2. Four 25 micron bag filters and two extra 10 micron bag filters.
 3. One set of mechanical seals for each centrifugal style pump provided with the skid package.
- B. The owner shall be responsible for replacement parts not covered under Warranty, including depleted treatment chemicals from the initial supply, which may be replenished by the owner through a preferred chemical vendor.

3.04 START-UP REQUIREMENTS

- A. The manufacturer shall ensure one initial 15 gallon chemical drum of 12.5 percent Sodium Hypochlorite treatment chemical solution and one polyethylene chemical containment pallet are at the jobsite prior to the scheduled start-up. The chemical drum and containment pallet shall be placed on the packaged skid's footprint. Pallet shall be capable of retaining all leakage from at least one 15 gallon chemical drum.
- B. Contractor to flush and clean piping, cistern and day tank prior to final startup at the jobsite. No abnormal materials shall be present in the day tank or cistern prior to startup.
- C. Contractor to coordinate with manufacturer's representative and ensure adequate cistern water level is achieved prior to scheduled system startup.
- D. Contractor to facilitate necessary communication and coordination of all involved trades for onsite system activation, calibration and start-up at the pre-scheduled start-up date/time.
- E. Contractor to provide a minimum 15 day prior notice for scheduling of packaged system start-up services. Contact manufacturer's representative for scheduling; only manufacturer's authorized representative may perform startup.
- F. The manufacturer's authorized representative shall perform a final inspection of installation and verification of system readiness prior to start-up.

3.05 OWNER TRAINING

- A. Manufacturer's authorized representative shall provide on-site training to owner's selected maintenance staff to review operation and maintenance documents in their entirety. Training shall be pre-scheduled after start-up date, no later than 75 days after start-up.

END OF SECTION

SECTION 22 2113
PIPE AND PIPE FITTINGS PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Furnish piping, pipe fittings, and incidental related items as required for complete piping systems.
- B. Related Sections Include:
 - 1. Section 22 2500, Plumbing Water Treatment

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Piping material and installation to meet requirements of the local plumbing, fire, and building codes and serving utility requirements.
 - 2. Provide chlorination of domestic cold and hot water piping in accordance with County and State health requirements.
- B. All grooved joint couplings and fittings shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - 1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.
- C. Pipe Cleaning: Should any pipe be plugged or should foaming of water systems occur, disconnect piping, reclean, and reconnect without additional expense to the Owner.
- D. Correct any damage to the building or systems resulting from failure to properly clean the system without additional expense to the Owner.
- E. All products with a wetted surface installed in potable water systems shall be UL classified in accordance with ANSI / NSF-61 for potable water service, and shall be certified to the low lead requirements of NSF-372.

1.04 SUBMITTALS

- A. Submit the Following:
 - 1. List of piping materials indicating the service it is being used for. (Do not submit piping product data).
 - 2. Product data on mechanical couplings and related components, double wall fuel oil pipe and fittings, and polypropylene waste and vent pipe.
- B. Test Reports and Certificates: Submit certificates of inspections and pipe tests to Owner.
- C. Other: Make certified welders' certificates available.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. As indicated.

2.02 CAST IRON SOIL PIPE, SERVICE WEIGHT (NO-HUB)

- A. General: A code approved hubless system conforming to Cast Iron Soil Pipe Institute Standard 301.

- B. Pipe and Fittings: Service weight hubless cast iron conforming to ASTM A 74, marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International. Tyler, AB&I, or Charlotte.
- C. Gaskets: Compression type conforming to ASTM C 564.
- D. Couplings:
 - 1. Above Grade: Band type coupling in conformance with Cast Iron Soil Pipe Institute (CISPI) 310-90, consisting of stainless steel clamp and corrugated shield assemblies with a neoprene sealing sleeve ANSI A21.6, ANSI A21.10 Fittings.
 - 2. Buried: Husky 28 gauge 304 stainless steel hubless type clamp and orange corrugated shield assemblies (80-inch pound torque) with neoprene sealing gaskets (ASTM-C-564), or Clamp-All (125-inch pound torque), 24 gauge 304 stainless steel hubless type clamp, and shield assemblies with neoprene sealing gaskets (ASTM-C-564).
- E. Service:
 - 1. Sanitary, storm, and overflow drain.
 - 2. Vent piping 2 inches and above.

2.03 DUCTILE IRON WATER PIPE

- A. Pipe: Ductile iron pipe conforming to ANSI A21.51.
- B. Fittings: Below grade, Class 150 "Boltite" mechanical joint type complete with gaskets, bolts, and nuts, or "Tyton" for joints employing a single gasket for the joint seal with bell-and-spigot pipe. Above grade, mechanical couplings and fittings as specified herein. Provide interior pipe coating per ANSI Regulation listed.
- C. Service:
 - 1. Below grade, incoming domestic water main, 4 inches and over.

2.04 BLACK STEEL PIPE, SCHEDULE 40

- A. General: Fittings and joints must be UL listed for use with pipe chosen for use. Listing restrictions and installation procedures per state and local authorities must be followed.
- B. Pipe: Schedule 40 conforming to ASTM A 135 or A 53.
- C. Fittings: 150 pound screwed malleable iron on 2 inches and below, Schedule 40 welding fittings conforming to ASTM A 234 for 2-1/2 inches and above or mechanical couplings on select piping as herein specified. Fittings below grade shall be welding fittings. All elbows on pumped systems shall be long radius type. Short radius elbows not acceptable for use except as approved on a case by case basis.
- D. Service:
 - 1. Natural gas piping and vent lines. Piping within the building shall be socket welded.
 - 2. Propane piping and vent lines.

2.05 GALVANIZED STEEL PIPE

- A. Pipe: Schedule 40 conforming to ASTM A 135 or A 53.
- B. Fittings: 150 lb. screwed galvanized malleable iron on 2-inch and below, Victaulic, Gruvlok, Gustin-Bacon, or Mech Line full flow galvanized, grooved end on 2-1/2-inch and above. Provide grooved type gasketed couplings and fittings for pipe 2-1/2-inch and above.
- C. Service:
 - 1. Miscellaneous indirect waste piping.
 - 2. At Contractor's option, waste and vent piping 1-1/2 inches and under, above grade.
 - 3. Pumped waste (above grade only).

2.06 COPPER PIPE

- A. Pipe: Hard drawn copper tubing, Class L or K, ASTM B 88.

B. Fittings: Wrought copper, 150 psi; ANSI B16.22 for soldered joints, ANSI B16.50 for brazed joints; Chase, Revere, Mueller or approved equal. At contractor's option, a system using mechanically extracted collars in main with branch line inserted to not obstruct flow may be used on domestic water piping above ground, similar to T-drill.

C. Service:

1. Domestic hot and cold water piping below ground (Type K, hard drawn) on piping 3 inches and smaller.
2. Domestic hot and cold water piping above ground (Type L, hard drawn) on piping 4 inches and smaller.
3. Trap priming lines (Type L, annealed).
4. Pumped waste (DWV).
5. Miscellaneous drains and overflows.

2.07 POLYETHYLENE PIPE

A. Pipe: Polyethylene pipe and tube PE 3406 conforming to ASTM D2513-80a.

B. Fittings: Provide copper alloy, PE 3306, PE 3406, stainless steel or other listed materials. Mechanical connectors for PE pipe and tubing and for transition fittings shall be approved compression type couplings or other special listed joints. Provide anodeless riser as required by Code.

C. Storage: Do not store unprotected pipe in direct sunlight. Store in a way to protect it from mechanical damage.

D. Service: Buried natural gas piping.

2.08 PVC PIPE (DWV)

A. Pipe: PVC, wall thickness equal to Schedule 40 standard steel pipe, conforming to ASTM D2665-85a.

B. Fittings: PVC building drain, waste, and vent fittings conforming to ASTM D2665-85 and ASTM D3311-82.

C. Solvent Cement: For PVC pipe conforming to ASTM D2564-80.

D. Service: Sanitary waste and vent, except not allowed in air plenums (Mechanical Platforms), and below grade.

2.09 ABS PIPE (DWV)

A. Pipe: ABS, wall thickness equal to schedule 40 standard steel pipe, conforming to ASTM D2661-85a.

B. Fittings: ABS waste and vent fittings conforming to ASTM D2661-85a and ASTM D3311-82.

C. Solvent Cement: For ABS pipe conforming to the requirement of ASTM D2235-81.

D. Service: Sanitary waste and vent, storm and overflow, except not allowed in air plenums.

2.10 POLYPROPYLENE PIPING - POTABLE

A. Approved Manufacturer: Aquatherm Green Pipe MF.

B. Description: Pipe shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall be made in an extrusion process. Domestic hot water shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61, and ASTM F 2389 or CSA B137.11.

C. Fittings: Same material as piping.

D. Service: Domestic cold and hot water.

2.11 POLYPROPYLENE PIPING - NONPOTABLE

- A. Approved Manufacturer: Aquatherm Lilac Pipe.
- B. Description: Pipe shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11. The pipe shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipe shall comply with the rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.
- C. Fittings: Same material as used for potable piping. Aquatherm Green Pipe.
- D. Service: Non-potable water.

2.12 PEX POTABLE WATER TUBING

- A. Acceptable Manufacturers:
 - 1. Wirsbro, Uponor.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Regulatory Listings: Submit appropriate NSF International, UL, Warnock Hesey or CSA listings as proof of compliance with local building and plumbing codes.
- C. PEX tubing and components shall be installed in full compliance with all local jurisdictional codes, standards, and requirements.
- D. Submit listings that indicated that the PEX tubing system has been certified to ANSI/NSF Standards 14 and 61.
- E. Quality Assurance:
 - 1. Installer Qualifications: Installer experienced in performing work of this Section who has specialized in installation of work similar to that required for this project.
 - 2. Installer shall provide in writing to the Owner that the PEX tubing and components furnished under this Section conforms to the material and mechanical requirements specified herein.
- F. Materials:
 - 1. Tube Materials: Tube shall be cross-linked polyethylene (PEX) manufactured by PEX-A or peroxide method. Provide "blue" colored PEX for cold water systems and "red" colored PEX for hot water systems.
 - 2. Tubing Type: PEX tubing shall be manufactured in accordance with ASTM F876, ASTM F877 and CAN/CDA-B137.5. The tube shall be listed to ASTM by an independent third party agency.
 - a. PEX tubing shall have Standard Grade hydrostatic design and pressure ratings of 200 degrees F at 80 psi and 180 degrees F at 100 psi. Temperature and pressure ratings shall be issued by the Plastic Pipe Institute (PPI).
 - b. Minimum bend radius for cold bending of the PEX tubing shall not be less than 6 times the outside diameter. Bends with the radius less than stated shall require the use of a bend support as supplied by tube manufacturer.
 - 3. Manifold Type: Wirsbro Type L Q-Series copper manifold with integral valves.
 - 4. Fittings: Fittings shall be brass. Fittings shall be PEX-A cold expansion type fitting. Wirsbro ProPEX fittings.
 - a. Fittings shall be supplied by the PEX tubing manufacturer.
 - b. PEX fittings shall be manufactured in accordance with ASTM F1960. The fittings shall be listed to ASTM by an independent third party agency.
 - c. PEX-A cold expansion type fittings shall be an assembly consisting of insert and PEX-A cold expansion ring.

G. Accessories:

1. Wall Penetration Brackets: Brackets designed for wall membrane penetrations shall be supplied by PEX tubing manufacturer; Wirsbro Drop Ear Bend Support.
2. Concrete Tube Support Brackets: Brackets to hold PEX tubing in place in structural concrete slabs shall be of rigid PVC construction and be designed for that purpose.
3. Wirsbro "Stand-Up" bracket.
4. Service: Domestic cold and hot water supply drops to individual lavatories, sinks, tank type toilets and to the shower mixing valves. PEX tubing shall not serve any fixtures with fast closing valves (flush valves, solenoid valves, etc.) and shall not be used downstream of the shower mixing valve. Domestic water piping distribution systems serving PEX manifolds shall be copper.

2.13 FLANGED JOINTS

- A. Flanged Joints: Flanges shall be cast iron or steel for screwed piping and forged steel welding neck for welded line sizes. Pressure rating and drilling shall match the apparatus, valve, or fitting to which they are attached. Flanges shall be in accordance with ANSI B16.1; 150 lb. for system pressures to 150 psig; 300 lb. for system pressures 150 psig to 400 psig. Gaskets for all flanged services, except steam and pumped condensate, shall be Garlock 3700 or equal, 1/8-inch thick, non-metallic type. Gaskets for steam and pumped condensate shall be Flexitaulic Style CG or equal, 1/8-inch thick, semi-metallic type. Make joint using American Standard hexagon head bolts, lock washers, and nuts (per ASTM A307 GR.B) for service pressures to 150 psig; alloy steel stud bolts, lock washer, and American Standard hexagon head nuts (per ASTM A307 GR.B) for service pressures 150 psig to 400 psig. Use length of bolt required for full nut engagement. Provide electro-cad plated bolts and nuts on cold and chilled water lines.

2.14 UNIONS

- A. 150 psi malleable iron, brass to iron seat, ground joint, black or galvanized to match pipe. 200 psi WOG bronze, ground joint, solder type for copper tubing.
1. Unions or flanges for servicing or disconnect are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as disconnect points.)
- B. Dielectric fittings shall be nationally listed, have a dielectric thermoplastic interior lining, and meet requirements of ASTM F-492. Fittings shall be suitable for the pressure and temperature to be encountered.

2.15 SOLDER AND BRAZING

A. Brazed Joints:

1. Wrought Copper Piping Fittings: Westinghouse Phos-Copper or Dyna-Flow by J.W. Harris Co., Inc.
2. Applied locations:
 - a. Below grade piping.
 - b. Above grade piping larger than 2-inches for the following services: Industrial cold water, domestic hot and cold water, and pumped waste.
 - c. Joints in Domestic Hot and Cold Water Piping: Use mechanically extracted collars. Braze in accordance with Copper Development Association Copper Tube Handbook using BCUP series filler material.

B. Soldered Joints:

1. Wrought Copper Pipe Fittings: All-State 430 with Duzall Flux, Engelhard Silvabrite with Engelhard General Purpose Flux or J.W. Harris Co.
2. Valves, Cast Fittings or Bronze Fittings: Harris Stay-Silv-15 or Handy & Harmon Sil-Fos.
3. Applied locations: Above grade piping 2-inch and smaller for the following services: Industrial cold water, domestic hot and cold water, pumped waste, trap priming lines.

2.16 UTILITY MARKERS

- A. Provide plastic tape utility markers over all buried piping. Provide identification on tape.
- B. Material to be Brady Identoline plastic tape, 6-inch, Seton, or as approved.

2.17 PIPE WRAPPING

- A. For all below ground steel piping and fittings, provide complete covering of Scotchrap 51, 20 mil thickness, protective tape applied over Scotchrap pipe primer applied at 1 gal/800 SF of pipe surface.
- B. At Contractor's option as approved, pipe may be furnished with factory applied jacket of "X-tru-coat" with Scotchrap as previously specified for field joints.

2.18 PREPARATION

- A. Measurements, Lines and Levels:
 - 1. Check dimension at the building site and establish lines and levels for work specified in this Section.
 - 2. Establish all inverts, slopes, and manhole elevations by instrument, working from an established datum point. Provide elevation markers for use in determining slopes and elevations in accordance with Drawings and Specifications.
 - 3. Use established grid and area lines for locating trenches in relation to building and boundaries.

2.19 EXCAVATION AND BACKFILL

- A. General: Perform all necessary excavation and backfill required for the installation of mechanical work in accord with Division 31. Repair pipelines or other work damaged during excavation and backfilling.
- B. Excavation: Excavate trenches to the necessary depth and width, removing rocks, roots, and stumps. Include additional excavation to facilitate utility crossovers, additional offsets, etc. Excavation material is unclassified. Width of trench shall be adequate for proper installation of piping. The trench shall be widened, if not wide enough for a proper installation.
- C. Bedding: All cast iron, steel, and copper piping shall be full bedded on sand. Place a minimum 4-inch deep layer on the leveled trench bottom for this purpose. Remove the sand to the necessary depth for piping bells and couplings to maintain contact of the pipe on the sand for its entire length. Lay all other piping on a smooth level trench bottom so that contact is made for its entire length.
- D. Backfill: Place in layers not exceeding 8 inches deep, and compact to 95 percent of standard proctor maximum density at optimum moisture content. Earth backfill shall be free of rocks over 2 inches in diameter and foreign matter. Disposal of excess material as directed.
 - 1. Interior: All backfill under interior slabs shall be compactible.
 - 2. Exterior: Excavated material may be used outside of buildings at the Contractor's option. The first 4 inches shall be sand, and final 12-inch layer course shall be soil in any event.

2.20 PIPING INSTALLATION

- A. Install unions in all non-flanged piping connections to apparatus and adjacent to all screwed control valves, traps, and appurtenances requiring removal for servicing so located that piping may be disconnected without disturbing the general system.
- B. Mechanical Pipe Couplings and Fittings:
 - 1. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - 2. Flexible couplings to be used only when expansion, contraction, deflection or noise and vibration is to be dampened, as detailed or specified.
 - 3. On systems using galvanized pipe and fittings, fittings shall be galvanized at factory.

4. Before assembly of couplings, lightly coat pipe ends and outside of gaskets with approved lubricant.
 5. Pipe grooving in accordance with manufacturer's specifications contained in latest published literature.
 6. Gaskets shall be molded and produced by the coupling manufacturer, and shall be suitable for the intended service.
 7. The coupling manufacturer's factory trained representative shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the project site to ensure best practices in grooved installation are being followed. (A distributor's representative is not considered qualified to conduct the training or field visits.)
- C. Install all piping as to vent and drain. Install according to manufacturer's recommendations.
- D. Support all piping independently at apparatus so that its weight shall not be carried by the equipment.
- E. Run piping clear of tube cleaning or removal/replacement access area on heat exchangers, water heaters, etc.
- F. Utility Marking: Installed over the entire length of the underground piping utilities. Install plastic tape along both sides and the center line of the trenches at the elevation of approximately 12 inches above the top of utility.
- G. Underground Water System: Prior to testing pipe provide concrete thrust blocks at changes in direction. Block size as required for types of fittings involved.
- H. Dielectric Fittings: Provide dielectric couplings, unions, or flanges between dissimilar metals. In addition, provide dielectric couplings as required to isolate cathodically protected piping and equipment.
- I. No-Hub Couplings: Install per manufacturer's instructions.

2.21 PIPING JOINTS

- A. Pipe and fittings shall be joined using methods and materials recommended by manufacturer in conformance with standard practice and applicable codes. Cleaning, cutting, reaming, grooving, etc. shall be done with proper tools and equipment. Hacksaw pipe cutting prohibited. Peening of welds to stop leaks not permitted.
- B. Copper Piping: Pipe cut evenly with cutter, ream to full inside diameter; end of pipe and inside of fitting thoroughly cleaned and polished. Joint shall be uniformly heated, and capillary space completely filled with solder or braze material, leaving full bead around entire circumference.
- C. No couplings installed in floor or wall sleeves.
- D. Steel Piping:
1. Screwed Joints: Pipes cut evenly with pipe cutter reamed to full inside diameter with all burrs and cuttings removed. Joints made up with Teflon liquid dope or Teflon tape applied to male threads only, leaving two threads bare. Joints tightened so that not more than two threads are left showing. Junctions between galvanized steel waste pipe and bell of cast iron pipe shall be made with tapped spigot or half coupling on steel pipe to form spigot end and caulked.
 2. Flanged Joints: Pressure rating of flanges shall match valve or fitting joined. Joint gaskets shall be coated with graphite and oil.
- E. Welded Joints:
1. Preparation for Welding: Bevel piping on both ends before welding:

- a. Use following weld spacing on all butt welds:

Nominal Pipe Wall Thickness	Spacing	Bevel
1/4-inch or less	1/8-inch	37-1/2
Over 1/4-inch, less than 3/4-inch	3/16-inch	27-1/2

- b. Before welding, remove all corrosion products and foreign material from surfaces.
2. Welded Joints: Joints shall be made by the "arc-welding" process using certified welders. Port openings of fittings must match the inside diameter of the pipe to which they are welded. Use full radius welding elbows for all turns, use welding tees for all tees. Reducing fittings must be used for size reduction. "Weldolets" may be used for branches up through one-half the pipe size of the main to which they are attached. Nipples are not allowed.
3. Welding Operation:
 - a. After deposition, clean each layer of weld metal to remove slag and scale by wire brushing or grinding. Chip where necessary to prepare for proper deposition of next layer.
 - b. Weld reinforcement no less than 1/16-inch not more than 1/8-inch above normal surface of jointed sections. Reinforcement crowned at center and taper on each side to surfaces being joined. Exposed surface of weld shall present professional appearance and be free of depressions below surface of jointed members.
 - c. No welding shall be done when temperature of base metal is lower than 0°F. Material to be welded during freezing temperatures shall be made warm and dry before welding is started. Metal shall be "warm to the hand" or approximately 60°F.
- F. Polypropylene joints: Fusion welding per manufacturer's requirements.

2.22 ADJUSTING AND CLEANING

A. General:

1. Clean interior of all piping before installation.
2. Flush sediment out of all piping systems after installation before connecting plumbing fixtures to the piping.
3. When placing the water systems in service during construction, each system shall be cleaned by circulating a solution with 1000 ppm (1#20 gallon) of trisodium phosphate for 24 hours, then drained, flushed and placed in service.
4. Clean all strainers prior to placing in service.

2.23 INSTALLATION, NATURAL GAS PIPING

A. Install piping where shown on Drawings.

B. Black Steel Pipe:

1. Welded joints shall be made by the "arc-welding" process by certified welders as outlined above.
2. On piping below grade install protective pipe wrap after testing and prior to backfilling in accordance with the manufacturer's recommendations. Overlap one-half spiral lap for double thickness.
3. Piping installed under building floor slabs in vented sleeve per code.

C. Polyethylene Pipe:

1. Thermal Expansion:

- a. Snaking: The pipe and tubing to be "snaked" in the trench bottom with enough slack to provide for thermal expansion and contraction before stabilizing. The normal slack created by residual coiling is generally sufficient for this purpose.
- b. If, however, the pipe has been allowed to straighten before it is placed in the trench, 6 inches per 100 feet of pipe length shall be allowed for this purpose.
- c. Stabilizing:
 - 1) Pipe and tubing temperature to be stabilized by backfilling and leaving all joints exposed so they can be examined during the pressure test.

- 2) Allow to stand overnight.
2. Joints:
 - a. Heat Fused Joints: Heat fused joints to be made as recommended by the manufacturer.
 - b. Mechanical Joints: Mechanical joints to be made in an approved manner with tools recommended by the joint manufacturer. Mechanical joints shall be made with listed compression type couplings, or other listed special fittings.
 - c. Joints to Other Materials: Listed plastic to steel transition fittings to be installed on each end of the plastic piping system. Transition fittings to be installed outside of building walls with metallic piping extending into the building a sufficient distance to permit the use of backup wrenches.
 - d. Threaded joints or joints made with adhesives or solvent are prohibited.
 3. Pipe temperatures to be stabilized before testing.
 4. Pipe and tubing shall be installed only outside the foundation of any building or structure or parts thereof.
 5. Provide 18 gauge bare copper tracer wire over entire length of pipe.
 6. Installation shall be acceptable to the serving gas supplier.

END OF SECTION

SECTION 22 2123
HYDRONIC PUMPS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Centrifugal pumps.

1.03 QUALITY ASSURANCE

- A. Select pump impellers such that impellers shall not be greater than minimum impeller size plus 90 percent of the difference between the maximum and minimum impeller size for pump selected.
- B. Select motor to be non-overloading under all operating conditions.
- C. Select pump with a minimum efficiency as listed in schedule.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Product data for each pump including performance curves, pump efficiency, motor data, operating weights, and pressure ratings. Submit control information and wiring diagrams for packaged equipment.
 - 2. Operating and maintenance data for each product specified under this Section.

PART 2 PRODUCTS

2.01 IN-LINE CIRCULATING PUMPS

- A. Acceptable Manufacturers:
 - 1. Bell and Gossett, Armstrong, Paco, Peerless, Grundfos, Aurora.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description:
 - 1. Pipe mounted, integral centrifugal pump and resiliently mounted motor.
 - 2. Rigid coupling between pump and motor.
 - 3. Mechanical shaft seals.
 - 4. Bronze fitted construction.
 - 5. Rising head characteristics with decrease in volume.
 - 6. Drip-proof construction.
 - 7. Motors: 1750 RPM or 3500 RPM maximum speed as scheduled, drip proof. Refer to Section 22 0500, Common Work Results for Plumbing for energy efficient motor requirements. Provide totally enclosed motors for pumps located in any ceiling or space used as an air plenum.

2.02 SUMP PUMP (ELEVATOR)

- A. Acceptable Manufacturers:
 - 1. Weil, Paco, Bell & Gossett, Peabody Barnes, Aurora.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: Packaged sump pump, complete including pump and controls; pump with cast iron body and motor housing, cast iron impeller, mechanical seals, stainless steel shaft and strainer.

- C. Controls / Electrical: Provide float operated controls arranged to allow pump operation and alarm bell initiation. Furnish complete control unit, including disconnect, starter, TOA selector switch(es), float and high water alarm control with alarm bell, and contacts for remote alarm point pickup. Package for single point electrical connection including controls.

PART 3 EXECUTION

3.01 IN-LINE CIRCULATING PUMP INSTALLATION

- A. Motor in horizontal or vertical depending on normal design of pump.
- B. Provide for convenient access to oil cups and as required by the manufacturer.
- C. Provide valves and specialties as detailed on Drawings.
- D. Lubricate in accordance with manufacturer's instructions before operation.
- E. Support and isolate circulators as specified and as scheduled on the Drawings.

3.02 SUMP PUMP INSTALLATION

- A. During construction, the contractor shall provide temporary pumps if evacuation of sump is required. Permanent pumps provided hereunder shall not be used for removal of construction debris.
- B. Install pumps in sumps where shown on Drawings. Adjust sump level controls to those scheduled or detailed.
- C. Provide valves and specialties as detailed on Drawings.
- D. Support interconnecting piping independently to prevent stresses on casings.

3.03 FIELD QUALITY CONTROL

- A. Field Test for Sump Pump: After installation is complete, conduct a test of the system as follows:
 - 1. Operate complete pump sequence to assure proper operation of pumps with respect to fluid level in sumps. Confirm operation of both remote and local alarm devices.

END OF SECTION

SECTION 22 2500
PLUMBING WATER TREATMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Treatment of domestic water systems.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings
 - 2. Product Data
 - 3. Operating and Maintenance Data
 - 4. Certificate of Completion
 - 5. Treatment Reports

PART 2 PRODUCTS

2.01 ACCEPTABLE CHEMICAL TREATMENT MANUFACTURER/SUPPLIER

- A. US Water Services, Nalco, Mogul, Chemax, Chemcoa, DuBois Chemicals.
- B. Other Manufacturer/Suppliers: Submit Substitution Request.

2.02 PLUMBING WATER TREATMENT

- A. Domestic Water Chlorination:
 - 1. Chlorination shall be accomplished by personnel in employed of firm licensed to do this type of work.
 - 2. As a minimum, potable water systems shall be disinfected prior to use as outlined within the current state or local Plumbing Code or as prescribed by the Health Authority, whichever requirements are more stringent.
 - 3. Chemicals: Sodium Hypochlorite 12.5 percent EPA registered for drinking water application.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Plumbing Domestic Water Systems:
 - 1. Provide 1/2-inch injection point on incoming water line immediately after the backflow device.
 - 2. Flush system with fresh water to remove all dirt and construction debris.
 - 3. Open all fixtures to develop slow rate of flow through system.
 - 4. Injection Sodium Hypochlorite solution at a rate to achieve greater at 100 ppm chlorine at all fixtures.
 - 5. Flush entire system so no chlorine is present.
 - 6. Bacteriological samples shall be submitted to a certified laboratory who shall certify that the water is suitable for drinking. The certificate stating purity of water shall be delivered to the Architect.

3.02 FINAL ADJUSTMENT

- A. When the systems are accepted by the Owner the chemical treatment supplier shall make final adjustments in the required concentrations.
- B. Submit report of indicating initials and final concentrations and system chemistry.

END OF SECTION

**SECTION 22 3000
PLUMBING EQUIPMENT**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing, apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Water heaters, domestic water expansion tanks, backflow preventers, utility vaults, oil/water separators, catch basin, heat trace, acid neutralization systems, pH monitoring system, fuel oil fill stations.
- B. Related Sections include:
 - 1. Section 22 4000, Plumbing Fixtures

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements: Water heaters to meet state energy code requirements.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Product data for each item specified.
 - 2. Operating and maintenance data.

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Gas Water Heater (Storage Type, Condensing, Direct Vent):
 - 1. Acceptable Manufacturers:
 - a. Lochinvar.
 - b. Other Manufacturers: Submit Substitution Request.
 - 2. General: Provide direct vent type commercial gas-fired storage water heater of sizes, capacities, and efficiencies as indicated on the Drawing Schedules.
 - a. Gas water heater constructed of heavy gauge steel with ceramic glass lining applied after the tank is assembled and welded. The condensing flue coil shall be coated on the flue gas side acid resistant glass lining designed for use in condensing heaters.
 - b. Insulate tank with foam insulation to comply with ASHRAE 90 standards and local codes, with a baked enamel steel jacket.
 - c. ASME pressure and temperature relief valve and ASME rated pressure vessel.
 - d. Safety Controls: CSD-1 and as required by current local codes for automatic operation.
 - e. The following shall be factory installed and provided; high temperature limiting device, drain valve, low water protective device, dielectric nipples, flue baffle, heat traps, inlet dip tube, and suspended sacrificial anode rod.
 - f. Heater and burner shall be UL listed.
 - g. Water heater shall be a fully condensing unit with a 90 percent – 98 percent thermal efficiency. Refer to Drawings for efficiency at scheduled operating conditions.
 - h. Suitable for sealed combustion direct venting with 3-inch PVC combustion air and exhaust vent piping.

- i. The power burner shall be of a design that requires no special calibrations on start up. The heater shall be approved for 0-inch clearances to combustibles.
 - j. The control shall be an integrated solid state temperature and ignition control device with integral diagnostics, LED fault display capability and a digital display of temperature settings.
 - k. The tanks shall be equipped with an ASME rated temperature pressure relief valve. The water heater shall be UL listed and exceed the minimum efficiency requirements of ASHRAE 90.
 - l. This heater shall be listed by SCAQMD Rule 1146.2 Low NOx.
3. Condensate Management System: Provide neutralizer kit to assure any condensate discharge is controlled to a pH range of 6.5 - 7 before discharge into the drainage system. Use materials approved by the authority having jurisdiction. Provide Owner with a one year supply of condensate neutralizer (reagent grade calcium carbonate).

2.02 BACKFLOW PREVENTERS

A. Acceptable Manufacturers:

1. Watts, Febco, Wilkins, Hersey, Ames.
2. Other Manufacturers: Submit Substitution Request.

B. Reduced Pressure Backflow Assembly (RPBA) Type:

1. 2-inch Size and Smaller: Screwed ends with bubble-tight ball valves, bronze main valve body and cover, bronze main valve with stainless steel 316 trim and four test cocks. Maximum working pressure of 150 psi unless scheduled.
2. 2-1/2-inch Size and Larger: Flanged ends with non-rising stem shutoff valves, cast iron main valve body and cover with epoxy coated interior, bronze main valve trim, bronze differential relief valve with stainless steel 316 trim and four test cocks. Maximum working pressure of 150 psi unless scheduled.

C. Double Check Valve Assembly (DCVA) Type:

1. 2-inch Size: Flanged ends, bronze, check valve body and cover and bronze check valve trim. Complete unit consisting of two independently acting spring-loaded toggle lever check valves, and two shutoff valves and four test cocks.
2. 2-1/2-inch through 10-inch Size: Flanged ends, cast iron check valve body and cover and bronze check valve trim. Complete unit consisting of two independently acting spring-loaded toggle lever check valves, and two shutoff valves and four test cocks.

D. Double Check Detector Assembly (DCDA) Type: 3-inch through 10-inch size with 3/4-inch bypass line, OS&Y type of shutoff valve with tattle-tale meter, main line check valve body and cover cast iron epoxy coated internally, bypass line check valve body and cover bronze and check valve trim bronze, and four test cocks.

E. Vacuum Breakers:

1. Atmospheric Type (AVB): 1/2-inch through 2-inch size, all brass body, non-spilling type, 150 psig working pressure with maximum temperature of 140°F. Rough brass finish.

2.03 DOMESTIC WATER EXPANSION TANK

A. Acceptable Manufacturers: Amtrol, Bell & Gossett, Armstrong, Wheatley, Taco, or equal.

B. Expansion Tank: Diaphragm type of welded steel, constructed and stamped in accordance with ASME code for 150 psi working pressure. Heavy-duty butyl diaphragm shall meet FDA requirements for potable water supply. Support with steel legs or bases for vertical installation or steel saddles for horizontal installation. Tank shall be precharged with compressed air to minimum fill pressures as indicated on the Drawings.

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

- A. Install per manufacturer's installation instructions and in accordance with all applicable codes.
- B. Provide pressure/temperature relief valve on storage tanks. Provide piping from relief valve to floor drain utilizing a 1-inch air gap at discharge point.
- C. Support: Install water heater oriented so that controls and devices needing service and maintenance have adequate access. Install water heaters level. Provide required strapping to structure and floor in accordance with code requirements.
- D. Gas Supply: Provide gas pipe with drip leg, tee, gas cock, union, and specialties as detailed on the Drawings. Provide gas pipe of size shown on drawings or the full size of unit inlet connection. Install piping so as not to interfere with service of units.
- E. Water Piping: Provide hot and cold water piping to units with shutoff valves, unions, and specialties as detailed on the Drawings. Provide recirculating water line to unit with shutoff valve, check valve, and union.
- F. Water Heater Vent:
 - 1. Coordinate vent connections, size, material, and routing with Division 23.
- G. Water Heater Combustion Air
 - 1. Coordinate pipe connections, size, material, and routing with Division 23.
- H. Condensate Management System: Install in strict compliance with manufacturer's installation instructions, and local authority having jurisdiction.

3.02 BACKFLOW PREVENTERS

- A. Install at height and location suitable for testing purposes by the local governing authority.
- B. Provide funnel drain below reduced pressure backflow device for collecting periodic discharge and testing purposes. Pipe 2-inch indirect waste from funnel drain to floor drain. Discharge indirect waste above floor drain utilizing a 1-inch air gap.

END OF SECTION

**SECTION 22 4000
PLUMBING FIXTURES**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 22 0500, Common Work Results for Plumbing HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Plumbing Fixtures
 - 2. Fixture Trim
 - 3. Drainage Products
 - 4. Miscellaneous Plumbing Items

1.03 QUALITY ASSURANCE

- A. Water closets shall have Maximum Performance (MaP) score of no less than 800.
- B. Faucets certified NSF/ANSI 61.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Product data for each item specified.
 - 2. Operating and Maintenance Data:
 - a. Sensor operated flush valves.
 - 3. Mounting heights for all fixtures.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturers are stated for each fixture specified. The following manufacturers are also acceptable, except when indicated only.
- B. Drainage Products and Carrier Products: J.R. Smith, Josam, Sioux Chief, Zurn, Wade, Watts Drainage, Woodford, Mifab.
- C. Fixtures: American Standard, Kohler, Sloan, Toto.
- D. Seats: Olsonite, Church, Beneke, Bemis.
- E. Mixing Valves: Powers, Leonard, Symmons, Chicago, Acorn Controls.
- F. Stainless Steel Products: Elkay, Just, Franke.
- G. Mop Sinks: Fiat, Williams, Mustee, Acorn.
- H. Faucets: Chicago, Delta Commercial, Kohler, Moen Commercial.
- I. Shower Controls: Delta Commercial, Acorn.
- J. Shower Enclosure: Aquatic Bath, Fiber-Fab, Maax.
- K. Shock Arrestors: PPP, J.R. Smith.
- L. Trap Primer Stations: PPP.
- M. Exposed Waste and Supply Piping Insulation Kits: Truebro, McGuire.
- N. Other Manufacturers: Submit Substitution Request.

2.02 FIXTURE TRIM

- A. Supply Stops: Chicago cast brass rigid riser supplies with loose key angle stops, wall flanges, NPT female inlet, all chrome plate finish; equivalent NPT McGuire (LK series), Brasscraft (SCR series) or NPT stops by fixture supplier.
- B. Traps:
 - 1. For floor drains, provide coated cast iron P-trap; recessed, screw jointed or bell and spigot.
 - 2. For other fixtures, provide 17 gauge, chrome plated cast brass P-Traps with solder bushings, and clean-out.
- C. Support Rims: Hudee stainless steel rims, if sink not furnished with integral rim.
- D. Vacuum Breakers: Chicago Faucet, A.W. Cash or Febco chrome plated.

2.03 PLUMBING FIXTURES

- A. WC-1 Water Closet (Child ADA):
 - 1. Kohler "Kingston", vitreous china, wall hung, elongated bowl, siphon jet action, 1-1/2-inch top spud, white color finish. Complete with Sloan Royal 113-1.28 manual flushometer.
 - 2. Bemis 1600 series white open-front seat, less cover with external check hinge including 300 series stainless steel post and pintles to stop seat at 11 degrees beyond vertical.
 - 3. J.R. Smith Series 200 chair carrier.
- B. WC-2 Water Closet (Adult ADA):
 - 1. Kohler "Kingston", vitreous china, wall hung, elongated bowl, siphon jet action, 1-1/2-inch top spud, white color finish. Complete with Sloan Royal 113-1.28 manual flushometer.
 - 2. Bemis 1600 series white open-front seat, less cover with external check hinge including 300 series stainless steel post and pintles to stop seat at 11 degrees beyond vertical.
 - 3. J.R. Smith Series 200 chair carrier.
- C. U-1 Urinal:
 - 1. Kohler Bardon, vitreous china, wall mounted wash down urinal with 3/4-inch top spud, white color finish. Complete with Sloan Sloan Royal 186-0.5 manual flushometer.(0.5 GPF)
 - 2. J. R. Smith Series 600 floor mounted urinal support.
- D. L-1 Lavatory :
 - 1. Kohler Kingston 21-1/4-inch by 18-1/8-inch, vitreous china, self-draining deck, backsplash, 4-inch centers, wall hung, concealed arm support, grid drain, white color finish.
 - 2. Chicago 802 series faucet with polished chrome plated solid brass body construction, 4-inch spout, vandal proof metering push handle, 1/2 gpm pressure compensating aerator, adjustable cycle time closure cartridge, vandal resistant complete.
- E. WS-1 Wash Station (ADA):
 - 1. Bradley, Model MG series, 2 station, wall-hung, equipped with Chicago MVP 3500 faucet, 0.5 gpm, manual push button metering faucet with single supply for tempered water service, and Chicago ECAST thermostatic mixing valve.
- F. WS-2 Wash Station (ADA):
 - 1. Bradley, Model MG series,3 station, wall-hung, equipped with Chicago MVP 3500 faucet, 0.5 gpm, manual push button metering faucet with single supply for tempered water service, and Chicago ECAST thermostatic mixing valve.
- G. S-1 Sink:
 - 1. Elkay CDKAD-251765, 25-inch by 17-inch by 6-1/2-inch, single compartment, 18 gauge, Type 302, 1-hole center, self-rimming, stainless steel sink; LK-18 grid strainer. Additional hole provided for bubbler valve on opposite end.

2. Chicago 748 series deck mounted, single hole drinking fountain chrome plated solid brass body construction, vandal proof metering push handle, anti-microbial flexible mouth guard.
 3. Chicago 50 series deck mounted, single hole mixing sink faucet, 5-1/4-inch rigid gooseneck spout, 4-inch wristblade handle, 1.5 gpm pressure compensating laminar flow outlet, vandal resistant complete.
- H. S-2 Sink:
1. Elkay LR series, 15-inch by 17-inch by 7-1/2-inch single compartment 18 gauge, Type 302, 3-hole, self rimming stainless steel sink, nickel plated brass grid strainer.
 2. Chicago 2300 series faucet with polished chrome plated solid brass body construction, single lever mixing valve, 10-inch cast brass spout, high temperature limit stop, 8-inch trim plate, 1.5 gpm pressure compensating laminar flow outlet, vandal resistant complete.
- I. S-3 Sink:
1. Elkay LR series, 17-inch by 20-inch by 7-1/2-inch single compartment 18 gauge, Type 302, 3-hole, self rimming stainless steel sink, nickel plated brass grid strainer
 2. Chicago 2300 series faucet with polished chrome plated solid brass body construction, single lever mixing valve, 10-inch cast brass spout, high temperature limit stop, 8-inch trim plate, 1.5 gpm pressure compensating laminar flow outlet, vandal resistant complete.
- J. MS-1 Mop Sink:
1. Fiat TSB series, 28-inch by 28-inch by 12-inch molded stone mop basin, wall bracket, 5-foot hose, bumper guards and wall guards (two sides).
 2. Chicago 540 series wall mounted service faucet with polished chrome plated solid brass body construction, lever handles, pail hook, wall brace, vacuum breaker, check stops and hose thread outlet.
- K. SH-1 Shower (ADA):
1. Delta TEK series shower valve assembly with polished chrome finish, pressure balance mixing valve, high temperature limit stop, lever handle, 1.5 gpm hand held shower with two integral check valves and 70-inch hose, 24-inch ADA wall/grab bar and R10000 series rough in kit. Shower Enclosure: Fiberglass shower stall for the handicapped with 3-inch grid strainer outlet, grab bars, fold-up seat and curtain rod. FiberFab 60 H1 with curtain rod.
 2. J.R. Smith 200 series floor drain with nickel bronze grate.
- L. Master Mixing Valve Assembly: Leonard Type TM New Generation High Low, exposed, factory tested and assembled mixing valve assembly consisting of but not limited to: large and small rough bronze finish thermostatic mixing valves, high temperature limit stops, angle check stops, outlet ball valve shutoffs, built-in spring check valve with pressure gauges, thermometer, inlet piping manifolds with unions. Unit to control discharge temperature to ± 1 percent. Unit shall be mounted in locking stainless steel cabinet. See schedule on drawings for capacities.
- M. DF-1 Drinking Fountain (ADA): Elkay EZWS dual height wall hung drinking fountain with integral bottle filler.
1. Surface mounted fountain.
 2. Contoured basins.
 3. Push pad operated bubblers.
 4. Vandal resistant bubbler guards.
 5. Surface mounting plate.
 6. 1.5 gpm Bottle Filler.
- N. Exposed Waste and Supply Piping Insulation Kits: McGuire Prowrap insulation kit for exposed supplies and waste piping below ADA lavatories and ADA sinks.

- O. SB-1 Supply Box: Sioux Chief Series 696 washing machine supply box with bottom valve supplies, integral shock arrestors and 2-inch drain outlet.
- P. SB-2 Supply Box: Sioux Chief 696 ice maker supply box with bottom valve supply and shock arrestor.

2.04 DRAINAGE PRODUCTS

- A. HB-1 Hose Bibb: Chicago 952, chrome-plated, removable key, 3/4-inch hose thread, integral vacuum breaker.
- B. WH-1 Wall Hydrant: J.R. Smith 5609QT, bronze finish, loose key, 3/4-inch hose thread, integral vacuum breaker, freeze proof.
- C. WH-2 Hot and Cold Water Hose Bibb: J.R. Smith 5500, bronze finish, hot and cold water control box, 3/4-inch hose thread, integral vacuum breaker, removable key handle, freeze proof.
- D. WSCB-1 Water Supply Control Box (for Garbage Can Wash): J.R. Smith 3380 series, recessed water supply control box in Type 304 stainless steel with a No. 4 satin finish, cylinder type key lock, cold and hot water screwdriver stops, flow control valve, and atmospheric vacuum breaker.
- E. RD-1 Roof Drain (Small Area): J.R. Smith 1330, 8-1/2-inch low profile diameter dome, cast iron body with combined flashing clamp and gravel stop, no-hub outlet and under deck clamp.
- F. OD-1 Overflow Roof Drain (Small Area Overflow): J.R. Smith 1330, 8-1/2-inch low profile diameter dome, 2-inch high solid water dam, cast iron body with combined flashing clamp and gravel stop, no-hub outlet and under deck clamp.
- G. FD-1 Floor Drain: J.R. Smith 2005, round nickel bronze vandal resistant grate, cast iron body with flashing collar and adjustable strainer head and no-hub outlet.
- H. FD-2 Floor Drain (Unfinished Areas): J.R. Smith 2110, round cast iron grate, cast iron body, no-hub outlet, sediment bucket.
- I. FD-3 Floor Drain (Finished Areas - Kitchens): J.R. Smith 2010, vandal-proof, square nickel bronze hinged grate, sediment bucket, cast iron body with flashing collar, adjustable strainer head and no-hub outlet
- J. FD-4 Floor Drain (Garbage Can Wash Drain): J.R. Smith 3370, acid resisting coated interior, nickel bronze grate, free standing sediment bucket lined with 1/4-inch stainless steel mesh screen, no-hub outlet and bronze adjustable nozzle assembly
- K. FS-1 Floor Sink (Finished Areas - Kitchens): J.R. Smith 3101-12, acid resistant coated floor sink, vandal-proof 8-1/2-inch by 8-1/2-inch nickel bronze 1/2 grate and sediment bucket, no-hub outlet and flashing collar.
- L. FS-2 Floor Sink (Finished Areas - Kitchens): J.R. Smith 3101-12, acid resistant coated floor sink, vandal-proof 8-1/2-inch by 8-1/2-inch nickel bronze 3/4 grate and sediment bucket, no-hub outlet and flashing collar.
- M. FS-3 Floor Sink (Finished Areas - Kitchens): J.R. Smith 3101-12, acid resistant coated floor sink, vandal-proof 8-1/2-inch by 8-1/2-inch nickel bronze and sediment bucket, no-hub outlet and flashing collar.
- N. FS-4 Floor Sink (mechanical room indirect waste): J.R. Smith 3041 floor sink with 8-inch deep receptor, basket strainer, 1/2 cast iron grate, no-hub outlet and flashing collar.
- O. FS-5 Floor Sink (Finished Areas - Kitchens):): J.R. Smith 3101-12, acid resistant coated floor sink, vandal-proof 8-1/2-inch by 8-1/2-inch nickel bronze full grate with center hole and sediment bucket, no-hub outlet and flashing collar.
- P. WCO Wall Cleanout: J.R. Smith 4530, round stainless steel vandal resistant cover and screw.
- Q. FCO Floor Cleanout: J.R. Smith 4020, round vandal resistant, nickel bronze top.
- R. CTG Cleanout to Grade: J.R. Smith 4220, round, extra heavy duty cast iron top set in 12-inch by 12-inch by 4-inch deep concrete pad, vandal resistant.
- S. DSB-1 Downspout Boot: J.R. Smith 1787, 4-inch round downspout connection.

- T. DSB-2 Downspout Boot: J.R. Smith 1785, 4-inch by 3-inch rectangular downspout connection.
- U. Trap Priming Valves: Precision Plumbing Products Prime-time electronic trap priming manifold including but not limited to: atmospheric vacuum breaker, pre-set 24 hour clock, manual override, 120V solenoid valve, calibrated manifold for equal water distribution, 3/4-inch water hammer arrestor. Components pre-installed in recessed steel cabinet with SS access door.
- V. Water Hammer Arrestor: Precision Plumbing Products Model SC (Maintenance-Free).
- W. DSN-1 Downspout Nozzle: J.R. Smith 1770 series in nickel bronze.

PART 3 EXECUTION

3.01 FIXTURE TRIM

- A. Provide plumbing fixture trim where applicable on fixtures, including but not limited to supply stops, traps, support rims, flush valve, and vacuum breakers.
- B. Provide rough-in and final piping connection to fixtures. Carefully review all construction documents to assure that all fixtures are provided with necessary services for a complete operating system.
- C. Rigidly secure rough-in piping, carriers and supports, and other service piping to structure.

3.02 PLUMBING FIXTURES

- A. Americans with Disabilities Act:
 - 1. Comply with and be installed in accordance with Americans with Disabilities Act Guidelines (ADAAG). Where applicable building code requirements are more stringent than ADAAG guidelines, building code requirements shall be followed.
 - 2. Water Closets:
 - a. Mounting height of ADA water closet shall be 17 to 19-inches from floor to top of the toilet seat.
 - b. Mount flush valve for ADA water closets on wide side of enclosure.
 - 3. Lavatories:
 - a. Mounting height of ADA lavatories shall be at a maximum height of 34-inches from floor to rim.
 - b. Provide insulation kits on exposed hot water and waste piping beneath ADA lavatories.
 - 4. Sinks: Provide insulation kits on exposed hot water and waste piping beneath ADA sinks.
 - 5. Urinals:
 - a. Mounting height of ADA water closet shall be at a maximum height of 17-inches from floor to rim.
- B. Fixture Mounting Heights: All fixtures standard rough-in catalogued heights unless shown otherwise on the Architectural Drawings.
- C. Showers:
 - 1. Piping from shower mixing valve to shower head shall be rigid pipe. PEX piping not allowed.
 - 2. Shower Head Mounting Heights: Mount so that face of head is at 6-feet-6-inches above finished floor and shall not conflict with shower enclosure.
- D. Water Supplies: When both hot and cold water to a fixture is required, connect the hot on the left and the cold on the right.
- E. Lavatories:
 - 1. Public toilet room lavatories shall have grid strainers.
 - 2. Those lavatories indicated as ADA are ADA compatible. Coordinate with Architect to verify if all wall hung lavatories are to be installed at ADA height.

- F. Floor Drain and Floor Sinks:
1. Set top flush with finished floor.
 2. Provide flashing clamp for all drain bodies installed in floors provided with waterproof membranes.
- G. Cleanout:
1. Where shown or required.
 2. Cover set flush with finished surface.
- H. Roof and Area Drains: Provide sump receivers for all drains except poured in place installations. Provide extension section as required to compensate for the specified insulation thickness above the roof slab or deck.
- I. Water Hammer Arresters: Provide where shown and where recommended by Plumbing Drainage Institute (PDI).
- J. Water Coolers and Drinking Fountains:
1. All water-bearing materials shall comply with the Safe Drinking Water Act of 1986 and the Lead Contamination Control Act of 1988. The waterway system of the unit shall be manufactured of copper components and other completely lead-free materials.
 2. All water cooler refrigerants will be non-CFC.
 3. Provide fixture manufacturer's wall mounting plate or floor mounted support for all wall-hung water coolers or drinking fountains.
- K. Mixing Valves: Provide piping connections per manufacturer's installation instructions.
- L. Wall hung lavatories with pop-up waste assemblies: Contractor shall verify there is no vertical pull rod assembly conflict with lavatory backsplash prior to submitting product data.

3.03 PRIMING VALVES

- A. All floor drains, floor sinks, and similar traps shall be primed. Use minimum 3/8-inch type K annealed copper tubing. Primer line to be continuous and without joints.
- B. Where priming valves are installed in finished rooms, conceal in wall and provide access panel.
- C. Coordinate locations of electronic trap primer stations with electrical contractor for 120V service.

3.04 KITCHEN EQUIPMENT

- A. General: Kitchen equipment is supplied and set in place by Kitchen Supplier, installed in construction contract. Obtain drawings before any rough-in is started. Complete installation and furnish all equipment required or scheduled below to give complete working installation. Symbol numbers are indicated by oval symbol with number inside. See "PLUMBING FIXTURES" for supply types and traps.

END OF SECTION

SECTION 23 0500
COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of This Section, Common Work Results for HVAC, apply to all sections in Division 23.
- C. All Sections of Division 23 are interrelated. When interpreting any direction, material, and method specified in any section of Division 23, consider it within the entirety of Work in Division 23.

1.02 SUMMARY

- A. The intent of Division 23 Specifications and the accompanying Drawings is to provide a complete and workable facility with complete systems as shown, specified and required by applicable codes. Include all work specified in Division 23 and shown on the accompanying Drawings, including appurtenances, connections, etc., in the finished job.
- B. The Division 23 Specifications and the accompanying Drawings are complementary and what is called for by one shall be as binding as if called for by both. Items shown on the Drawings are not necessarily included in the Specifications and vice versa. Specifications shall supersede drawings in case of conflict.
- C. Imperative language is frequently used in Division 23 Specifications. Except as otherwise specified, requirements expressed imperatively are to be performed by the Contractor.
- D. The Drawings that accompany the Division 23 Specifications are diagrammatic. They do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts. Offsets and transitions shall be assumed at a minimum at each duct crossing, structural penetrations through shear walls or beams, structural grids where ceiling heights are restricted, and at piping mains. Follow the Drawing as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the Building, subject to approval, and without additional cost to the Owner. The right is reserved to make any reasonable changes in outlet location prior to roughing-in, without cost impact.

1.03 RELATED WORK

- A. The General and Supplemental Conditions apply to this Division, including but not limited to:
 - 1. Drawings and Specifications
 - 2. Public Ordinances, Permits
 - 3. Include payments and fees required by governing authorities for work of this Division.
- B. Division 01, General Requirements, applies to this Division.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. All products and equipment shall comply with Oregon Revised Statute (ORS) 453.005(7)(e) prohibiting pentabrominated, octabrominated and decabrominated diphenyl ethers. Where products or equipment within this specification contain these banned substances, provide complying products and equipments from approved manufacturers with equal performance characteristics.
 - 2. General: All work and materials shall conform to the local and State codes, and all Federal, State and other applicable laws and regulations.
 - 3. Contractor responsible for obtaining and payment for all permits, licenses, and inspection certificates required in accordance with provisions of Contract Documents.

- B. Materials and equipment shall be new. Work shall be of good quality, free of faults and defects and in conformance with the Contract Documents.
- C. Apparatus shall be built and installed to deliver its full rated capacity at the efficiency for which it was designed.
- D. The entire mechanical system and apparatus shall operate at full capacity without objectionable noise or vibration.
- E. All equipment shall be installed level and true. Housekeeping pads and curbs shall account for floor or roof slope.
- F. Materials and Equipment:
 - 1. 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 along with other manufacturers.
 - 2. Where two or more units of the same class of equipment are furnished, use products of the same manufacturer. Component parts of the entire system need not be products of same manufacturer.
 - 3. Furnish all materials and equipment of size, make, type, and quality herein specified.
 - 4. Equipment scheduled by performance or model number shall be considered the basis of the design. If other specified manufacturer's equipment is provided in lieu of the basis of design equipment the contractor is responsible for all changes and costs which may be necessary to accommodate this equipment, including different sizes and locations for connections, different electrical characteristics, different dimensions, different access requirements or any other differences which impact the project.
- G. Workmanship:
 - 1. General: All materials shall be installed in a neat and professional manner.
 - 2. Manufacturer's Instructions: Follow manufacturer's directions where they cover points not specifically indicated. If they are in conflict with the Drawings and Division 23 Specifications, obtain clarification before starting work.
- H. Cutting and Patching:
 - 1. Cutting, patching, and repairing for the proper installation and completion of the work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting shall be performed by skilled craftsmen of each respective trade in conformance with the appropriate Division of Work.
 - 2. Additional openings required in building construction shall be made by drilling or cutting. Use of jackhammer is specifically prohibited.
 - 3. Fill holes which are cut oversize so that a tight fit is obtained around the sleeves passing through.
 - 4. Beams or columns shall not be pierced without permission of Architect and then only as directed.
 - 5. All new work cut or damaged shall be restored to its original condition. Where alterations disturb lawns, paving, walks, etc., the surfaces shall be repaired, refinished, and left in condition existing prior to commencement of work.

1.05 SUBMITTALS

- A. Submittal in accordance with section 01 3300- Submittal Procedures.

B. Shop Drawings:

1. The Contract Drawings indicate the general layout of the piping, ductwork, and various items of equipment. Coordination with other trades and with field conditions will be required. For this purpose, prepare Shop Drawings of all piping, ductwork and equipment installations. Shop Drawings shall be new drawings prepared by Contractor and not reproductions or tracings of Architect's Drawings. Overlay drawings with shop drawings of other trades and check for conflicts. All drawings shall be same size as Architect's Drawings with title block similar to Contract Drawings and identifying Architect's Drawing number or any reference drawings. All drawings shall be fully dimensioned including both plan and elevation dimensions. Shop drawings cannot be used to make scope changes.
2. Shop drawings shall be prepared in two-dimensional format.
3. Shop drawings shall include but are not limited to:
 - a. Complete floor plans with sheet metal and HVAC piping to a minimum of 1/4-inch equals 1'-0" scale.
 - b. Sheet metal and HVAC piping of mechanical and fan rooms to a minimum of 1/2-inch equal 1'-0" scale.
 - c. Sections of congested areas to a minimum of 1/2-inch = 1'-0" scale.
 - d. Controls and Instrumentation: Scale and drawing sizes to suit controls supplier.
 - e. Fabricated Equipment: Scale and drawing sizes to suit contractor except equipment shall not be less than 1/4-inch equals 1'-0" scale.
 - f. Superplot plans of above ground work with a colored overlay of all trades including, but not limited to, HVAC piping, HVAC equipment, plumbing piping and equipment, sprinklers, lighting, lighting controls, cable tray, fire alarm devices, electrical power conduit, and ceiling system to a minimum of 1/2" = 1'-0" scale.
 - g. Superplot plans of below ground work with a colored overlay of all trades including, but not limited to, structural footings and foundation, HVAC piping, civil piping, plumbing piping, and power conduit to a minimum of 1/2" = 1'-0" scale.
 - h. Beam penetration drawings indicating beam penetrations meeting the requirements indicated on the floor plans and on the structural drawings to a minimum of 1/4" = 1'-0" scale.
 - i. Slab penetration drawings of HVAC, plumbing, sprinklers, lighting and electrical to a minimum of 1/4-inch equals 1'-0" scale.
 - j. Fabrication drawings of radiant ceiling panels, architectural metal ceiling, including panel penetrations for lighting, sprinkler heads, fire alarm devices, and any other penetrations.
4. Submit shop drawings for review prior to beginning fabrication. Additional shop drawings may be requested when it appears that coordination issues are not being resolved in the field or when there is a question as to whether contract documents are being complied with or the design intent is being met.

C. Product Data:

1. In general, submit product data for review on all scheduled pieces of equipment, on all equipment requiring electrical connections or connections by other trades, and as required by each specification section or by Drawing notes. Include manufacturer's detailed shop drawings, specifications and data sheets. Data sheets shall include capacities, RPM, BHP, pressure drop, design and operating pressures, temperatures, and similar data. Manufacturer's abbreviations or codes are not acceptable.
2. List the name of the motor manufacturer and service factor for each piece of equipment.
3. Indicate equipment operating weights including bases and weight distribution at support points.

4. In the case of equipment such as wiring devices, time switches, valves, etc., specified by specific catalog number, a statement of conformance will suffice.

D. Submission Requirements:

1. Shop Drawings and Product Data:
 - a. Refer to Division 1 for additional requirements related to submittals.
 - b. Submit electronic copies of shop drawings and product data for Work of Division 23 in PDF format with each item filed under a folder and labeled with its respective specification section number, article and paragraph and mark if applicable.
 - c. Include a complete index in the original submittal. Indicate both original items submitted and note stragglers that will be submitted at a later date to avoid delay in submitting.

E. Contractor Responsibilities: It shall be the Contractor's responsibility to:

1. See that all submittals are submitted at one time and are in proper order.
2. Ensure that all equipment will fit in the space provided.
3. Assure that all deviations from Drawings and Specifications are specifically noted in the submittals. Failure to comply will void review automatically.

1.06 OPERATING AND MAINTENANCE MANUAL, PARTS LISTS, AND OWNERS INSTRUCTIONS

- A. Refer to Division 1 Section 01 7823 Operation and Maintenance Data for additional requirements.
- B. Instruct Owner thoroughly in proper operation of equipment and systems, in accordance with manufacturer's instruction manuals. Operating instructions shall cover all phases of control.
- C. Furnish competent engineer knowledgeable in this building system for minimum of five 8-hour days to instruct Owner in operation and maintenance of systems and equipment. Contractor shall keep a log of this instruction including dates, times, subjects, and those present and shall present such log when requested by Architect.

1.07 PROJECT CONDITIONS

- A. Existing Conditions: Prior to bidding, verify and become familiar with all existing conditions by visiting the site, and include all factors which may affect the execution of this Work. Include all related costs in the initial bid proposal.
- B. Coordinate exact requirements governed by actual job conditions. Check all information and report any discrepancies before fabricating work. Report changes in time to avoid unnecessary work.
- C. Coordinate shutdown and start-up of existing, temporary, and new systems and utilities. Notify Owner, City and Utility Company.

1.08 WARRANTY

- A. Provide a written guaranty covering the work of this Division (for a period of one calendar year from the date of acceptance by the Owner) as required by the General Conditions.
- B. Provide manufacturer's written warranties for material and equipment furnished under this Division insuring parts and labor for a period of one year from the date of Owner acceptance of Work of this Division.
- C. Correct warranty items promptly upon notification.

1.09 PROVISIONS FOR LARGE EQUIPMENT

- A. Contractor shall make provisions for the necessary openings in building to allow for admittance of all equipment.

1.10 TEST REPORTS AND CERTIFICATES

- A. Contractor shall submit one copy of all test reports and certificates specified herein to the Architect.

1.11 SUBSTITUTIONS

- A. Contractor shall submit any requests for product substitutions in accordance with the Instructions to Bidders, Section 01 6000 – Product Requirements and the General and Supplemental Conditions.

PART 2 PRODUCTS

2.01 ACCESS PANELS

- A. Furnish under this Division as specified in Section 08 3100 – Access Doors & Panels.

2.02 PIPE AND DUCT SLEEVES

- A. Interior Wall and Floor Sleeves: 18 gauge galvanized steel, or another pre-approved system.
- B. Interior Wall and Floor Sleeves (fire rated): Fire rated and water tight system approved by Authority Having Jurisdiction and Owners Insurance underwriter, with rating equal to floor or wall penetration, and designed specifically for the floor or wall construction, piping material, size and service.
- C. Exterior Wall Sleeves: Cast iron.
- D. On Grade Floor Sleeves: Same as exterior wall sleeves.
- E. Water Tight Sleeves: Combination steel pipe sleeves with water stop and anchor plate; Link Seal Model WS, mated with synthetic rubber links interlocked with bolts and nuts; Link Seal Model LS.

2.03 FLOOR, WALL AND CEILING PLATES

- A. Furnish stamped split type plates as follows:
 - 1. Floor Plates: Cast brass, chromium plated.
 - 2. Wall and Ceiling Plates: Spun aluminum.

2.04 MACHINERY GUARDS

- A. Furnish guards for protection on all rotating and moving parts of equipment. Provide guards for all metal fan drives and motor pulleys, regardless of being enclosed in a metal cabinet.
- B. Design guards so as not to restrict air flow at fan inlets resulting in reduced capacity.
- C. Provide shaft holes in guards for easy use of tachometers at pulley centers. Guards shall be easily removable for pulley adjustment or removal and changing of belts.
- D. All guards shall meet OSHA requirements including back plates.
- E. Provide inlet and outlet screens on all fans in plenums or where exposed to personnel.

2.05 ELECTRICAL EQUIPMENT

- A. General: All equipment and installed work shall be as specified under Division 26, Electrical.
- B. Coordinate with the electrical Drawings and electrical contractor for minimum electrical equipment bracing requirements based on the available fault current rating at the bus of the panelboard or switchboard serving the piece of equipment. Provide equipment with a Short Circuit Current Rating (SCCR) that meets the bracing requirement.
- C. Motors:
 - 1. Motors shall be furnished as integral part of driven equipment. They shall be drip proof induction type with ball bearings unless noted otherwise. Motors 1 HP and above shall be premium energy efficient type, except for emergency equipment motors. Motors shall be built to NEMA Standards for the service intended. The motors shall be rated for the voltage specified, suitable for operation within the range of 10% above to 10% below the specified voltage.
 - 2. Energy efficient motors shall be Baldor, Westinghouse, and General Electric or approved equal.

3. The motor shall meet the efficiency standards identified in the table below as determined using the IEEE Method B test at full load.

MINIMUM MOTOR EFFICIENCIES					
		RPM			
		IEEE 112B Efficiency			
HP	KW	900	1200	1800	3600
1	0.75	--	82.5	85.5	80.0
1.5	1.15	--	86.5	86.5	85.5
2	1.53	--	87.5	86.5	86.5
3	2.3	84.0	89.5	89.5	88.5
5	3.8	85.5	89.5	89.5	89.5
7.5	5.6	87.5	91.7	91.7	91.0
10	7.5	88.5	91.7	91.7	91.7
15	7.5	88.5	91.7	92.4	91.7
20	15.9	90.2	92.4	93.0	92.4

4. Refer to Equipment Schedules on the Drawings for motor horsepower, voltage, and phase.
 5. Refer to individual product sections for additional motor requirements.
 6. Furnish motors on belt drive equipment of nominal nameplate horsepower not less than 120% of equipment brake horsepower required for performance specified.
 7. Motors shall have built-in thermal overload protection, or be protected externally with separate thermal overload devices with low voltage release or lockout. Hermetically sealed motors shall have quick trip devices.
 8. All motors controlled by variable frequency drives shall be inverter duty rated and have Class F insulation or better. They shall also be able to withstand repeated voltage peaks of 1600 volts with rise times of 0.1 microseconds and greater in accordance with NEMA Standard MG1 Part 31.
 9. Motors served from variable frequency drives shall be equipped with shaft grounding system which shall provide a path for current to flow between the shaft and motor frame. SGS or equal.
 10. Motors located in environment air plenums not tied to air handling functions shall be totally enclosed type motors.
- D. Starters: Provided under Division 26, Electrical, suitable for performing the control functions required, with the exception of self-contained equipment and where the starters are furnished as part of the control package.
- E. Equipment Wiring: Interconnecting wiring within or on a piece of mechanical equipment shall be provided with the equipment unless shown otherwise. This does not include the wiring of motors, starters and controllers provided under Division 26, Electrical.
- F. Control Wiring: All control wiring for mechanical equipment shall be provided under Section 23 09 00, Instrumentation and Controls for HVAC.
- G. Codes: All electrical equipment and products shall bear the Underwriters label as required by governing codes and ordinances.

PART 3 EXECUTION

3.01 ACCESS PANELS

- A. Install in accord with manufacturer's recommendations, coordinated with architectural features.
- B. Provide 2-hour fire rated doors where required bearing the U.L. label.
- C. Furnish 18x18-inch panels for ceilings and for access to equipment in soffits and shafts, and 12"x12" for walls unless indicated otherwise.

- D. Furnish where indicated and where required to access valves, fire/smoke dampers, trap primers, shock arresters, and other appurtenances requiring operation, service or maintenance. Submit proposed locations for review prior to installation.

3.02 SLEEVES

- A. Interior Floor and Wall Sleeves: Provide sleeves large enough to provide 3/4-inch clearances around pipe or ductwork. Where pipe or ductwork is insulated, insulation shall pass continuously through sleeve with 3/4-inch clearance between insulation and sleeve. Penetrations through mechanical room and fan room floors shall be made watertight by packing with safing insulation and sealing with Tremco Dymeric Sealant or approved system.
- B. Sleeves Through Rated Floors and Walls: Similar to interior sleeves except install fire rated system approved by Authority Having Jurisdiction and Owners insurance underwriter, with rating equal to floor or wall penetration, and designed specifically for the floor or wall construction, piping or duct material, size and service.
- C. Sleeves specified or indicated at fire damper penetrations shall take precedence over this article.
- D. Exterior Wall Sleeves Below Grade: Provide water tight sleeves. Install at pipes entering building below grade and where shown. Adjust to provide positive hydrostatic seal. Contractor shall be responsible for following manufacturer's procedure for installing and tightening seal. Secure sleeves against displacement.
- E. On Grade Floor Sleeves: Same as below grade exterior wall sleeves, caulked from inside.
- F. Exterior Wall Sleeves Above Grade: Similar to interior wall sleeves except caulk outside with Tremco Dymeric Sealant.
- G. Layout work prior to concrete forming. Do all cutting and patching required. Reinforce sleeves to prevent collapse during forming and pouring.
- H. All floor sleeves shall maintain a water barrier by providing a water tight seal or they shall extend 1-inch above finished floor except through mechanical equipment room floors and shafts where sleeves shall extend 2 inches above finished floor level. Sleeves through roof shall extend 8 inches above roof. Wall sleeves shall be flush with face of wall unless otherwise indicated.
- I. Do not support pipes by resting pipe clamps on floor sleeves. Supplementary members shall be provided so pipes are floor supported.
- J. Special sleeves detailed on drawings shall take precedence over this section.

3.03 CLEANING

- A. General: Clean mechanical equipment, piping and ductwork of stampings and markings (except those required by codes), iron cuttings, and other refuse.
- B. Painted Surfaces: Clean scratched or marred painted surfaces of rust or other foreign matter and paint with matching color industrial enamel, except as otherwise noted.
- C. Additional requirements are specified under specific Sections of this Division.

3.04 EQUIPMENT PROTECTION

- A. Keep pipe, ductwork and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect piping, conduit, ductwork, equipment and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore damaged or contaminated fixtures, equipment, or apparatus to original conditions or replace at no cost to the Owner.
- B. Protect bright finished shafts, bearing housings, and similar items until in service. No rust will be permitted.
- C. Cover or otherwise suitably protect equipment and materials stored on the job site.

3.05 ACCESSIBILITY

- A. General: Locate valves, thermometers, cleanout fittings and other indicating equipment or specialties requiring frequent reading, adjustments, inspection, repairs, and removal or replacement conveniently and accessibly with reference to the finished building.
- B. Thermometers and Gauges: Install thermometers and gauges so as to be easily read from the floors, platforms and walkways.

3.06 FLOOR, WALL AND CEILING PLATES

- A. Install on piping and ductwork passing through finished walls, floors, ceilings, partitions, and plaster furrings. Plates shall completely cover opening around pipe and duct.
- B. Secure wall and ceiling plates to pipe, insulation, or structure.
- C. Plates shall not penetrate insulation vapor barriers.
- D. Plates not required in mechanical rooms or unfinished spaces.

3.07 PAINTING

- A. General: Coordinate painting of mechanical equipment and items with products and methods in conformance with Section 099000- Painting & Coating. All exposed work under this division shall receive either a factory painted finish or a field prime coat finish, except:
 - 1. Exposed copper piping.
 - 2. Aluminum jacketed outdoor insulated piping.
- B. Equipment Rooms and Finished Areas:
 - 1. Insulation: Not painted.
 - 2. Hangers, Uninsulated Piping, Miscellaneous Iron Work, Structural Steel Stands, Uninsulated Tanks, and Equipment Bases: Paint one coat of black enamel.
 - 3. Steel Valve Bodies and Bonnets: One coat of black enamel.
 - 4. Brass Valve Bodies: Not painted.
 - 5. Equipment: One coat of grey machinery enamel. Do not paint nameplates.
 - 6. Grilles, Diffusers, Registers: Paint sheet metal and visible ductwork behind grilles, diffusers and registers flat black.
- C. Concealed Spaces (above ceilings, not visible):
 - 1. Insulation: Not painted.
 - 2. Hangers, Uninsulated Piping, Miscellaneous Iron Work, Valve Bodies and Bonnets: Not painted.
- D. Exterior Steel: Wire brush and apply two coats of rust-inhibiting primer and one coat of grey exterior machinery enamel.
- E. Roof Mounted Equipment: Paint two coats of exterior machinery enamel. Color as selected by Architect. Where factory standard finish is indicated in the equipment specification, it is assumed that the standard finish is painted.
- F. Exterior Black Steel Pipe: Wire brush and apply two coats of rust-inhibiting primer and one coat of exterior enamel. Painting schemes shall comply with ANSI A13.1.

3.08 ADJUSTING AND CLEANING

- A. Before operating any equipment or systems, make thorough check to determine that systems have been flushed and cleaned as required and equipment has been properly installed, lubricated, and serviced. Check factory instructions to see that installations have been made accordingly and that recommended lubricants have been used.
- B. Use particular care in lubricating bearings to avoid damage by over-lubrication and blowing out seals. Check equipment for damage that may have occurred during shipment, after delivery, or during installation. Repair damaged equipment as approved or replace with new equipment.

3.09 ELECTRICAL EQUIPMENT

- A. Ductwork or piping for mechanical systems not serving electrical space shall not be installed in any switchgear room, transformer vault, telephone room, or electric closet except as indicated.
- B. Ductwork or piping for mechanical systems shall not pass over switchboards or electrical panelboards. Where conflicts exist, bring to attention of Architect.

3.10 EQUIPMENT CONNECTIONS

- A. Make final connections to equipment specified in sections other than Division 23 of the specifications and Owner furnished equipment in accordance with manufacturer's instructions and shop drawings furnished and as indicated.
- B. Piping:
 - 1. Provide valves and specialties as specified and as detailed on the Drawings. Provide increasers, reducers, and any other fittings required for complete installation.
 - 2. All piping connections shall be independently supported to prevent undue strain on equipment.
- C. Ductwork: Make exhaust connections to fume hoods and any other processing, laboratory, or kitchen equipment in strict accordance with manufacturer's instructions.
- D. Refer to Specification Section 11 4000, Food Service Equipment for requirements.

END OF SECTION

SECTION 23 0514
VARIABLE FREQUENCY DRIVES FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Variable frequency drives.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Product data on variable frequency drives and related components.
 - 2. Startup log/check list showing successful operation.
 - 3. Operation and Maintenance Data

PART 2 PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES

- A. Acceptable Manufacturers:
 - 1. Reliance, Toshiba, ABB, Cirrus, Emerson, Yaskawa, Square D, Siemens, Safronics, Allen-Bradley, Danfoss.
 - 2. Other Manufacturers: Submit substitution request.
- B. General Description:
 - 1. Variable frequency AC motor drive (VFD) to be of pulse width modulated (PWM) inverter type. The VFD designed to convert 60 Hz input power to adjustable frequency output power to provide positive speed control to standard induction motors. The VFD to be dedicated variable torque design for specific use with centrifugal loads.
 - 2. Provide completely solid state variable frequency power and logic unit.
 - 3. Speed control to be stepless throughout the range under variable torque load on continuous basis. Speed controlled by remote building energy management system providing 4-20MA input signal to drive and remote start/stop signal. Coordinate with Section 23 0900.
 - 4. Provide adjustable frequency control with diode bridge/capacity input designed to provide high, constant power factor of 0.95 regardless of load or speed and eliminate SCR line noise.
 - 5. Equipment will be designed and manufactured in accordance with applicable current NEMA and IEEE recommendations and be designed for installation per NEC. Equipment will be UL listed and bear the UL label.
 - 6. Control shall be suitable for operation in ambient temperatures of 32 degrees F to 104 degrees F.
 - 7. Every VFD shall be factory tested with an AC induction motor 100 percent loaded and temperature cycled within an environmental chamber at 104 degrees F.
- C. Self Protection and Reliability Features:
 - 1. Adjustable current limit to 60 to 110 percent of drive rating.
 - 2. Adjustable instantaneous overcurrent trip.
 - 3. Under voltage trip.

4. Over temperature trip.
5. Short circuit protection phase to phase and phase to ground faults phase rotation insensitive.
6. Momentary power loss, more than 17 ms.
7. Transient protection against all normal transients and surges in incoming power line.
8. Orderly shutdown in event of any of above conditions, drive shall be designed to shut down safely without component failure.
9. Provide visual indication and manual reset.

D. Standard Features:

1. Drive logic shall be microprocessor based. Control logic shall be isolated from power circuitry.
2. Standalone operation to facilitate start up and troubleshooting procedures.
3. VFD shall be UL 508C listed for drives serving a single motor or UL 508A listed for drives serving multiple motors, for use on distribution systems with 22,000 AIC.
4. Output voltages shall be equal to applied input voltage.
5. Isolated signal inputs.
6. Frequency Stability. Output frequency will be held to +0.1 percent of maximum frequency regardless of load, +10 percent input voltage change or temperature changes within ambient specification.
7. Built-in digital display shall indicate output frequency, voltage, and current and shall provide indication of over current, over voltage, current limit, ground fault, over temperature, input power on, minimum or maximum speed adjustment, power on, fault condition. Display shall be on panel face.
8. Start/Stop Control - Controlled decelerated stop.
9. Primary and secondary fused for a control circuit transformer.
10. Minimum and maximum speed control.
11. Adjustable Accel/Decel - independently adjustable 10-100 second.
12. Hand-Off auto switches.
13. Programmable Auto Restart - after power outage.
14. Provide fused disconnect, including auxiliary contacts to isolate control circuit when disconnect is in "off" position, except fused disconnects not required where packaged equipment is provided with a single point connection with single point disconnect and internal overcurrent protection for VFD and motors.
15. Remote contacts for fault, and on/off status.
16. Adjustable motor output voltage.
17. Analog output voltage of 0-10 VDC, -20 MA proportional to control output frequency.
18. Provide a NEMA 1 enclosure for indoor applications and NEMA 3R enclosure for outdoor applications to isolate each motor starter and control section with its associated disconnect switch.
19. Manual speed control for each motor.
20. Manual bypass (3 contactor) to provide ability to service control while motor is operational.
21. Provide RF, and EMI, noise suppression network to limit RF and EM interference.
22. Provide isolated analog output signals for volts, amps, and frequency, from each VFD for connection to the building energy management system.
23. Provide line (input) reactors.

24. Provide output filters for all VFD's located more than 25 conductor feet from the motor they serve. Output reactors shall permit VFD's to be located up to 350-inch from the motors they serve.
25. VFD shall be designed to catch a spinning load in forward and reverse direction.
26. Harmonic calculations shall be performed on a manufacturer supplied Harmonic Analysis program to provide conformance with IEEE 519-1992.
27. Automatic Bypass option.

E. Communications:

1. Provide factory installed communication chip for direct network connection to DDC Control System. Interface allows for control and interface functions. Interface control functions and information shall include, but not be limited to the following:
 - a. Start/Stop
 - b. Change Directions
 - c. Drive Fault
 - d. Drive Fault Codes
 - e. Reset Drive
 - f. Percent Output
 - g. Speed
 - h. Power
 - i. Drive Temp
 - j. KWH
 - k. Run Time
2. Provide isolated analog output signals for volts, amps and frequency from each VFD for connection to the DDC Control System.
3. Provide RS485 communications port and programming software capability.

PART 3 EXECUTION

3.01 VARIABLE FREQUENCY DRIVE INSTALLATION

- A. Install VFD in accordance with manufacturer's written installation instructions.
- B. Install on strut support stand.
- C. Provide one drive for each motor as scheduled.

3.02 START UP

- A. General: Comply with manufacturer's instructions for startup.
- B. Startup provided under the direct supervision of the manufacturer's representative with factory trained personnel.

3.03 FIELD QUALITY CONTROL

- A. Prior to installation, manufacturer's representative shall coordinate variable speed drive control interface with the controls contractor and verify that intended installation (controls, wiring, etc.) complies with the manufacturer's recommendations.
- B. Field Test: Except where initial variable speed drive operation clearly shows the performance meets or exceeds the requirements, test to show compliance. Tests performed by the manufacturer's representative in the presence of the Engineer.

END OF SECTION

SECTION 23 0518
HVAC EXPANSION COMPENSATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Expansion joints and compensation.
- B. Related Sections include:
 - 1. Section 23 0529, Hangers, Supports and Anchors for HVAC
 - 2. Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment
 - 3. Section 23 2113, Pipe and Pipe Fittings HVAC

1.03 QUALITY ASSURANCE

- A. The expansion joints, pipe guides, and related supports, braces, and anchorages to building structure shall be designed to absorb thermal expansion and contraction of piping and terminal movement, as well as resist the static and dynamic loads due to fluid flow at design conditions, hydraulic testing pressures, and seismic forces.
- B. The system of expansion joints, guides, and related supports, braces, and anchorage to building structure shall be designed, detailed, and bear the seal of a professional engineer registered in the State having jurisdiction.
- C. Use expansion joints in straight lengths of rigid pipe; preferably welded steel, anchored and guided in accordance with best practices recommendations of Crocker and King, Piping Handbook, latest edition.
- D. Avoid use of expansion joints in conjunction with U-bends or other piping systems with "inherent" flexibility. If expansion joints are used in piping with bends, thorough analysis of pipe stresses and deflections shall be conducted and extra care and attention shall be paid to radial thrust capacity of pipe guides, braces, and anchors.
- E. Design shall include:
 - 1. Pipe stress analysis indicating loads, deflections, and pipe stress at critical points throughout the piping systems under the following conditions:
 - a. At hydraulic design test pressure and ambient water temperature.
 - b. At design operating temperature, pressure, and flow.
 - c. Model number, size, location, and details of expansion joints, compensator guides, supports, braces, and anchorage to building structure, with substantiating calculations that the components and building can accept the calculated loads and deflections.
 - d. Detailed shop drawings stamped and signed by a registered professional engineer.
 - e. Structural details and calculations stamped and signed by a registered professional structural engineer.
 - f. Expansion Joints to be designed and manufactured to the current Expansion Joint Manufacturers Association (EJMA) standards. Manufacturer of expansion joints to be certified by EJMA.

1.04 SUBMITTALS

A. Submit the following:

1. Product data.
2. Shop Drawings showing details of construction, dimensions, arrangement of components, and isolation.
3. Structural Details and Calculations: Submit structural details and calculations substantiating that building structure, anchorages, and fabricated steel braces can safely withstand maximum calculated loads.
4. Specified testing requirements.
5. Operating and maintenance data.

PART 2 PRODUCTS

2.01 EXPANSION JOINTS AND COMPENSATORS

A. Acceptable Manufacturers:

1. Flexonics, Keflex, Hyspan, Metraflex.
2. Other Manufacturers: Submit Substitution Request.

B. Description:

1. Expansion compensators to be of the packless, externally pressurized type to allow for axial movement constructed of stainless steel bellows, stainless steel shroud, integral guide rings, internal liner, limit stops, with drain port and plug.
2. All materials of construction and pressure ratings shall be appropriate for the application as specified for each piping material and service.

2.02 EXPANSION LOOPS / SEISMIC EXPANSION JOINTS

A. Acceptable Manufacturers:

1. Metraflex Metraloop.
2. Other Manufacturers: Submit Substitution Request.

B. Description:

1. Flexible stainless steel hose and braid connector.
2. Connector shall accept differential support displacement without damaging pipe, equipment connections, or support connections.
3. All materials of construction and pressure ratings shall be appropriate for the application as specified for each piping material and service.

2.03 PIPE GUIDES

A. Acceptable Manufacturers: Hyspan, Grinnell, Flexonics, Adsco, Pipe Shields Inc., Unistrut, or equal.

B. Spider Clamp Assembly: Heavy gauge pressed steel, fusion welded, bolted construction, black enamel finish. Hyspan 9500, or equal.

PART 3 EXECUTION

3.01 EXPANSION JOINTS AND COMPENSATORS

- A. Install in all piping risers in wood structures to compensate for 1/2" of shrinkage per floor. Contractor is responsible to determine quantities and locations required.
- B. Install in piping to compensate for thermal expansion and contraction. Contractor is responsible to determine quantities and locations required.
- C. Install in other locations indicated on the drawings.

- D. Provide and install pipe alignment guides as recommended by the expansion joint manufacturer with the first guide no more than 4 pipe diameters away from the expansion joint or compensator and second guide no more than 14 pipe diameters from first guide.
- E. Install per manufacturer's installation instructions.

3.02 EXPANSION LOOP / SEISMIC EXPANSION JOINT

- A. Install at building seismic expansion joints. Select loops/joints to accommodate six inches of movement.
- B. Install in piping to compensate for thermal expansion and contraction. Determine lengths required to enable groups of loops to fit in available space.
- C. Install per manufacturer's installation instructions.

END OF SECTION

**SECTION 23 0519
METERS AND GAUGES FOR HVAC**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Thermometers
 - 2. Pressure Gauges
 - 3. Differential Pressure Gauges
 - 4. Water Meters
 - 5. Flow Meters

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Products listed in this Section.
 - 2. Operating and Maintenance Data

PART 2 PRODUCTS

2.01 THERMOMETERS, WATER

- A. Acceptable Manufacturers:
 - 1. Ashcroft, Weiss, Trerice, Marsh, Weksler, Tel-Tru.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Direct drive 4-1/2-inch dial type, stainless steel case, separable sockets, stem length to penetrate minimum of 1/2 pipe diameter, adjustable face, extension necks where required to clear insulation.
- C. Range:

HVAC Systems	Temperature	Graduations
Chilled/Heating Water	30-180 degrees F	2 degrees F

2.02 PRESSURE GAUGES - GENERAL

- A. Acceptable Manufacturers:
 - 1. Marsh, Ashcroft, Weiss, Trerice, Weksler, Tel-Tru.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: 4-1/2-inch dial, molded black polypropylene turret case.
- C. Range:

HVAC Systems	Pressure	Graduations
Chilled/Heating Water	0-100 psi	1 psi

2.03 DIFFERENTIAL PRESSURE GAUGES

- A. Description: Surface mounted diaphragm-actuated dial type with zero pointer adjustment. Provide 4-inch minimum dial diameter with black figures on a white background.
- B. Tubing: Copper; polytube may be used if concealed inside walls.

C. Manufacturer:

1. Across Filters: Dwyer magnahelic Model 2002-AF, 0-2-inches of water range with air filter gauge accessory package.

2.04 WATER METER

A. Acceptable Manufacturers:

1. Hersey, Badger, Sparling.
2. Other Manufacturers: Submit Substitution Request.

B. Description:

1. Disc type meter, bronze split casing, magnetic drive.
2. Heavy duty gear train, completely sealed, circular meter, totalize in cubic feet with sweep hand.
3. Comply with AWWA performance standards.

2.05 CHILLED/HEATING WATER FLOW METER

A. Type: Vortex shedding flow meter.

B. Description:

1. Provide output signals which are linear with the flow rate.
2. Accuracy +/-1 percent of measurement for volumetric flow rates greater than 5 percent of specified maximum flow rate for each building.
3. Flowmeters provide specified accuracy when installed and configured for upstream minimum straight runs of 24-inches.
4. Vortex flow meters will be Intelligent microprocessor-based, with integral LCD digital Display/Configurator allowing complete commissioning and operation without external programming devices.
5. Meter design permits maintenance and repair of flow sensor and electronics without removing the meter from line or shutting down steam flow.
6. Flowmeter: Turn down ration of 50:1 or higher. ANSI 150 flanged end connections, wafer style not acceptable.
7. Flange Size of Adjoining Pipe: Same nominal size as the flow meter.
8. The flow meter shall be mounted in a straight, unobstructed pipe with a minimum of 10 pipe diameters upstream of the meter and 5 pipe diameters downstream, compensating for any induced flow effects according to manufacturer's recommendations.
 - a. Maximum Operating Pressure 400 psi
 - b. Output Signal Analog 4-20mA signal
 - c. Supply Voltage 24VDC
 - d. Interrogation FoxCom Version
 - e. Based On FoxBoro I/A Series Intelliegent Vortext Flow Meter 83

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Provide meters and gauges where shown on Drawings.
- B. Install all gauges and meters as required and as recommended by equipment manufacturer or their representative.
- C. Extend all connections, wells, cocks, or gauges to a minimum of 1-inch beyond insulation thickness of the various systems.

- D. Locate all gauges so that they may be conveniently read at eye level or easily viewed and read from the floor or from the most likely viewing area, i.e., platform, catwalk, etc.
- E. Install instruments over 6-feet-6-inches above floor, to be viewed from the floor, with face at 30 degrees to horizontal.

3.02 INSTALLATION - PRESSURE GAUGES

- A. Provide instrument gauge cock at inlets.
- B. Locate pressure gauge taps for measuring pressure drop or increase across pumps, coils, condensers, etc., as close to the device as possible.

3.03 WATER METER

- A. Installed in accord with manufacturer's recommendations and as shown on the Drawings.

3.04 FLOW METER

- A. Install device in accordance with the manufacturer's recommendations, with sufficient upstream and downstream straight pipe to obtain accurate readings.

END OF SECTION

SECTION 23 0523

GENERAL DUTY VALVES AND SPECIALTIES FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC, apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Valves, general purpose gauge cocks, and balance fittings.

1.03 SUBMITTALS

- A. Submit Product Data
- B. Submit balancing valve schedule with manufacturer, model, size, flow rate and pressure drop.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER VALVES

- A. General: Where only NIBCO figure numbers are listed, equivalent products by those specified below are acceptable.
 - 1. Gate, Globe, Swing Check: Victaulic, Crane, Kennedy, Stockham, Milwaukee, Walworth and Hammond.
 - 2. Silent Check: Mueller, Metraflex, Victaulic, Bell and Gossett, Milwaukee and Gruvlok.
 - 3. Balancing: DeZurik, Homestead, Bell and Gossett, Armstrong, Walworth, Taco, Wheatley, Tour and Andersson, Victaulic, Gruvlok, Nibco, Nutech, Pro Hydronic.
 - 4. Butterfly: Victaulic, Gruvlok, Crane, Walworth, Milwaukee and Metraflex.
 - 5. Ball: Gruvlok, Apollo, Crane, Hammond, Milwaukee and Victaulic.
- B. Other Manufacturers: Submit Substitution Request.
- C. All such valves shall be of one manufacturer.
- D. Valve ends may be threaded, flanged, soldered, or grooved, as applicable to piping system. Refer to Section 23 2113, Pipe and Pipe Fittings HVAC for allowable fittings.

2.02 GATE VALVES

- A. Iron Gate, OS&Y: Iron body, bronze trim, OS&Y pattern, solid wedge, 150 psi rating; NIBCO 637.

2.03 GLOBE VALVES

- A. Bronze Globe and Angle Globe: Bronze body, bronze mounted, renewable composition disc, 150 psi rating; NIBCO 235 or 335.
- B. Bronze Globe and Angle Globe High Pressure: Bronze body, stainless steel disc, union bonnet, 300 psi steam; NIBCO 276-AP or 376-AP.
- C. Iron Globe: Iron body, bronze mounted, OS and Y pattern, renewable composition disc, 125 psi rating; NIBCO 718-B.

2.04 CHECK VALVES

- A. Horizontal Bronze Swing Check: Bronze body, bronze mounted, regrinding bronze disc, 150 psi steam rating, 300 psi WOG; NIBCO 433-Y.
- B. Horizontal Iron Swing Check: Iron body, bronze mounted, regrinding bronze disc and seat ring, 125 psi rating; NIBCO 918.
- C. Vertical and Silent Check Valves:

GENERAL DUTY VALVES AND SPECIALTIES FOR HVAC

1. 250 pound WOG, iron body, stainless steel trim, globe type with flanged ends; NIBCO 960.
 2. 300 psig CWP, ductile iron body, stainless steel spring and shaft. Victaulic 716.
 3. 230 psig CWP, AGS grooved end ductile iron body, stainless steel spring, shaft, and disc, EPDM seat. Victaulic W715.
- D. Vertical and Silent Check Valves: 250 pound WOG, iron body, stainless steel trim, wafer type; NIBCO W-960.
- E. Iron Swing Check with Lever and Spring: Iron body, bronze fitted, with adjustable lever and spring; NIBCO F-918-BL&S.

2.05 BALL VALVES

- A. Bronze Ball: Bronze cast body or forged brass, chrome-plated full port ball, with handle, Teflon seat, 300 psi WOG, 150 psi steam; NIBCO 585-70 or Victaulic 589.

2.06 BUTTERFLY VALVES

- A. Ductile iron body, electroless-nickel chrome plated disc and stainless steel shaft (shaft shall be offset from the disc centerline to provide complete 360-degree circumferential seating), with lever handle and locking feature on valves 6-inches and less., gear operator on valves 8-inches and over; stem neck length to accommodate insulation where applicable, pressure responsive EPDM liner, 300 psi water; Victaulic MasterSeal, NIBCO 2000, NIBCO 4765.
- B. Copper Grooved Piping System Butterfly Valve: Nylon coated or Cast bronze body per Copper Development Agency-836, ductile iron disc encapsulated with EPDM coating, lever handle up to 6-inches, gear operator on valves 8-inches and greater, stem length to accommodate insulation, 300 psi water; Victaulic Series 608, per ASTM A-584.
1. Grooved ends shall be manufactured to copper-tubing sizes. Flaring tube or fitting ends to accommodate alternate sized couplings is not permitted.

2.07 BALANCING VALVE

- A. Calibrated:
1. Venturi style design. Valve to perform the following functions: Precision flow measurement, precision flow balancing, memory stops, positive shut-off to a minimum of 250 psi, drain port suitable for hose bibb fitting. Threaded or solder ends for 1/2-inch through 2-inches. 1/2-inch valve shall be capable of balance to 0.5 GPM. Grooved or flanged ends for 2-1/2-inches through 12-inches. Bell and Gosset, Flow Design, Griswold, Nutech, Pro Hydronic.
 2. Size balancing valves based on the published performance curve characteristics for the scheduled flow rate for each location to ensure proper operation at design conditions.

2.08 SPECIALTY VALVES

- A. Gauge Cocks: Brass, tee handle, male to female, 200 psi working pressure, 1/4 inch; Conbraco 41 series.
- B. Drain Valves: Bronze globe valve or full port ball valve, garden hose end, cap, and chain 3/4 inch size.

2.09 SYSTEM SPECIALTIES

- A. Manual Air Vents: Coin type; Dole No. 9 or approved equal.
- B. Automatic Air Vents:
1. Acceptable Manufacturers:
 - a. Spirotherm Spirotop.
 - b. Other Manufacturers: Submit Substitution Request.
 2. Description: Water main type, cast brass body, built-in check valve, 1/8-inch IPS top tapping for moisture discharge, 3/4-inch size, 150 psi operating pressure.
- C. Pressure/Temperature Test Plug:

1. Acceptable Manufacturers:
 - a. Peterson Engineering, Inc., Universal Lancaster, Sisco, Terrice.
 - b. Other Manufacturers: Submit Substitution Request.
2. General: 1/2-inch NPT fitting to receive either a temperature or pressure probe 1/8-inch O.D., fitted with a color coded and marked cap with gasket.
3. Material: Solid brass with valve core of Nordel.
4. Rating: Minimum 300 psig at 275 degrees F.
5. Gauges and Thermometers: Supply Owner with two pressure gauge adapters with 1/8-inch OD probe and two five-inch stem pocket test thermometers 25 degrees F-125 degrees F for chilled water, 40 degrees F-240 degrees F for heating water.

2.10 INTEGRATED COIL PIPING CONNECTOR

- A. Acceptable Manufacturers: Flow Design, Griswold Controls, HCl, Pro Hydronic.
- B. Components shall consist of full port forged brass isolation valves with integral union and pressure temperature port, strainer where indicated, flow meter, balance valve with memory stop, air vents, and drains.
- C. Use of integrated flexible braided hoses is not acceptable.
- D. Components shall be of same manufacturer as approved assembly supplier listed in this section or other approved manufacturers listed for each component in other sections of this specification.
- E. Components shall meet the specifications for each component as listed on other sections of the specification.
- F. Assembly shall be capable of continuous operation at 150 psi and system test pressure when installed in piping systems.
- G. Assembly shall be the same size as the pipe it connects and have pipe thread connectors on both ends with male or female end adapters as required, except the balancing valve may be a smaller size as required to balance the flow.

2.11 BLADDER EXPANSION TANK SYSTEM

- A. Acceptable Manufacturers:
 1. Amtrol, Bell & Gossett, Armstrong, Wheatley, Taco.
 2. Other Manufacturers: Submit Substitution Request.
- B. Expansion Tank: Bladder type of welded steel, constructed and stamped in accordance with ASME Code for 125 psi working pressure. Support with steel legs or bases for vertical installation or steel saddles for horizontal installation. Tank shall be precharged with compressed air to minimum fill pressures as indicated. Bladder shall be replaceable.
- C. Size: ET-1, minimum 124 gallons, vertical tank as indicated.

2.12 AIR/DIRT SEPARATOR – HIGH EFFICIENCY COALESCING

- A. Acceptable Manufacturers:
 1. Spirotherm Spirovent model VDT.
 2. Other Manufacturers: Submit Substitution Request.
- B. Description:
 1. Turbulence suppressive type air eliminator to separate microbubbles and to remove stationary air pockets through absorption. Brass or steel body with centerlined inlet and outlet for in-line piping. Valved side tap to bleed large amounts of air during system fill.
 2. Spirotubing made of copper wire woven around central copper tube inside housing. Integrated brass venting mechanism on top. Blowdown connection port at bottom.

GENERAL DUTY VALVES AND SPECIALTIES FOR HVAC

3. Maximum working pressure, 150 psi. Maximum working temperature 270 degrees F. Maximum allowable water velocity, 4ft/second. Maximum pressure drop 0.5-feet.
4. Air elimination efficiency Of 100 percent free air, 100 percent entrained air, 99.6 percent dissolved air.
5. Dirt separation efficiency of 80 percent of particles 30 micron and larger with 100 passes.

2.13 PRESSURE REDUCING VALVE (CLOSED HYDRONIC SYSTEM FEED)

- A. Acceptable Manufacturers:
 1. Bell & Gossett, Armstrong, Taco, Amtrol, Cash Acme.
 2. Other Manufacturers: Submit Substitution Request.
- B. Description: Self-filling type with low inlet pressure check valve, removable strainer, adjustable range, and set point as indicated on the Drawings.
- C. Construction: Iron body for steel piping installation, brass body for copper piping installation. All working parts shall be brass.
- D. Size: 3/4-inch unless shown otherwise.

2.14 WATER RELIEF VALVES

- A. Acceptable Manufacturers:
 1. Consolidated, Kunkle, B&G, Armstrong, Cash Acme.
 2. Other Manufacturers: Submit Substitution Request.
- B. Description: Bronze or steel body, stainless steel or bronze, pressure settings to 160 psi at 250°F, conforming to Section IV of ASME Code, size per manufacturer's recommendations based on Code, setting as indicated; Kunkle Model 537.

2.15 STRAINERS

- A. Acceptable Manufacturers:
 1. Nibco, Armstrong, McAlear, Sarco, Steamflo, Mueller, R.P. & C. Company Titan Flow Control.
 2. For Grooved Coupling Systems: Gruvlok or Victaulic.
 3. Other Manufacturers: Submit Substitution Request.
- B. Wye Pattern:
 1. Bronze: Bronze body, 250 psi, 1/16-inch perforated Type 304 stainless screen.
 2. Ductile Iron: Ductile iron body, 300 psi, 1/16 or 1/8-inch Type 304 stainless steel screen.
 3. Cast Iron: Cast iron body, 125 psi, 1/16-inch perforated Type 304 stainless screen.
 4. Cast Iron, High Pressure: Cast iron body, 250 psi, 1/16-inch perforated Type 304 stainless screen.
- C. Basket Pattern: Semisteel body, 125 psi WOG, flanged, 1/8-inch perforated Type 304 stainless steel screen, closed bottom basket, clamped or bolted cover.

2.16 SUCTION DIFFUSERS

- A. Acceptable Manufacturers:
 1. Bell & Gossett, Armstrong, Taco, Amtrol, Wheatley, Paco, Mueller.
 2. For Grooved Piping Systems: Gruvlok or Victaulic.
 3. Other Manufacturers: Submit Substitution Request.
- B. Description: Angle type body with inlet straightening vanes and combination orifice cylinder-diffuser-strainer with 3/16-inch diameter openings. Provide inlet vane length equal to 2-1/2 times pump connection diameter. Provide adjustable support foot to carry the weight of suction piping, drain plug, and pressure gauge tap.

- C. Construction: Cast iron body rated for 175 psig operating pressure at 300 degrees F. Provide steel inlet vanes on closed systems, stainless steel on open systems and domestic water systems. Provide steel orifice cylinders on closed systems, stainless steel on open systems and domestic water systems. Provide bronze mesh start-up strainers on closed systems and domestic water systems, none on open systems.
- D. Selection: Outlet size shall match pump inlet size. Inlet size shall match pipe size upstream. Maximum of 2 psi drop without start-up strainer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide valves at connections to equipment where shown or required for equipment isolation.
- B. Install all valves and strainers in accessible locations and same size as connected piping (not the size of the equipment connection), except balancing valves shall be sized by the contractor to properly balance the flow.
- C. Provide separate support for valves where necessary.
- D. Provide drain valves in all low points in the piping system, at coils and equipment, and as indicated.

3.02 APPLIED LOCATIONS HVAC VALVES

- A. In piping 2-inches and smaller:

System	Valve Types				
	Gate	Globe	Swing Check	Ball	Butterfly
Heating Water and Dual Temperature Water	Not Allowed	Bronze	Bronze	Bronze	Not Allowed

- B. In piping 2-1/2-inches and larger:

System	Valve Types				
	Gate	Globe	Check	Ball	Butterfly
Chilled Water and Dual Temperature Water	Not allowed	Iron	Iron, Swing	Not Allowed	Ductile Iron
Heating Water	Iron (Boiler iso only)	Iron	Iron, Swing	Not Allowed	Ductile Iron
Pump Discharge	Not allowed.	Iron	Iron, Silent Check: Globe or Water Style, Swing with Lever and Weight or Lever and Spring	Not Allowed	Ductile Iron

- C. Calibrated venturi balancing valves 1/2-inch through 12-inches, on water coils and in piping systems in accordance with manufacturer's recommendations.
- D. Provide gauge cock for all pressure gauges.
- E. Provide gate valves with pressure type packing glands for heating water boiler shutoff applications. Valves shall meet requirements of ASME Boiler and Pressure Vessel Code, Section IV, Article 7 for Stop Valves.

3.03 VALVE IDENTIFICATION

- A. General: Identify valves to indicate their function and system served.
- B. See Section 23 0553, Identification for HVAC Piping and Equipment.

3.04 CHAIN OPERATORS

- A. All valves in equipment rooms or fan rooms used for equipment or coil isolation and more than 8 feet above floor shall be installed with stem horizontal and equipped with chain wheels and chains extending to 6 feet above floor.

3.05 INSTALLATION

A. Manual Air Vents:

1. Install at all high points where automatic air vents are not used, where noted, and where required for proper venting of system.
2. Install in accordance with manufacturer's recommendations.

B. Automatic Air Vents:

1. Install automatic air vents at high points where air can collect in water systems where indicated. Route drain lines from vent to nearest floor drain.
2. Install 3/4-inch globe shut-off valve ahead of air vent. Install ball valve where bucket drainage is required.

C. Grooved Mechanical Pipe Valve End Connections:

1. Refer to Section 23 2113, Pipe and Pipe Fittings HVAC for allowed service installations.
2. Shall be installed in accordance with the manufacturer's published installation instructions.
3. Gaskets shall be molded and produced by the coupling manufacturer, and shall be suitable for the intended service.
4. The coupling manufacturer's factory trained representative:
 - a. Shall provide on-site training for the contractor's field personnel in the use of grooving tools and installation of grooved joint products.
 - b. Shall periodically visit the project site to ensure best practices in grooved installation are being followed.
 - c. A distributor's representative is not considered qualified to conduct the training or field visits.

D. Test Plugs: Install where indicated and in accordance with the manufacturer's recommendations.

E. Coil Connectors:

1. Applied Locations: Integrated coil connectors are prohibited except where specifically indicated below or on the drawings.
2. Make all connections in accordance with Section 23 2113, Pipe and Pipe Fittings HVAC.

F. Expansion Tanks:

1. Support with steel rods and brackets from structure or from structural steel stand as required.
2. Pipe valve drain to over floor drain.

G. Air Separator:

1. Install as shown on Drawings and in accordance with the manufacturer's recommendations.
2. Suspend from structure with steel rods or brackets or support from steel stand as required.
3. Bleed system air at start-up according to manufacturer's recommendations.

H. Pressure Reducing Valves:

1. Install where indicated and in accordance with manufacturer's recommendations with 3 valve bypass.

I. Water Relief Valves:

GENERAL DUTY VALVES AND SPECIALTIES FOR HVAC

1. Install where indicated, and in accordance with manufacturer's instructions. Pipe discharge to nearest floor drain using Schedule 40 steel pipe.

J. Strainer:

1. Provide valved blow off for each strainer of same size as plugs with maximum size of 1-1/2 inches. Pipe blow off full size and terminate over floor drains except finned tube, reheat coils, fan coils, terminal units, and unit heaters.
2. Applied Locations HVAC:
 - a. Cast iron wye, chilled, heating water.
 - b. Bronze wye, in piping 2-inch and smaller.
 - c. Basket, in piping 2-1/2-inch and larger.

K. Suction Diffusers:

1. Install on inlets of pumps where indicated in accordance with manufacturer's recommendations.
2. Support suction diffuser and piping from same surface as pump base is supported unless shown otherwise. Adjust foot so that pump inlet does not carry any piping weight.
3. Pipe pressure gauges to gauge port, and blow down to drain with ball shut-off valve.
4. After operating pumps for seven days, clean strainer and remove start-up strainer.

END OF SECTION

SECTION 23 0529
HANGERS, SUPPORTS, AND ANCHORS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Supports and anchors for piping systems and equipment.
- B. Related Sections include:
 - 1. Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment
 - 2. Section 23 0700, Insulation for HVAC
 - 3. Section 23 2113, Pipe and Pipe Fittings HVAC

1.03 QUALITY ASSURANCE

- A. Provide pipe and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports and seismic restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor shall be responsible for their design.
 - 2. Seismic restraints and anchorages resist seismic forces as specified in the latest edition of the International Building Code for the seismic zone in which the project is constructed.
 - 3. Seismic restraint do not introduce excessive stresses in the piping caused by thermal expansion or contraction.
 - 4. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
 - 5. Seismic restraints in accordance with the latest edition of the SMACNA "Seismic Restraint Manual - Guidelines for Mechanical Systems" for the Seismic Hazard Level corresponding to the seismic zone in which the project is constructed.
 - 6. Seismic restraints shall be in accordance with the applicable code.
 - 7. Seismic restraints shall follow the provisions described in Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment.
- B. Engineered Support Systems: The following support systems shall be designed, detailed, and bear the seal of a professional engineer registered in the State having jurisdiction.
 - 1. Supports and seismic restraints for suspended piping and equipment.
 - 2. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
 - 3. Equipment and piping support frame anchorage to supporting slab or structure.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings of contractor fabricated support structures.
 - 2. Structural Details and Calculations: Submit structural details and calculations substantiating that building structure, anchorages, and fabricated steel braces can safely withstand maximum calculated loads.
 - 3. No other submittals required under this section.

PART 2 PRODUCTS**2.01 SUPPORTS, GENERAL**

- A. Fabricate support members from welded standard structural shapes, pipe, and plate to carry the necessary rollers, hangers, and accessories as required. Support piping less than 4-inch pipe size from or by prefabricated roll-formed channels with necessary accessories to adequately support piping system.
- B. Acceptable Manufacturers: Unistrut, Superstrut, Powerstrut and Kinline, B-Line Systems, AnvilStrut.
- C. Supports and Accessories: Preformed roll-formed channels and accessories with matching compatible accessories as shown, as specified, and as required.
- D. Dissimilar Metal Protection: Hydra-Zorb cushions or Cush-a-strip.
- E. Clamps: Super Strut Series 700 through 702 or AnvilStrut Series 1000 through 1200.

2.02 PIPE ATTACHMENTS

- A. Acceptable Manufacturers: Anvil as noted or equivalent products by Superstrut, B-Line Systems, Tolco, Michigan Hanger.
- B. Uninsulated Horizontal Copper Piping:
 - 1. 2-inch and Smaller: Anvil CT-65, CT-69, CT-99C.
 - 2. Larger than 2-inch: Anvil 260 field or factory copper plated, plastic coated or other recognized industry methods. Electricians' tape is unacceptable.
- C. Insulated Horizontal Copper Pipe with Hangers Inside of Insulation: Same as Uninsulated Horizontal Copper Pipe.
- D. Insulated Horizontal Copper Pipe with Hangers Outside of Insulation:
 - 1. 2-inch and Smaller: Anvil 65, 70, 104 or 260.
 - 2. Larger than 2-inch: Anvil 260.
- E. Other Uninsulated Horizontal Pipe:
 - 1. 2-inch and Smaller: Anvil 65, 70, 104 or 260.
 - 2. Larger than 2-inch: Anvil 260.
- F. Other Insulated Horizontal Pipe With Hangers Inside of Insulation:
 - 1. 2-inch and Smaller: Anvil 65, 70, 104, 260 or 300.
 - 2. Larger than 2-inch: Anvil 260.
- G. Other Insulated Horizontal Pipe with Hangers Outside of Insulation:
 - 1. 2-inch and Smaller: Anvil 65, 70, 104 or 260.
 - 2. Larger than 2-inch: Anvil 260.
- H. Riser Clamps Copper Pipe:
 - 1. 4-inch and Smaller: Anvil CT-121, CT-121C or 261C.
 - 2. Larger than 4-inch: Anvil 261C.
- I. Riser Clamps Other Piping: Anvil 261.

2.03 PIPE ROLLERS, INSULATION PROTECTION SHIELDS AND INSULATION PROTECTION SADDLES

- A. Acceptable Manufacturers: Anvil as noted or equivalent Super Strut, B-Line Systems, Tolco, Michigan Hangers.
- B. Pipe Rollers: Anvil 174 or 274 as required. Size for pipe plus insulation for insulated pipe.
- C. Insulation Protection Shields: Anvil 167.

- D. Insulation Protection Saddles: Anvil 160 through 166A as required. Saddles for copper pipe, factory, or field copper plated.

2.04 BUILDING ATTACHMENTS

- A. Acceptable Manufacturers: Anvil as listed or equivalent products by Elcen, Superstrut, B-Line Systems, Tolco, Michigan Hangers.
- B. Beam Hangers:
1. On piping 6-inch and smaller: Anvil 86 with retaining clip Fig. 89.
 2. On piping larger than 6-inch: Anvil 228, or 292.
- C. Inserts: Anvil 152 malleable iron or 281 steel inserts. Inserts sized for required rod to support load being carried.
- D. Expansion Plugs: Similar and equal to Phillips red-head self-drilling flush shell selected for safety factor of 4.
- E. Powder actuated fasteners with silencers as approved by Architect.

PART 3 EXECUTION

3.01 HANGERS AND SUPPORTS

- A. General:
1. Install all support systems as detailed and in accordance with manufacturer's recommendations. Provide pipe racks, pipe stands, trapeze hangers, etc., as required and as detailed on the Drawings.
 2. Provide adjustable hangers for all pipes complete with inserts, adjusters, bolts, nuts, swivels, all-thread rods, etc., except where specified otherwise.
 3. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping and do not support piping from other piping.
 4. Except as otherwise indicated for exposed continuous pipe runs, install hangers, and supports of same type and style as installed for adjacent similar piping.
 5. Support all piping within 2-feet of each change of direction on both sides of fitting.
- B. Insulated Piping Systems:
1. Refer to Section 23 0700, Insulation for HVAC for insulation requirements.
 2. Insulated Piping Systems with Vapor Barrier Insulation:
 - a. Install hangers outside of insulation.
 - b. On piping 1-1/2-inch and larger, provide insulation protection shields at each support location.
 3. Other insulated Piping Systems with Non-Vapor Barrier Insulation:
 - a. At the contractor's option, hangers may be installed inside or outside of insulation for piping 2-inch and smaller.
 - b. If hangers are installed outside of insulation, provide insulation protection shields at all support locations on piping 1-1/2-inch and larger.
 - c. On piping larger than 2-inch, provide insulation saddles at each support location.
- C. Vertical Piping:
1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.
 2. Riser clamps on steel pipe to be directly welded to pipe. Riser clamps on copper pipe to be installed directly under fitting.

3. Risers that are not subject to thermal change to be supported at each floor of penetration.
4. Risers that are subject to thermal change require engineered supports. Size supports to carry all forces exerted by piping system when in operation. Riser supports shall follow the provisions described in Section 23 0548 Vibration and Seismic Controls for HVAC Piping and Equipment.

D. Horizontal Piping:

1. Trapeze Hangers: Multiple pipe runs where indicated shall be supported on channels with rust resistant finish. Provide all necessary rods and supporting steel.
2. Support Spacing: Provide support at minimum spacing per MSS SP-69-1996 Pipe Hangers and Supports - Selection and Application:

a. Support piping within 2 feet of each change in direction.

b. Steel Pipe, Copper Tubing:

Minimum Pipe Size	Maximum Span Steel	Maximum Span Copper	Rod Size
1-inch and smaller	7-feet	5-feet	1/4-inch
1-1/4-inch to 2-inch	8-feet	8-feet	3/8-inch
2-1/2-inch to 3-inch	11-feet	9-feet	1/2-inch
4-inch to 5-inch	14-feet	12-feet	1/2-inch
6-inch	17-feet	14-feet	1/2-inch

c. Plastic Pipe: Supported a maximum of 3-feet on center for piping 1-inch and smaller and 4 feet on center for piping 1-1/4-inch and larger with rod sizes as recommended by the manufacturer.

d. Piping provided with acoustical lagging wrap shall be supported a maximum of 5-feet on center. Install hangers outside of acoustical lagging.

E. Building Attachments:

1. Fastening or attaching to steel deck (without concrete fill) is prohibited. It will be necessary to support all piping from structural members, beams, joists, or provide intermediate angle iron supporting members between joists. Supports may be attached to concrete filled steel deck with load limitations shown on the structural drawings or otherwise obtained from the structural engineer.
2. Provide horizontal bracing on all horizontal runs 1-1/2 inch and larger and exceeding 50-feet in length at 75-foot intervals and as required to provide stabilized piping systems.
3. Provide all additional structural steel angles, channels, or other members required to support piping where structures do not occur as required for proper support.
4. Arrange supports to prevent eccentric loading of joists and joist girders. Locate supports at joist panel points.

END OF SECTION

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Isolation of mechanical equipment as indicated on the Drawings and specified herein.
 - 2. Seismic restraint of equipment, piping, and ductwork.
- B. Related Sections include:
 - 1. Section 23 0518, HVAC Expansion Compensation
 - 2. Section 23 0529, Hangers, Supports and Anchors for HVAC
 - 3. Section 23 3101, HVAC Ducts and Casing-Low Pressure

1.03 QUALITY ASSURANCE

- A. A single manufacturer shall select and furnish all isolation required, except packaged equipment with integral isolators meeting all the isolation and seismic requirements of this specification.
- B. The system of vibration isolators and seismic controls shall be designed, detailed, and bear the seal of a professional engineer registered in the State having jurisdiction.
- C. Isolation performance requirements are indicated in the specifications. All deflections indicated are nominal static deflections for specific equipment supported.
- D. Isolator Stability and Rated Capacity:
 - 1. Spring diameters not less than 0.8 of the compressed height of the spring at rated load.
 - 2. Springs shall have a minimum additional travel to solid equal to 50 percent of the rated deflection.
- E. Seismic Restraints:
 - 1. Restraint of equipment, piping, and ductwork to be in accordance with the current state and local Building Code.
 - 2. All calculations shall be in accordance with current state and local Building Code.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Submit Shop Drawings showing complete details of construction for steel and concrete bases and frames including:
 - a. Equipment mounting holes.
 - b. Dimensions.
 - c. Isolation selected for each support point.
 - d. Details of mounting brackets for isolator.
 - e. Weight distribution for each isolator.
 - f. Code number assigned to each isolator.
 - 2. Submit product data and calculation sheets for isolators, showing:
 - a. Size, type, load rating, and rated deflection of each required isolator.

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

- b. Percent of vibration transmitted based on the lowest disturbing frequency of the equipment.
- 3. Structural Details and Calculations: Submit structural details and calculations substantiating that building structure, anchorages, and fabricated steel braces can safely withstand maximum calculated loads.
- B. Installation report as specified in PART 3 of this Section.
- C. Operation and maintenance data.

1.05 EQUIPMENT VIBRATION ISOLATION

- A. Provide a balanced set of vibration isolators for each piece of equipment listed in the Equipment Schedules.
- B. Isolation work to include, but not necessarily be limited to, the following:
 - 1. Isolation support of motor-driven equipment.
 - 2. Inertia base frames in conjunction with isolation.
 - 3. Isolation support of air-handling housings.
 - 4. Isolation support of piping, piping risers, and ductwork.
 - 5. Penetration isolation of pipework, ductwork, and conduits through walls, floors, or ceilings.
 - 6. Flexible connections of ductwork and piping to equipment.
- C. Each piece of rotating equipment must meet a reasonable criterion for maximum vibration levels at each bearing, while in operation. The criteria for varying operating speeds are given as follows:
 - 1. Rotating equipment operating peak vibration velocities must not exceed 0.08 in./sec.
 - 2. If it is discovered that the operating vibration velocities exceed this criteria, the equipment shall be repaired or replaced at no expense to the owner until approval of the equipment is given by the engineer.
- D. Any components or materials not specially mentioned herein, but necessary to the proper vibration isolation of the equipment, shall be provided.

1.06 ACCEPTABLE MANUFACTURERS

- A. Amber Booth.
- B. Mason Industries, Inc.
- C. Kinetics Corporation.
- D. Vibrex.
- E. Vibro-Acoustics
- F. Approved equal, meeting all of the conditions and requirements specified herein.

1.07 CONTRACTOR RESPONSIBILITY

- A. All vibration isolation devices, including auxiliary steel bases and pouring forms, shall be designed and furnished by a single manufacturer or suppliers.
- B. Adequately restrain all equipment, piping, and ductwork to resist seismic forces. Design and select restraint devices to meet seismic requirements as defined in the latest issue of the International Building Code under Earthquake Design and applicable state and local codes.
- C. In addition, the contractor shall have the following responsibilities:
 - 1. Selection, installation, adjustment, and performance of vibration isolators which will meet the requirements given on the plans or in the specifications.
 - 2. Provide Engineering drawings, details, supervision, and instruction to assure proper installation and performance.

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

3. Provide whatever assistance necessary to ensure correct installation and adjustment of the isolators.

PART 2 PRODUCTS**2.01 TYPE 1 - NEOPRENE WAFFLE PAD**

- A. 3/4-inch thick neoprene waffle pads with pattern repeating on 1/2-inch centers.
- B. Select Duro rating for recommended deflection at average load rating.
- C. Include load distribution steel plate as required.
- D. Include anchor bolt grommet as required.
- E. Acceptable Manufacturer: Mason Type Super W or Super WM and HG Grommet; Similar Amber-Booth, Kinetics Corporation.

2.02 TYPE 2 - RESTRAINED NEOPRENE MOUNT

- A. Bridge-bearing neoprene mountings shall have all directional seismic capability.
- B. Provide minimum deflection of 0.2-inch.
- C. The mount shall consist of a ductile iron casting containing two separated and opposing molded neoprene elements.
- D. The elements shall prevent the central threaded sleeve and attachment bolt from contacting the casting during normal operation.
- E. The shock absorbing neoprene materials shall be compounded to bridge-bearing specifications.
- F. Manufacturer: Mason type BR.

2.03 TYPE 8 – ISOLATING NEOPRENE HANGERS

- A. Double deflection neoprene hangers.
- B. Provide minimum static deflection of 0.35-inches.
- C. Provide projecting bushing to prevent steel to steel contact.
- D. Manufacturer: Mason HD, similar Amber-Booth, Consolidated Kinetics, Vibrex.

2.04 ISOLATING SLEEVES

- A. Provided for all piping through walls and floors of penthouses and chiller room. Size for piping as required.
- B. Manufacturers: Potter-Roemer PR isolators or Grinnell Semco Trisolators.

2.05 SEISMIC RESTRAINTS

- A. General Requirements:
 1. Seismic restraints shall be provided for all equipment, piping, and ductwork, both supported and suspended.
 2. Bracing of piping and ductwork shall be in accordance with the code and with the provisions set forth in the SMACNA seismic restraint manual.
 3. The structural requirements for the restraints, including their attachment to the building structure, shall be reviewed and approved by the structural engineer.
 4. Attachments to supported or suspended equipment must be coordinated with the equipment manufacturer.
- B. Supported Equipment:
 1. All-directional seismic snubbers shall consist of interlocking steel members restrained by a one-piece molded neoprene bushing of bridge bearing neoprene.
 2. Bushing shall be replaceable and a minimum of 1/4-inch thick. Rated loadings shall not exceed 1000 psi.
 3. An air gap of 1/4-inch shall be incorporated in the snubber design in all directions before contact is made between the rigid and resilient surfaces.

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

4. Snubber end caps shall be removable to allow inspection of internal clearances. Neoprene bushings shall be rotated to ensure no short circuits exist before systems are activated.
5. Snubber: Mason Industries, Inc. Type Z-1225.

C. Bracing of Pipes:

1. Provide seismic bracing of all piping as detailed below to meet the building code requirements:
 - a. Exception: Piping suspended by individual hanger's 12-inches or less in length, as measured from the top of the pipe to the bottom of the support where the hanger is attached, need not be braced where the following criteria are met.
 - 1) Seismic braces are not required on high deformability piping when the $l_p=1.0$ and provisions are made to avoid impact with larger pipe or mechanical components or to protect the pipe in the event of such impact and the nominal pipe size is 3-inches diameter or less.
 - 2) Seismic braces are not required on high deformability piping when the $l_p=1.5$ and provisions are made to avoid impact with larger pipe or mechanical components or to protect the pipe in the event of such impact and the nominal pipe size is 1-inch diameter or less.
2. Seismic braces for pipes on trapeze hangers may be used.
3. Provide flexibility in joints where pipes pass through building seismic joints or expansion joints, or where pipes connect to equipment.
4. Cast iron pipe of all types, glass pipe, and any other pipe jointed with a shield and clamp assembly, where the top of the pipe is 12-inches or more from the supporting structure, shall be braced on each side of a change in direction of 90 degrees or more. Riser joints on unsupported sections of piping shall be braced or stabilized between floors.
5. Vertical risers shall be laterally supported with a riser clamp at each floor. For buildings greater than six stories high or for piping subject to thermal change all risers shall be engineered individually.

D. Bracing of Ductwork:

1. Brace rectangular ducts with cross sectional areas of 6 square feet and larger. Brace flat oval ducts in the same manner as rectangular ducts. Brace round ducts with diameters of 28 inches and larger. Brace flat oval ducts the same as rectangular ducts of the same nominal size.
2. Exception: No bracing is required if the duct is suspended by hangers 12 inches or less in length, as measured from the top of the duct to the bottom of the support where the hanger is attached, and the $l_p=1.0$.
3. Transverse bracing shall occur at the interval specified in the SMACNA tables or at both ends if the duct run is less than the specified interval. Transverse bracing shall be installed at each duct turn and at each end of a duct run, with a minimum of one brace at each end.
4. Longitudinal bracing shall occur at the interval specified in the SMACNA tables with at least one brace per duct run. Transverse bracing for one duct section may also act as longitudinal bracing for a duct section connected perpendicular to it if the bracing is installed within four feet of the intersection of the ducts and if the bracing is sized for the larger duct. Duct joints shall conform to SMACNA duct construction standards.
5. Install duct flex connections at equipment connections to accept expected differential displacement and protect the equipment connection from damage.

E. Suspended Equipment and Piping and Ductwork:

1. Seismic cable restraints shall consist of galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

2. Cable must be pre-stretched to achieve a certified minimum modulus of elasticity. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.
3. Cable assemblies shall be type SCB at the ceiling and at the clevis bolt, SCBH between the hanger rod and the clevis or SCBV if clamped to a beam, all as manufactured by Mason Industries, Inc.
4. Steel angles, sized to prevent buckling, shall be clamped to pipe or equipment rods utilizing a minimum of three ductile iron clamps at each restraint location when required. Welding of a minimum of three ductile iron clamps at each restraint location when required. Welding of support rods is not acceptable. Rod clamp assemblies shall be type SRC or UC as manufactured by Mason Industries, Inc.
5. Pipe clevis cross-bolt braces are required in all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the cross bolt. Clevis cross brace shall be type CCB as manufactured by Mason Industries, Inc.

PART 3 EXECUTION**3.01 GENERAL**

- A. Do not install any equipment or pipe which makes rigid contact with the building. "Building" includes slabs, beams, studs, walls, etc.
- B. The installation or use of vibration isolators must not cause any change of position of equipment or piping which would result in stresses in piping connections or misalignment of shafts or bearings. In order to meet this objective, equipment and piping shall be maintained in a rigid position during installation. The load shall not be transferred to the isolator until the installation is complete and under full operational load.
- C. Correct, at no additional cost, all installations which are defective in workmanship or materials.

3.02 PREPARATION

- A. Treat all isolators, including springs, hardware, and housing, with a corrosion protective coating of epoxy powder or electro galvanizing.
- B. Coat steel frames exposed to weather with a rustproof metal primer.
- C. Provide hot dipped galvanizing on steel frames as indicated on the plans for corrosion protection in severe conditions.

3.03 INSTALLATION

- A. General:
 1. Install isolation where indicated on the Drawings by type and location and where indicated below.
 2. The assigned code number shall be marked on the isolators and bases to assure placement in the proper location.
 3. Anchor isolator seismic housing baseplate to floor.
 4. Rubber grommets and washers shall be provided to isolate the bolt from the building structure.
 5. Do not let the isolation efficiency be destroyed when bolting the isolators to the building structure.
- B. Type 1 – Neoprene Waffle Pad
 1. Service:
 - a. Small Air Handlers

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

C. Type 2 – Restrained Neoprene Mount

1. Service:
 - a. Inline Centrifugal Fans

D. Type 8 – Isolating Neoprene Hanger

1. Service:
 - a. Split-System Air Conditioning Unit
 - b. Cabinet Unit Heaters.
 - c. Inline Centrifugal Fans

E. Flexible Connectors:

1. Mechanical Couplings: Provide three or more flexible couplings as vibration isolation as indicated on the drawings.

3.04 SEISMIC RESTRAINTS

A. General:

1. Install and adjust seismic restraints so that the equipment, piping, and ductwork support is not degraded by the restraints.
2. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.

B. Supported Equipment:

1. Each vibration isolation frame for supported equipment shall have a minimum of four seismic snubbers mounted as close as possible to the vibration isolators and/or the frame extremities.
2. Care must be taken so that the 1/4-inch air gap in the seismic restraint snubber is preserved on all sides in order that the vibration isolation potential of the isolator is not compromised. This requires that the final snubber adjustment be completed after the vibration isolators are properly installed and the installation approved.

C. Bracing of Pipes:

1. Branch lines may not be used to brace main lines.
2. Transverse bracing shall be at 40-feet maximum, except where a lesser spacing is indicated in the SMACNA tables for bracing of pipes
3. Longitudinal bracing shall be at 80-feet maximum except where a lesser spacing is indicated in the tables. In pipes where thermal expansion is a consideration, an anchor point may be used as the specified longitudinal brace provided that it has a capacity to resist both the seismic load and the additional force induced by expansion and contraction.
4. A rigid piping system shall not be braced to dissimilar parts of the building or to two dissimilar building systems that may respond differently during an earthquake.
5. Transverse bracing for one pipe section may also act as longitudinal bracing for a pipe section of the same size connected perpendicular to it if the bracing is installed within 24-inches of the elbow or tee.
6. Subject to confirmation by field inspection, seismic bracing is not required on piping when the piping is supported by rod hangers and the hangers in the entire run are 12-inches or less in length from the top of the pipe to the supporting structure, hangers are detailed to avoid bending of the hangers and their attachments and provisions are made for piping to accommodate expected deflections.

D. Bracing of Ductwork:

1. Hanger straps must be positively attached to the duct within 2-inches of the top of the duct with a minimum of two 10 sheet metal screws.

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

2. A group of ducts may be combined in a larger frame so that the combined weights and dimensions of the ducts are less than or equal to the maximum weight and dimensions of the duct for which bracing details are selected.
 3. Walls, including gypsum board nonbearing partitions, which have ducts running through them, may replace a typical transverse brace. Provide solid blocking around duct penetrations at stud wall construction.
 4. Unbraced ducts shall be installed with a 6-inch minimum clearance to vertical ceiling hanger wires.
- E. Suspended Equipment, Piping, and Ductwork Cable Method:
1. The cables shall be adjusted to a degree of slackness approved by the Structural Engineer.
 2. The uplift and downward restraint nuts and Mason type RW neoprene covered steel rebound washers for the Type 6 hangers shall be adjusted so that there is a maximum 1/4-inch clearance.

3.05 FIELD QUALITY CONTROL

- A. Installation Report: Isolation manufacturer's representative shall confirm that all isolation is installed correctly and submit report stating that isolators are installed as shown on Shop Drawings, isolators are free to work properly, and that installed deflections are as scheduled and as specified.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Identify valves, piping, and equipment components of the mechanical systems to indicate their function and system served.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Valve Tag Directory: Submit for approval prior to fabrication of valve tags.
 - 2. Equipment Nameplate Directory: Submit for approval prior to fabrication.
 - 3. Operating and Maintenance Data: Include a copy of valve tag and equipment nameplate directories in each set of Operating and Maintenance manuals.

PART 2 PRODUCTS

2.01 VALVE IDENTIFICATION

- A. Valve Tags:
 - 1. General: Identify valves with metal tags, legends to be stamped or embossed. It shall indicate the function of the valve and its normal operating position; i.e.,

56 HW	(NUMBER AND CONTENT OF PIPE)
ISOLATION	(VALVE FUNCTION)
NO	(NORMAL OPERATION POSITION)
 - 2. Size: Valve tags 2-inch diameter with 1/4-inch high letters.
 - 3. Material: Use 0.050 or 0.064-inch brass tags.
 - 4. Automatic Valves and Regulating Valves: Use 1/16-inch thick laminated 3-ply plastic, center ply white, outer ply red, "Iamicoid" or equal. Form letters by exposing center ply.
- B. Valve Tag Directory: Include tag number, location, exposed or concealed, service, valve size, valve manufacturer, valve model number, and normal operating position of valve.

2.02 PIPING MARKERS

- A. Acceptable Manufacturers:
 - 1. W.H. Brady, Seton, Marking Systems, Inc. (MSI).
 - 2. Other Manufacturers: Submit Substitution Request.

- B. Pipes shall be labeled with all-vinyl, self-sticking labels or letters. For pipe covering sizes up to and including 3/4-inch outside diameter, select labels with 1/2-inch letters. For sizes from 3/4 to 2-inch outside diameter, 3/4-inch letters; above 2-inches outside diameter, 2-inch letters. The pipe markers shall be identified and color coded as follows with black directional arrows.

HVAC SERVICE	BACKGROUND PIPE MARKER*	COLOR
HEATING WATER	HEATING WATER SUPPLY	GREEN
	HEATING WATER RETURN	GREEN
CHILLED WATER	CHILLED WATER SUPPLY	GREEN
	CHILLED WATER RETURN	GREEN
DUAL TEMPERATURE WATER	DUAL TEMP WATER SUPPLY	GREEN
	DUAL TEMP WATER RETURN	GREEN
REFRIGERANT SUCTION	REFRIGERANT SUCTION	YELLOW
REFRIGERANT LIQUID	REFRIGERANT LIQUID	GREEN

* Directional arrow applied adjacent to pipe marker indicating direction of flow.

2.03 EQUIPMENT IDENTIFICATION

A. Nameplates:

1. Tag all pumps, air handling supply units, fans, terminal units, and miscellaneous items of mechanical equipment with engraved nameplates. Nameplates shall be 1/16-inch thick, 3-inch by 5-inch laminated 3-ply plastic, center ply white, outer ply black. Form letters by exposing center ply.
2. Identify unit with equipment tag as shown on Drawings and area served.
3. Access points to fire dampers, smoke dampers, and combination fire and smoke dampers shall be permanently identified on the exterior of the duct by a label with letters 1/2-inch in height reading: Fire Damper, Smoke Damper, or Fire/Smoke Damper, as appropriate. Label constructed from same material as equipment nameplates.

- B. Equipment Nameplate Directory: List pumps, air handlers, terminal units, and other equipment nameplates. Include Owner and Contractor furnished equipment. List nameplate designation, manufacturer's model number, location of equipment, area served or function, disconnect location, and normal position of HOA switch.

2.04 CONCEALED EQUIPMENT IDENTIFICATION

A. Acceptable Manufacturers:

1. W.H. Brady, Seton
2. Other Manufacturers: Submit substitution request.

B. Adhesive Laminated Tape:

1. 3/4-inch width transparent clear tape with black lettering.
2. Lettering in ALL CAPS Helvetica font 24 point.

PART 3 EXECUTION

3.01 VALVE IDENTIFICATION

A. Valve Tags:

1. Attach to valve with a brass chain.
2. Valve tag numbers shall be continuous throughout the building for each system.

- B. Valve Tag Directory: Post final copy in Operation and Maintenance Manual.

3.02 PIPING MARKERS

- A. Unless recommendations of ANSI A13.1, 1981 are more stringent, apply labels or letters after completion of pipe cleaning, insulation, painting, or other similar work, as follows:

1. Every 20-feet along continuous exposed lines.
2. Every 10-feet along continuous concealed lines.

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

3. Adjacent to each valve and stubout for future.
 4. Where pipe passes through a wall, into and out of concealed spaces.
 5. On each riser.
 6. On each leg of a T.
 7. Locate conspicuously where visible.
- B. Further, apply labels or letters to lower quarters of the pipe on horizontal runs where view is not obstructed or on the upper quarters when pipe is normally viewed from above. Apply arrow labels indicating direction of flow. Arrows to be the same color and sizes as identification labels.

3.03 EQUIPMENT IDENTIFICATION

- A. Nameplates: Attach to prominent area of equipment, either with sheet metal screws, brass chain, or contact cement as applicable.
- B. Nameplate Directory: Post final copy in Operation and Maintenance Manual.

3.04 CONCEALED EQUIPMENT IDENTIFICATION

- A. Where valves or equipment are located above ceilings or behind walls provide adhesive tape indicating the item at the access location.
- B. Applicable equipment includes, but is not limited to, the following:
1. Terminal Units
 2. Fan Coil Units
 3. Fans
 4. Isolation Valves
 5. Fire Smoke Dampers
 6. Pumps
 7. Control Valves

END OF SECTION

SECTION 23 0590
PRESSURE TESTING FOR HVAC SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Pressure testing of piping and ductwork systems.

1.03 QUALITY ASSURANCE

- A. Code Compliance: Perform required tests in the presence of the authority having jurisdiction.
- B. Owner Witness: Perform all tests in the presence of the Owner's representative.
- C. Engineer Witness: The Engineer or Engineer's representative reserves the right to observe all tests or selected tests to assure compliance with the specifications.
- D. Simultaneous Testing: Test observations by the authority having jurisdiction, the Owner's Representative, and the Engineer's representative need not occur simultaneously.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Test Reports:
 - a. Submit certificate of completion, inspection and test by authority having jurisdiction on required piping systems.
 - b. Submit certificate of test approval by Owner's representative on all systems.
 - c. For ductwork testing, submit the Test Report. Description of the testing procedure and results, including recommendation for any remedial actions needed. Engineer's representative will record witnessed tests.

PART 2 PRODUCTS – NOT APPLICABLE

PART 3 EXECUTION

3.01 GENERAL

- A. Piping: Test prior to concealment, insulation being applied, and connection to equipment, fixtures, or specialties. Conduct tests with all valves but those used to isolate the test section 10% closed.
- B. Ductwork: Test prior to connection to equipment and before applying insulation.
- C. Leaks: Repair all leaks and retest until stipulated results are achieved.
- D. Notification: Advise the Construction Manager 72 hours in advance of each test. Failure to so notify will require test to be rescheduled.
- E. Testing Equipment: Provide all necessary pumps, gauges, connections, and similar items required to perform the tests.

3.02 TESTING REQUIREMENTS

- A. Low Pressure Ductwork:
 - 1. Test all ductwork systems at 2-inch static pressure, using a Pacific Air Products Port-O-Lab or "Rolok", or a McGill Airflow LEAK DETECTIVE testing machine or approved equivalent.
 - 2. All ductwork testing shall be conducted in accordance with latest published version of the SMACNA "HVAC Air Duct Leakage Test Manual.

3. Prior to testing verify that all low pressure ductwork has been sealed to meet the SMACNA Seal Class C for joints.
 4. Low pressure ductwork leakage shall be less than or meet the requirement of the following SMACNA Leakage Classes:
 - a. Rectangular Metal – Class 24
 - b. Round or Flat Oval – Class 12
 5. Maximum allowable leakage is defined as Cubic Feet per Minute (CFM) air leakage per 100 SF SURFACE AREA of duct section tested.
 6. All low pressure ductworks shall be tested.
- B. Piping - General: Test all piping as noted below, with no leaks or loss in pressure for time indicated. Repair or replace defective piping until tests are completed successfully:

HVAC Systems	Test Pressure	Test Medium	Test Duration
Heating/Chilled Water	150 psig	Water	4-hours
Refrigerant piping	300 psig	Nitrogen	4-hours

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Testing and balancing of air systems.
 - 2. Testing and balancing of hydronic systems.
 - 3. Testing and balancing of miscellaneous mechanical equipment.

1.03 QUALITY ASSURANCE

- A. Acceptable Testing and Balancing Firms:
 - 1. A.I.R., Inc.
 - 2. Air Balance Specialty, Inc.
 - 3. Neudorfer Engineers, Inc.
 - 4. Northwest Engineering Services.
 - 5. Pacific Coast Air Balance.
 - 6. Accurate Balancing Agency, Inc.
- B. Other Firms: Submit Substitution Requests prior to Bid Date.
 - 1. Certification: The firm shall be certified by National Environmental Balancing Bureau (NEBB).
- C. Industrial Standards: Testing and Balancing shall conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:
 - 1. NEBB: Comply with Procedural Standards for Testing, Adjusting Balancing of Environmental Systems.
 - 2. ASHRAE: Comply with recommendations pertaining to measurements, instruments, and testing, adjusting and balancing.
 - 3. ANSI:
 - a. S1.4 Specifications for sound level meters.
 - b. S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
- D. Instrument Certification: All instruments used shall be accurately calibrated and certified within six months of balancing and maintained in good working order.
- E. Test Observation: If requested, the tests shall be conducted in the presence of the Architect or the Architect's representative.
- F. Pre-Balancing Conference: Prior to starting balancing, general techniques shall be reviewed with the Engineer. This conference must occur prior to measuring existing conditions. Measuring of existing conditions must occur prior to any demolition or new work. The conference will review existing conditions and systems to be affected by the project

1.04 SUBMITTALS

A. Submit the following:

1. Balancing Log: Include all air and water outlets, actual field measured air and water volume, and percentage of design volumes. Provide drawings identifying location of all outlets.
2. Equipment Data Sheets: Indicate actual equipment performance, model numbers, bearing and belt data, motor nameplate data, and final balanced motor data.
3. Additional Data: Submit all additional data as provided by Associated Air Balance Council (AABC) Standard forms.
4. Number of Copies: Submit six copies of the above completed information to the Engineer for review and insertion into the Operating and Maintenance Data.
5. Instrument Certification: When requested, submit certificate of calibration for all equipment to be used.

B. Record data on NEBB forms or forms approved by the Architect.

1.05 PROJECT CONDITIONS

- A. Do not perform final testing, adjusting, and balancing work until heating, ventilating, and air conditioning equipment has been completely installed and operating continuously as required.
- B. Conduct air testing and balancing with clean filters in place. Clean strainers, etc., prior to performing hydronic testing and balancing.

1.06 WARRANTIES

- A. In addition to the Requirements of the Contract, include an extended warranty of six months after completion of test and balance work during which time the Architect at his discretion may request a recheck or resetting of any equipment or device listed in the test reports.

PART 2 PRODUCTS – NOT APPLICABLE

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Balance to maximum measured flow. Deviation from specified values of ± 10 percent at terminal device and ± 5 percent at equipment, or mean sound level deviation of 15 decibels. Advise Engineer if deficiencies are generally noted to enable proper corrective actions.

3.02 AIR SYSTEMS

- A. General: Make measurements in accord with Industrial Standards specified above. Record on appropriate forms.
- B. Preliminary:
 1. Identify and list size, type, and manufacture of all equipment to be tested including air outlets and inlets.
 2. Use manufacturer's ratings for equipment to make required calculations except where field test shows ratings to be impractical.
- C. Central System:
 1. Set speed to provide air volume at farthest run without excess static pressure. Provide additional sheaves and belts as required to accomplish speed adjustment.
 2. Read and adjust air supply, return, and exhaust fan units to deliver design conditions at minimum OSA and at 100 percent OSA.
 3. Adjust all automatic dampers, outside air, return air, and exhaust dampers for design conditions.

4. Read static air pressure conditions on all air handling equipment including filter and coil pressure drops and total pressure across the fan. A Dwyer Series 400 air velocity meter only shall be used for final static pressures at equipment and where critical readings are required.
5. Measure temperature conditions across all outside air, return air, and exhaust dampers to check leakage.
6. Read and record motor data and amperage draw.
7. For variable volume systems, establish minimum static pressure required at sensing point to permit operation over entire VAV range. Adjust supply and return fan speed so that at maximum demand the associated VFD is controlling the motor of motor nameplate RPM to 100%. Adjust return fan speed so that return air volumes track with supply air volume minus exhaust air volume.
8. Assist controls contractor in establishing minimum outside air damper positions.

D. Distribution:

1. Evaluate all building and room pressure conditions to determine adequate supply and return air conditions. Generally, the building shall be balanced to be slightly positive to outdoors.
2. Evaluate all building and room pressure conditions to determine adequate performance of the system to maintain temperatures without draft.
3. Perform multipoint pitot traverses to confirm instrumentation, shaft tightness, fan operation, etc. Pitot traverses shall be performed using a Dwyer Series 400 air velocity meter only with applicable duct probe.
4. Mark all balancing dampers.

E. Fire Life Safety Systems:

1. Balance, adjust, and test the stair and elevator pressurization components in order to pass the city test as described in Section 23 0900, Instrumentation and Controls for HVAC. Balancer rebalances the system as necessary until it passes city tests.

3.03 HYDRONIC SYSTEMS

A. General: Make measurements in accord with Industrial Standards specified above. Record on appropriate forms.

B. Preliminary:

1. List complete data of tested equipment and verify against Contract Documents.
2. Open all line valves to full open position, close coil by-pass stop valves, set mixing control valve to full coil flow.
3. For each pump:
 - a. Verify rotation.
 - b. Test and record pump shut-off head.
 - c. Test and record pump wide-open head.
4. Verify proper system pressures.
5. Verify air vents in high points of water are properly installed and operating freely.

C. Central Equipment:

1. Check all conditions at all coils for required performance at design conditions.
2. Check conditions at all primary source equipment for performance of design conditions.
3. Read and record pump heads, motor data, and amperage draw.

D. Distribution:

1. Read and adjust water flow for design conditions.

2. Set all memory stops and mark position of adjuster on balancing valves.

3.04 ELECTRIC HEATING EQUIPMENT

- A. Test and record voltage and amperage readings at each electric heating device while fully energized and at part load conditions (each step) to verify proper operation.
- B. Record data on appropriate forms.

3.05 AUTOMATIC CONTROL SYSTEM

- A. In cooperation with control manufacturer's representative, set and adjust automatically operated devices to achieve required sequence of operations.
- B. Testing organization shall verify all controls for proper calibration and list controls requiring adjustment by control system installer.

3.06 COORDINATION

- A. Coordinate work with other trades to ensure rapid completion of the project.
- B. Deficiencies noted during the course of air balancing in the mechanical installation shall be promptly reported to the Architect to allow corrective action to proceed.
- C. Periodic review of progress shall be provided as requested.

END OF SECTION

**SECTION 23 0700
INSULATION FOR HVAC**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Insulation for piping, ductwork (external), ductwork (internal), and equipment.
- B. Related Sections include:
 - 1. Section 23 0529, Hangers, Supports and Anchors for HVAC
 - 2. Section 23 3101, HVAC Ducts and Casing – Low Pressure

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. All insulating products shall comply with the Oregon Revised Statute (ORS) 453.005(7)(e) prohibiting pentabrominated, octabrominated and decabrominated diphenyl ethers. Where products within this specification contain these banned substances, provide complying products from approved manufacturers with equal performance characteristics.
 - 2. Flame and Smoke Ratings: Installed composite flame spread not to exceed 25 and smoke developed not to exceed 50 as tested by UL 723.
 - 3. Energy Codes: Local Building and Energy Codes shall govern where insulation performance requirements for thickness exceeds thickness specified.
- B. Protection: Protect against dirt, water, chemical, or mechanical damage before, during, and after installation. Repair or replace damaged insulation at no additional cost.
- C. Source Quality Control:
 - 1. Service: Use insulation specifically manufactured for service specified.
 - 2. Labeling: Insulation labeled or stamped with brand name and number.
 - 3. Insulation and Accessories: Do not provide any nutritional or bodily use to fungi, bacteria, insects, rats, mice, or other vermin. Not to react corrosively with equipment, piping, or ductwork, and shall be asbestos free.

1.04 SUBMITTALS

- A. Submit the following.
 - 1. Product Data: For each type including density, conductivity, thickness, jacket, vapor barrier, and flame spread and smoke developed indices.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Equivalent products by Johns Manville, Knauf, Owens Corning, and CertainTeed are acceptable.
- B. Use only one manufacturer.
- C. Other Manufacturers: Submit substitution request.

2.02 PIPE INSULATION

- A. Fiberglass: Split sectional or snap-on type with 0.23-inch maximum thermal conductivity (K-factor) at 75 degrees F mean temperature, 850 degrees F maximum service rating and white, vapor barrier jacket with pressure sensitive closure system. Johns Manville Microlok HP.
- B. Elastomeric: Expanded closed cell, 0.27-inch maximum K-factor at 75 degrees F mean temperature, 220 degrees F maximum service rating with fitting covers and paintable surface. ArmacellAP Armaflex, Rubatex.
- C. Polyolefin: Semi-rigid polyolefin form snap-on or slip over type with 0.24-inch maximum thermal conductivity (K-factor) at 75 degrees F mean temperature -165 degrees F to 210 degrees F service factor and paintable surface. End joints in insulation on piping with fluid temperatures normally below 65 degrees F fuse sealed in accordance with the manufacturer's instructions. Joints longitudinal joints and other end joints made with manufacturer's approval contact adhesive in accordance with the manufacturer's instructions. Joints may be pre-glued or pre-coated with adhesive where applicable.

2.03 DUCTWORK BLANKET INSULATION

- A. Fiberglass: 1.0 pcf nominal density, 0.25-inch maximum K-factor at 75 degrees F mean temperature, 250 degrees F minimum operating temperature limit. Johns Manville Microlite Type 100 with facing as follows:
 - 1. Exposed: FSK facing (foil scrim Kraft) or vinyl - white appearance.
 - 2. Concealed with Vapor Barrier: FSK reinforced foil and paper.
 - 3. Concealed without Vapor Barrier: Facing not required.
- B. Semi-Rigid Fiberglass: 2.5 pcf nominal density, 0.24-inch maximum K-factor, at 75 degrees F mean temperature, 250 degrees F minimum operating temperature limit. Johns Manville Micro-Flex with facing as follows:
 - 1. Exposed: FSK facing (foil scrim kraft) or vinyl-white appearance.
 - 2. Concealed with Vapor Barrier: FSK reinforced foil and paper.
 - 3. Concealed without Vapor Barrier: Facing not required.

2.04 DUCT INSULATION, INTERNAL

- A. Description: Fiberglass with airstream surface protected with a glass mat facing that contains an EPA registered anti-microbial agent proven to resist microbial growth as determined by ASTM G21 and G22, 1-inch thick unless indicated otherwise. 2-inch thick insulation shall have 0.24 per inch maximum K-Factor at 75 degrees F mean temperature. Johns Manville Duct Liner PM for rectangular ductwork.
- B. Acoustical Absorption Coefficients: With minimum NRC of 0.70 for 1-inch and 0.90 for 2-inch as tested in accordance with ASTM C-423-90, Type A mounting.
- C. Liner must meet ASTM C1071.

2.05 DUCT ENCLOSURE, FIRE RATED

- A. Firemaster:
 - 1. Material: Thermal Ceramics "Firemaster" duct wrap ceramic fiber blanket, minimum 3-inch total thickness, ASTM E2336, 2-hour rated assembly.
- B. Fyrewrap:
 - 1. Material: Unifrax "Fyrewrap" duct wrap fiberglass blanket, 1-1/2-inch thickness for 1-hour rated assembly, 3-inch thickness for 2-hour rated assembly. ASTM E2336.

2.06 ACCESSORIES FOR PIPING

- A. Adhesives:
 - 1. Fiberglass: Zeston Z-Glu
 - 2. Elastomeric: Armacell 520

3. Polyolefin: As approved by the insulation manufacturer.
- B. Cements:
 1. Insulating: Ryder
 2. Heat Transfer: Zeston Z-20
- C. Wire Mesh: 1-inch mesh with 20 gauge annealed steel wire.
- D. Pipe Fitting Covers: One piece PVC insulated pipe fitting covers. Zeston, Ceel-Co.
- E. Grooved Coupling Insulation: One piece PVC insulated fitting cover. Zeston, Ceel-Co.
- F. Metal Pipe Jacket: 0.016-inch thick aluminum jacket with formed fitting covers, aluminum snap straps and sealant.
- G. Cloth Facing: Presized fiberglass cloth.
- H. Tapes: Pressure sensitive, weather resistant, and for temperatures up to 150 degrees F. Zeston Z-tape.
- I. Paint: Ultraviolet resistant latex paint with special adherence capabilities to the PVC fitting covers, elastomeric, aluminum facing, Kraft paper, tapes, and adhesives.

2.07 ACCESSORIES FOR DUCTWORK

- A. Adhesives:
 1. Fiberglass: Zeston Z-Glu.
 2. Duct Insulation, Internal: Benjamin Foster 85-20
- B. Weld Pins: Duro-Dyne with NC-1 nylon stop clips.
- C. Cements:
 1. Insulating: Ryder
 2. Heat Transfer: Zeston Z-20
- D. Wire Mesh: 1-inch mesh with 20 gauge annealed steel wire.
- E. Mastic: Chicago Mastic:
 1. Vapor Barrier: 17-475
 2. Outdoor Mastic: 16-110 white
- F. Cloth Facing: Presized fiberglass cloth.
- G. Tapes: Pressure sensitive, weather resistant, and for temperatures up to 150°F. Zeston Z-tape.
- H. Paint: Ultraviolet resistant latex paint with special adherence capabilities to the PVC fitting covers, elastomeric, aluminum facing, Kraft paper, tapes, and adhesives.

PART 3 EXECUTION

3.01 GENERAL

- A. Workmanship:
 1. Installation: Insulation installed in first class, neat professional manner.
 2. Applicators: Applicators shall be employed by firm that specializes in insulation work.
- B. Preparation: Surfaces of piping, ductwork, and equipment clean, free of oil or dirt, and dry before insulation is applied.
- C. Stamps: ASME stamps, UL labels, and similar stamps and labels shall not be covered.

3.02 HVAC PIPE AND EQUIPMENT INSULATION APPLIED LOCATIONS

A. Insulation Applied Locations – HVAC Piping:

System	Pipe Size	Insulation Type	Insulation Thickness	Notes
Heating Water (to 250°F)	1-1/4-inch and smaller	Fiberglass	2-inch	Note 1
	1-1/2-inch to 6-inch	Fiberglass	2 1/2-inch	Note 1
Chilled Water	1-1/4-inch to 6-inch	Fiberglass	1 1/2-inch	Note 1
Dual Temp Water	1-1/4-inch and smaller	Fiberglass	2-inch	Note 1
	1 1/2-inch to 6-inch.	Fiberglass	2 ½-inch	Note 1
Refrigerant Suction, Hot Gas	All	Elastomeric or Polyolefin	1 1/2-inch	Note 2
Air Separators	All	Fiberglass	3 1/2-inch	
		Elastomeric or Polyolefin	3 1/2-inch	Note 2
Note 1: Cover with metal pipe jacket where exposed to weather and over heat trace cable. Note 2: Elastomeric or Polyolefin insulation not allowed over heat trace cable.				

B. Insulation shall include all fittings, unions, flanges, mechanical couplings, valve bodies, valve bonnets, piping through sleeves.

1. Hot water heating inside building.

C. Piping insulation is not required between the control valve and coil on run-outs when the control valve is located within 4 feet of the coils and the pipe size is 1-inch or less.

D. Valves and Irregular Fittings:

1. Insulated with section of pipe insulation and insulating cement, securely fastened, and finished with 6 oz. canvas and Foster 30-36 lagging adhesive.
2. Option on flanges, valves, strainers, not requiring a vapor barrier to insulate with removable replaceable pads fabricated of 1-inch layer of Pittsburgh Corning Temp Mat sandwiched between inner and outer layer of 8 ounce glass cloth held together with stainless staples with sufficient stainless lacing hooks to hold pad firmly to flange or valve with minimum 3-inch overlap onto adjacent pipe insulation using 18 gauge S.S. lacing wire.

E. Expansion Joints and Flexible Connectors: Pipe insulation or block of same material and thickness as adjacent piping.

3.03 PIPING INSTALLATION

A. General:

1. Joints: Coat both sides of complete joining area with applicable adhesive.
 - a. Longitudinal Joints: Make joints on top or back of pipe to minimize visibility. Except foam plastic, seal with closure system or 3-inch wide tape.
 - b. Butt Joints: Butt lightly together and, except for foam plastic, seal with 3-inch wide tape or butt straps.
 - c. Multiple Layered Insulation: Joints staggered.
2. Access: Strainer and other items requiring service or maintenance with easily removable and replaceable section of insulation to provide access.

3. Voids: Fill all voids, chipped corners and other openings with insulating cement or material compatible with insulating material. In insulation with Heat Tracing: Where piping is shown or specified to be heat traced, bed heat tape into heat transfer cement with insulation over heat tape and cement.
 4. Seal joints, seams, and fittings of metal watertight jackets at exterior locations.
- B. Fiberglass Insulation: Exterior insulation encased in metal jacket.
- C. Elastomeric and Polyolefin Insulation:
1. Slit full length and snap around pipe.
 2. Make cuts perpendicular to insulating surface leaving no cut section exposed.
 3. Do not stretch insulation to cover joints or fittings.
 4. Seal joints in elastomeric insulation with adhesive.
 5. Seal joints in polyolefin as specified hereinbefore.
 6. Exterior insulation painted with two coats of specified paint in accordance with the manufacturer's instructions and encase in metal jacket.
 7. Sealing joints with tape will not be allowed.
- D. Fittings: Insulation specified with continuous vapor barrier, the vapor barrier must not be violated.
1. On Elastomeric and Polyolefin Insulation: Fittings covered with covers made up of mitered sections of insulation or with formed pipe fitting covers.
 2. In Other Insulation: Fittings covered with insulation to the same level of the adjoining insulation or fill with insulating cement. Finish with pipe fitting covers or cloth facing and tape.
- E. Unions, Mechanical Joints, Valves, etc.:
1. General:
 - a. As specified for fittings.
 - b. Minimum thickness same as specified for piping.
 2. Unions: Build up insulation at least 1/2-inch beyond adjoining insulation.
 3. Flanges: With square corners. Where flanges are not insulated, terminate adjacent insulation so flange bolts can be removed.
 4. Flanged Valves: Insulation with square corners.
- F. Vapor Barrier Insulation:
1. Refer to Section 23 0529, Hangers, Supports, and Anchors for HVAC for support requirements.
 2. Piping which requires vapor barrier protection shall have a continuous vapor barrier, which may not be pierced or broken. The following piping systems require vapor barrier protection:
 - a. Chilled water.
 - b. Refrigerant suction.
 - c. All other piping systems with a nominal operating temperature below 65 degrees F, including dual temperature piping.
 3. Vapor Barrier Insulation.
 - a. Insulation for pipe requiring vapor barrier protection 1-1/4-inch or smaller, insulation continuous through pipe hangers and rollers.
 - b. For pipe 1-1/2-inch and larger, 18-inch section of calcium silicate, same thickness as pipe insulation with continuous vapor barrier jacket at each hanger or roller. Provide pipe shield specified in Section 23 0529, Hangers, Supports, and Anchors for HVAC.

G. Non-Vapor Barrier Insulation:

1. Refer to Section 23 0529, Hangers, Supports, and Anchors for HVAC for support requirements.
2. At contractor's option, insulation may be interrupted at supports. Butt insulation tight to support.
3. If contractor elects to continue insulation at supports, installation as specified for piping systems with vapor barrier installation.
4. Void between saddle and pipe filled with insulation.

3.04 DUCT INSULATION APPLIED LOCATIONS

A. General:

1. All external insulation with continuous vapor barriers unless specifically noted otherwise.
2. Internally lined shall be lined completely to grille or diffuser or to indicated terminal points. Dimension shown are net inside of liner.
3. Internally lined ductwork need not be externally insulated.
4. In addition to locations described in specification, internally line medium, low, return and exhaust air ductwork where shown on drawings.

B. Insulation Applied Location – HVAC Ductwork, per table below and as follows where more stringent:

1. Air handling systems for classrooms: Line, 1-inch liner, supply and return duct from the air handler to a minimum of 20 feet from the unit plus one elbow.
2. AH-MEDIA system: Line (1-inch liner) supply and return air duct from the air handler to a minimum of 15' from the unit. Provide duct silencers as indicated and specified in Section 23 3319, Duct Silencers.
3. AH-GYM: Line (1-inch liner) supply duct from air handler to a minimum distance of 25 feet. Line, 1-inch liner, return plenum behind return grille and line, 2-inch liner, return duct from air handler to a minimum of 15-feet. Provide duct silencers as indicated and specified in Section 23 3319, Duct Silencers.
4. AH-CAFÉ: Line (1-inch liner) supply duct from air handler to a minimum of 20 feet. Line, 1-inch liner return plenum behind return grille and line, 2-inch liner, return duct from air handler to a minimum of 10-foot. Provide duct silencers as indicated and specified in Section 23 3319, Duct Silencers.
5. AH-MUSIC: Line supply and return ducts a minimum distance of 30-feet plus one elbow.

System	Location	Duct Type	Insulation Type	Thickness	Notes
Low Pressure Supply*	Exposed or Visible (including above a cloud ceiling)	Rectangular	Internally Lined	1 1/2-inch	
		Round	Internally Lined	1 1/2-inch	
	Concealed or in mechanical rooms	All	Fiberglass Blanket	1 1/2-inch	
	Exposed Outside Building Envelope	All	Internally Lined	3-inch	
	15-feet upstream and downstream of fans	All	Internally Lined	1-inch unless otherwise indicated	

System	Location	Duct Type	Insulation Type	Thickness	Notes
Return Air* (not insulated except:)	Concealed Outside Building Envelope	All	Externally insulated without vapor barrier	2-inch	
	Exposed Outside Building Envelope	All	Internally Lined	2-inch	
	15-foot upstream and downstream of fans	All	Internally Lined	1-inch unless otherwise indicated	
Exhaust Air* (not insulated except:)	15-foot upstream and downstream of fans	All	Internally Lined	1-inch unless otherwise indicated	
	In Toilet Rooms, 10-foot downstream of exhaust grilles	All	Internally Lined	1-inch	
Outside Air (untempered)	Exposed or Visible (Including above a cloud ceiling)	Rectangular	Internally Lined	2-inch	
		Round	Internally Lined	2-inch	
	Concealed or in mechanical rooms	All	Fiberglass Blanket	2-inch	
Supply and Return Plenums	All	All	Internally Lined	2-inch	Note 1
Grease Hood Exhaust	All	All	Duct Enclosure, Fire Rated	As Indicated	
Transfer Air	All	All	Internally Lined	1-inch	
OSA and Relief Plenums at Louvers	All	All	Fiberglass Blanket or Board	R-20 Equiv	Note 4
<p>* In addition to applied locations listed in this table, provide internally lined ductwork where indicated on drawings.</p> <p>Note 1: Insulation not required on factory fabricated insulated housings and plenums (AHP).</p> <p>Note 2: Where round or oval ductwork is indicated, provide double walled as specified in Section 23 3102, HVAC Ducts and Casing-Medium Pressure.</p> <p>Note 3: Use semi-rigid blanket for galvanized sheet metal duct and use semi-rigid board for stainless steel duct.</p> <p>Note 4: Plenums at louvers shall be insulated where extending beyond control damper.</p>					

3.05 DUCTWORK INSTALLATION

A. General:

1. Install in accordance with manufacturer's instruction.

2. The vapor barrier shall be continuous. Tears, holes, staples, etc. shall be coated with vapor barrier mastic and patch with facing or tape. Joints between insulation and access with vapor barrier mastic.
 3. Insulation at access panels to be removable or attached to panel with edges of panel and opening reinforced with metal beading.
- B. External Blanket Insulation:
1. Insulation secured to ductwork with 20-gauge snap wires 24-inches on center and at all joints.
 2. Joints and seams lapped a minimum of 3-inches and sealed with jacket tape.
- C. Internal Duct Liner:
1. The coated surface shall face air stream.
 2. Weld pins spaced maximum of 15-inch on center in both directions and within 2 inches of all corners and joints. Weld pins flush with liner surface.
 3. Complete duct surface coated with adhesive and insulation pressed tightly thereto.
 4. Edges at terminal points shall be provided with metal beading and heavily coated with adhesive.
 5. All joints and corners shall be heavily coated with adhesive.
 6. Damaged areas replaced or heavily coated with adhesive.
- D. Duct Enclosure - Fire Rated:
1. Installation: Per manufacturer's instructions.
 2. Joints:
 - a. Attached boards shall be cemented and attached to one another. Mating surfaces shall be "buttered" with a 1/8-inch layer adhesive.
 - b. Secure fiberglass type material with stainless steel banding, Type 304.
 3. Support: The duct enclosure may be hung from a conventional "trapeze" arrangement. Adequate support shall be provided at the bottom of vertical runs. On multi-story vertical runs, the Firetemp enclosure shall be supported at each story penetration with an angle iron collar attached to the Firetemp.
 4. Expansion: Adequate clearance shall be provided at the end of all straight runs to allow for expansion of the metal duct inside the enclosure.
- E. Plenums: Insulation on floors protected by wire mesh.
- F. Blank Off Panels: Insulation, enclosed with sheet metal on all sides.
1. Joints: Vapor barrier mastic and taped.
- G. Volume Dampers: Where volume dampers do not allow for continuous insulation, terminate insulation clear of handle sweep, and finish edges to maintain vapor barrier and to prevent damage to the insulation.
- H. Field Test: All systems shall be tested and approved prior to installation of insulation.

END OF SECTION

**SECTION 23 0800
COMMISSIONING FOR HVAC**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.
- C. The Work of this Section is supplemental to and does not supersede any other requirements of the Contract Documents.

1.02 SUMMARY

- A. The commissioning process is described in Section 01 9113, General Commissioning Requirements.
- B. Provide all labor and materials required to complete the commissioning of those Division 23 systems and equipment identified as Commissioned Systems and Equipment in Section 01 9113, General Commissioning Requirements.
- C. Related Sections include:
 - 1. Section 01 9113, General Commissioning Requirements
 - 2. Division 23

1.03 SUBMITTALS

- A. Refer to Section 01 9113, General Commissioning Requirements.

1.04 COMMISSIONING SCOPE OF WORK - COMMISSIONING AGENT

- A. Refer to Section 01 9113, General Commissioning Requirements.

1.05 COMMISSIONING SCOPE OF WORK - CONTRACTOR

- A. Refer to Section 01 9113, General Commissioning Requirements.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Refer to Section 01 9113, General Commissioning Requirements.

PART 3 EXECUTION

3.01 MEETINGS

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.02 INSTALLATION, CHECK-OUT, START-UP AND PREFUNCTIONAL CHECKS

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.03 FUNCTIONAL TESTING

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.04 TRAINING OF FACILITY OPERATING STAFF AND BUILDING OCCUPANTS

- A. Refer to Section 01 9113, General Commissioning Requirements.

END OF SECTION

**SECTION 23 0900
CONTROLS**

PART 1 GENERAL

1.01 WORK BY CONTRACTOR – RESPONSIBILITY MATRIX

- A. Owner is contracting direct with the Controls Installer.
- B. The following information is provided to coordinate scope required by the Contractor with the scope of the Owner's Controls Installer.
- C. Contractor to coordinate/provide all project updates, coordination meetings, change documents (RFIs, CCD's, ASI's, etc.), schedules, startup, test and balance activities with/to the Owner's Controls Installer.

ESD 4J/Contractor Responsibility Matrix			
	Furnish	Install	Notes
Controls System	ESD 4J	ESD 4J	
DDC Control Panel through devices, including terminations at said devices as a complete system. System includes including power supplies, boards/modules, pathway/raceway, and low voltage wiring.	ESD 4J	ESD 4J	*Room temperature/carbon dioxide sensor rough in to accessible ceiling space by Contractor.
Line Voltage to DDC Power Supplies	C	C	
Temperature Instrument Wells	ESD 4J	C	*Unless provided by manufacturer of Contractor purchased equipment, specific for their sensing equipment.
Piping Pressure Transmitters/Transducers	ESD 4J	C	
Motorized Control Dampers	C	C	
Motorized Control Valves	ESD 4J	C	
Damper and Valve Actuators	ESD 4J	ESD 4J	*If spec or equipment schedule states to provide with equipment then furnish will be by manufacturer.
Vortex Shedding Water Flow Meter	C	C	*ESD 4J to provide control wiring – Same on RRES?
Lighting Control Panel	ESD 4J	C	
ESD 4J – Eugene School District 4J's Controls Contractor			
C-Contractor			

1.02 FOR REFERENCE ONLY - SCOPE OF WORK (OWNER'S CONTROLS CONTRACTOR)

- A. General Note: The scope of work for HVAC controls work in this contract is different than is traditional in new construction. Specifically, instead of turnkey controls installation, the requirements of this contract are for physical installation of the control system only; determination of sequences-of-operation, the programming required to achieve said sequences, graphics, and database setup are outside this contract and will be provided by Owner. All other required work for a fully functioning control system are within the contract.
- B. Provide hardware installation of Automated Logic DDC System for the Project, to control HVAC and exterior lighting as identified in ESD 4J provided points list. Substantial completion as per contract, is defined as being complete with point checkout completion.

- C. Provide wiring installation diagrams for field installers and to serve as O&M drawings at end of project. Submit wiring diagrams along with submittal information for products to be installed for review and receive approval prior to beginning field installation work. Provide valve schedule and temperature well submittal information to installing contractor in timely manner.
- D. Furnish control valves, wet differential pressure transducer, and temperature wells, to be installed by contractor. Furnish and install required control cabinets, power supplies, control module cards, lighting panels, wire and raceway, room sensors, discharge and mixed air sensors, CO2 sensors, outside air sensors, CTs, pressure transducers, relays, valve/damper actuators and other I/O devices and terminations as required for a fully functional control system. Follow manufacturer's installation instructions for all devices and aspects of system.
- E. Coordinate with Owner, Owner's general contractor and subcontractors as required to complete the scope of work within the published schedule. Furnish installed by the building contractor or their tier contractors in a timely fashion as required to prevent schedule impacts. Participate in the General Contractor MEP coordination for installation of your work and sharing of wire tray and other common raceways when possible.
- F. Power supply locations have been identified on the project drawings, confirm, and coordinate locations with the electrical subcontractor to provide line voltage power.
- G. Perform point-to-point system commissioning and record on appropriate WebCtrl "properties" page. As noted below, Owner will setup database and will provide programs/graphics in database ready for download to modules by control contractor as modules are brought on-line.
- H. During course of installation work, mark up wiring diagrams to reflect any and all "as-built" conditions that vary from the drawings. Consult district engineer for prior approval of any substantial changes from approved wiring installation drawings. At end of project, submit edited version of wiring diagrams incorporating field markup as the final O & M drawings.
- I. Provide one-year warranty on installation, two years on control modules.
- J. All line-voltage/low voltage wiring not in concealed ceiling spaces or wall cavities in conduit, placed to achieve the best aesthetics, and in accordance with electrical code. Conduit wiring in mechanical rooms. Coordinate installation timeline such that painted areas are complete prior to the painting process.
- K. Pilot duty relays used with starters have a HOA switch if the starter (provided by others) does not have an HOA switch (RIB model U1S). If the existing starter does have an H-O-A already, pilot duty relay should not include that feature (RIB model U1C)
- L. Where small loads are directly switched with DDC-controlled relay, such as small exhaust fan motors, provide a relay with 20A-rated contacts and H-O-A switch (RIB model 2401SB or similar as required by power source).
- M. CTs on direct drive fan motors, fixed threshold (RIB XGF). CTs on belt driven equipment and EC motors, adjustable threshold (RIB XGA or Veris H608).
- N. Run proof on VFDs may utilize the VFDs integral run proof binary output contacts, or (preferred) analog speed output contacts.
- O. Label universal input and output wiring at module to match wiring diagrams.
- P. Auto reset freeze stats.
- Q. Mixed Air Sensors: Duct averaging.
- R. Actuators:
 - 1. Manufacturer: Belimo
 - 2. Valves characterized flow t2 and 3 way valves and do not require spring return actuators.
 - 3. Dampers on air handlers less than 2000 cfm only require a spring return actuator on outside air damper and any direct relief to the outdoors.
 - 4. RA may be either spring return or non-spring.

5. Units larger than 2000 cfm require coordinated spring return actuators on mixed air dampers.
- S. Power supplies outside of module cabinet to reduce heat buildup in cabinet. Power supplies include provisions to switch off 24VAC power inside of module cabinet and have overload protection on both primary and secondary side of transformer. Switches and overload devices behind covers to prevent student or staff access to said switches without tools. Typical models used: RIB PSH300A, PSH500A, PSC100AB10.
- T. This project is a prevailing wage job. Oregon prevailing rate of wage for this project are those shown in the Project Manual Section 00 7300 referenced BOLI publication.

1.03 REFERENCE ONLY - WORK BY OWNER

- A. Owner will set up database as required.
- B. Owner will generate and load programs into database for all modules to facilitate contractor's point testing/commissioning. Graphics will also be the responsibility of Owner.
- C. Sequence of operation, as determined by the Owner's programming will be solely the responsibility of Owner.
- D. Commissioning agent will be checking/verifying point-to-point checkout.

END OF SECTION

SECTION 23 2014
PREFABRICATED PIPING SYSTEMS FOR HVAC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Direct buried prefabricated piping systems for chilled water.
- B. Related Sections include:
 - 1. Section 23 0590, Pressure Testing for HVAC Systems
 - 2. Section 23 0700, Insulation for HVAC
 - 3. Section 23 2113, Pipe and Pipe Fittings HVAC

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Product Data.
 - 2. Installation Manuals.
 - 3. Complete shop drawings for piping systems including elbows, tees, flanges, coupling locations, and anchors. Include cutting lengths and thrust block sizes.
 - 4. Report on field piping tests with signatures of Architect and manufacturer's representative witnessing.

1.04 QUALITY ASSURANCE

- A. Provide the services of a qualified manufacturer's representative to instruct the contractor on the installation procedures for piping, and to be present on site to assist during critical stages of installation and testing.
- B. Include a report consisting of the installation log indicating actual installed conditions and test certification signed by the manufacturer's representative above, the contractor, and the Architect's representative. Include certification by manufacturer's representative that the installation is in conformance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.01 PREFABRICATED PEX OR HDPE CHILLED AND HEATING WATER PIPING

- A. Acceptable Manufacturers:
 - 1. Rovanco, Thermacore, Perma-Pipe, Thermal Pipe, and Insul-pipe.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. General: Provide complete prefabricated underground chilled water piping system suitable for direct burial as indicated on Drawings and as specified herein. Factory prefabricated HDPE jacketed system of factory pre-insulated pipe with all necessary fittings, seals, and accessories.
- C. Pipe: Carrier pipe shall be Cross-linked PEX pipe 100 psi minimum working pressure for temperatures up to 180 degrees F and or High Density Polyethylene pipe DR-17, 100 psiminimum working pressure for temperatures up to 110 degrees F.
- D. Expansion: All components of carrier pipe, insulation, and jacket must be able to expand and contract as a unit without overstressing or adversely affecting any of the materials. The piping system supplier shall be responsible for the overall design of the expansion and contraction compensation.

- E. End Seals: All direct-buried ends of insulated pipe with exposed insulation will be sealed with polyethylene end seals.
- F. Insulation: Insulation shall be as specified in Section 23 0700, Insulation for HVAC.
- G. Jacket: The outer protective jacket shall be corrugated seamless polyethylene completely encompassing and protecting the insulation from moisture and damage, designed for H-20 loading at a burial depth of 2-ft minimum.
- H. Joints: Straight run joints shall be field-insulated per the manufacturer's instructions, using polyurethane foam poured in an HDPE sleeve and sealed with a heat shrink sleeve. All joint closures and insulation shall occur at straight sections of pipe. All insulation and jacketing materials shall be furnished by piping system supplier.
- I. Fittings: Fittings shall be standard component factory prefabricated and pre-insulated to the thickness specified.
- J. Accessories: Provide all required accessories including wall sleeves, and miscellaneous materials as required for attachment to steel or copper pipe at ends and as required and detailed to a complete and total installation.
- K. Service:
 - 1. Chilled Water below grade.

PART 3 EXECUTION

3.01 PREPARATION

- A. Measurements, Lines and Levels:
 - 1. Check dimension at the building site and establish lines and levels for the work specified in this Section.
 - 2. Establish all inverts, slopes, and manhole elevations by instrument, working from an established datum point. Provide elevation markers for use in determining slopes and elevations in accordance with Drawings and Specifications.
 - 3. Use established grid and area lines for locating trenches in relation to building and boundaries.

3.02 EXCAVATION AND BACKFILL

- A. General: Perform all necessary excavation and backfill required for the installation of mechanical work in accord with Division 02. Repair pipelines or other work damaged during excavation and backfilling.
- B. Excavation: Excavate trenches to the necessary depth and width, removing rocks, roots, and stumps. Include additional excavation to facilitate utility crossovers, additional offsets, etc. Excavation material is unclassified. Width of trench shall be adequate for proper installation of piping. The trench shall be widened if not wide enough for a proper installation.
- C. Bedding: All piping shall be full bedded on sand. Place a minimum 4-inch deep layer on the leveled trench bottom for this purpose.
- D. Backfill:
 - 1. Immediately after all piping is installed in the ditch, make a partial backfill in the middle of each pipe length leaving the joints exposed for inspection prior to the hydrostatic tests.
 - 2. Place in layers not exceeding 8 inches deep and compact to 95 percent of standard proctor maximum density at optimum moisture content. Earth backfill shall be free of rocks over 2-inches in diameter and foreign matter. Disposal of excess material as directed.
 - 3. Interior: All backfill under interior slabs shall be bank sand or pea gravel.
 - 4. Exterior: Excavated material may be used outside of buildings at the contractor's option. The first 4 inches shall be sand, and final 12-inch layer course shall be soil in any event.

3.03 ADJUSTING AND CLEANING

A. General:

1. Clean interior of all piping before installation.
2. Flush sediment out of all installed piping systems.

3.04 INSTALLATION OF PEX AND HDPE CHILLED WATER PIPING

- A. Install piping in accordance with the Manufacturer's recommendations and installation Drawings.
- B. Install all piping as to vent and drain to building.
- C. The system shall be installed in a manner that will not require expansion loops or compensators of any type.
- D. The system shall be installed with the fewest number of underground joints possible.
- E. Make connection between PEX or HDPE and Copper or Steel pipe according to manufacturer's recommendations.
- F. Slope piping uniformly. Record exact location and depth with respect to established datum points.
- G. Test piping prior to sealing of conduits and before backfilling. Seal all leaks and retest until tight.
- H. Utility Marking: Installed over the entire length of the underground piping utilities. Install plastic tape along both sides and the center line of the trenches at the elevation of approximately 12-inches above the top of utility.
- I. Trace Wire: Install 16 gauge insulated copper tracer wire (green in color) above all buried nonmetallic piping. Tracer wire to run entire length of pipe.

END OF SECTION

**SECTION 23 2113
PIPE AND PIPE FITTINGS HVAC**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Furnish piping, pipe fittings, and incidental related items as required for complete piping systems, and treatment of HVAC water systems.
- B. Related Sections Include:
 - 1. Section 23 2500, HVAC Water Treatment

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. Piping material and installation to meet requirements of the local building codes and serving utility requirements.
- B. All grooved joint couplings and fittings shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
 - 1. Date stamp castings used for coupling housings, fittings, valve bodies, etc., for quality assurance and traceability.
- C. Pipe Cleaning: Should any pipe be plugged or should foaming of water systems occur, disconnect piping, re-clean, and reconnect without additional expense to the Owner.
- D. Correct any damage to the building or systems resulting from failure to properly clean the system without additional expense to the Owner.

1.04 SUBMITTALS

- A. Submit the Following:
 - 1. List of piping materials indicating the service it is being used for. Do not submit piping product data.
 - 2. Product data on mechanical couplings and related components.
 - 3. Certificate of completion
 - 4. Treatment Reports
- B. Test Reports and Certificates: Submit certificates of inspections and pipe tests to Owner.
- C. Other: Make certified welders' certificates available.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. As indicated.

2.02 BLACK STEEL PIPE, SCHEDULE 40 AND STANDARD

- A. Pipe: Schedule 40 conforming to ASTM A 135 or A 53. Schedule 40 up to 10-inch diameter. Standard weight for 12-inch diameter and above.
- B. Fittings:
 - 1. 150 pounds screwed malleable iron on 2-inches and below, Schedule 40 welding fittings conforming to ASTM A 234 for 2-1/2 inches and above or mechanical couplings on select piping as herein specified.

2. Fittings below grade shall be welding fittings.
 3. Elbows on Pumped Systems: Radius Type
 4. Short radius elbows not acceptable for use except as approved on a case by case basis.
- C. Service:
1. Chilled and heating water piping up to and including 6-inches.
 2. Safety and relief valve discharge.

2.03 COPPER PIPE

- A. Pipe: Hard drawn copper tubing, Class L, ASTM B 88.
- B. Fittings:
1. Wrought copper, 150 psi; ANSI B16.22 for soldered joints, ANSI B16.50 for brazed joints; Chase, Revere, Mueller or approved equal.
- C. Service:
1. Refrigerant piping (Type L, hard drawn, ACR cleaned).
 2. Chilled and heating water piping (Type L, hard drawn) up to and including 4-inches.
 3. Mechanical Platforms: Condensate traps and drains within air plenums.

2.04 PVC PIPE

- A. Pipe: Schedule 80 PVC, normal impact, Type 1, ASTM D 1785.
- B. Fittings: Schedule 80 PVC, deep socket, solvent welded, ASTM D2467.
- C. Service:
1. Coil condensate drains and traps, boiler condensate drains, and other miscellaneous drains, water heater combustion air and vent piping.
 2. Except not allowed in air plenums.

2.05 FLANGED JOINTS

- A. Flanged Joints: Flanges shall be cast iron or steel for screwed piping and forged steel welding neck for welded line sizes. Pressure rating and drilling shall match the apparatus, valve, or fitting to which they are attached. Flanges shall be in accordance with ANSI B16.1; 150 lb. for system pressures to 150 psig; 300 lb. for system pressures 150 psig to 400 psig. Gaskets for all flanged services, except steam and pumped condensate, shall be Garlock 3700 or equal, 1/8-inch thick, non-metallic type. Gaskets for steam and pumped condensate shall be Flexitauc Style CG or equal, 1/8-inch thick, semi-metallic type. Make joint using American Standard hexagon head bolts, lock washers, and nuts (per ASTM A307 GR.B) for service pressures to 150 psig; alloy steel stud bolts, lock washer, and American Standard hexagon head nuts (per ASTM A307 GR.B) for service pressures 150 psig to 400 psig. Use length of bolt required for full nut engagement. Provide electro-cad plated bolts and nuts on cold and chilled water lines.

2.06 UNIONS

- A. 150 psi malleable iron, brass to iron seat, ground joint, black or galvanized to match pipe. 200 psi WOG bronze, ground joint, solder type for copper tubing.
- B. Dielectric fittings shall be nationally listed, have a dielectric thermoplastic interior lining, and meet requirements of ASTM F-492. Fittings shall be suitable for the pressure and temperature to be encountered.

2.07 SOLDERING AND BRAZING

- A. Brazed Joints:
1. Westinghouse Phos-Copper or Dyna-Flow by J.W. Harris Co., Inc.
 2. Applied locations:
 - a. Below grade piping.

- b. All above grade piping larger than 2-inches for the following services: heating water, chilled water.
 - c. Refrigerant piping. Braze in accordance with Copper Development Association Copper Tube Handbook using BCUP series filler material.
- B. Soldered Joints:
- 1. Wrought Copper Pipe Fittings: All-State 430 with Duzall Flux, Engelhard Silvabrite with Engelhard General Purpose Flux or J.W. Harris Co.
 - 2. Valves, Cast Fittings or Bronze Fittings: Harris Stay-Silv-15 or Handy & Harmon Sil-Fos.
 - 3. Applied locations: Above grade piping 2-inch and smaller for the following services: Heating water, chilled water.
- C. Valves, Cast Fittings or Bronze Fittings: Harris Stay-Silv-15 or Handy & Harmon Sil-Fos.

2.08 POLYPROPYLENE PIPING

- A. Approved Manufacturer: Aquatherm Blue Pipe MF.
- B. Description:
- 1. Manufacture from PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F 2389 or CSA B137.11.
 - 2. Pipe contains no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.
 - 3. Pipe made in an extrusion process. Hydronic hot water and heating piping contains a fiber layer (faser) to restrict thermal expansion. Comply with rated pressure requirements of ASTM F 2389 or CSA B137.11. All pipe shall be certified by NSF International as complying with NSF 14, and ASTM F 2389 or CSA B137.11.
- C. Fittings: Same material as piping.
- D. Service: Chilled and heating water piping up to and including 6-inches, water heater combustion air and vent piping.
- E. Installation in an air plenum (Mechanical Platform) requires fire-wrap or insulation approved for the application.

PART 3 EXECUTION

3.01 PREPARATION

- A. Measurements, Lines and Levels:
- 1. Check dimension at the building site and establish lines and levels for work specified in this Section.
 - 2. Establish all inverts, slopes, and manhole elevations by instrument, working from an established datum point. Provide elevation markers for use in determining slopes and elevations in accordance with Drawings and Specifications.
 - 3. Use established grid and area lines for locating trenches in relation to building and boundaries.

3.02 PIPING INSTALLATION

- A. Install unions in all non-flanged piping connections to apparatus and adjacent to all screwed control valves, traps, and appurtenances requiring removal for servicing so located that piping may be disconnected without disturbing the general system.
- B. Install all piping as to vent and drain. Install according to manufacturer's recommendations.
- C. Support all piping independently at apparatus so that its weight shall not be carried by the equipment.
- D. Run piping clear of tube cleaning or removal/replacement access area on coils, heat exchangers, chillers, etc.

3.03 DIELECTRIC FITTINGS

- A. Provide dielectric couplings, unions, or flanges between dissimilar metals. In addition, provide dielectric couplings as required to isolate cathodically protected piping and equipment.

3.04 PIPING JOINTS

- A. Pipe and fittings shall be joined using methods and materials recommended by manufacturer in conformance with standard practice and applicable codes. Cleaning, cutting, reaming, grooving, etc. shall be done with proper tools and equipment. Hacksaw pipe cutting prohibited. Peening of welds to stop leaks not permitted.
- B. Purge refrigerant piping with nitrogen continuously during the piping installation, and seal each branch outlet with Visqueen and tape or similar method to assure continued cleanliness of interior of piping until system is completed.
- C. Copper Piping: Pipe cut evenly with cutter, ream to full inside diameter; end of pipe and inside of fitting thoroughly cleaned and polished. Joint shall be uniformly heated, and capillary space completely filled with solder or braze material, leaving full bead around entire circumference.
- D. No couplings installed in floor or wall sleeves.
- E. Steel Piping:
 - 1. Screwed Joints: Pipes cut evenly with pipe cutter reamed to full inside diameter with all burrs and cuttings removed. Joints made up with suitable lubricant or Teflon tape applied to male threads only, leaving two threads bare. Joints tightened so that not more than two threads are left showing. Junctions between galvanized steel waste pipe and bell of cast iron pipe shall be made with tapped spigot or half coupling on steel pipe to form spigot end and caulked.
 - 2. Flanged Joints: Pressure rating of flanges shall match valve or fitting joined. Joint gaskets shall be coated with graphite and oil.

F. Welded Joints:

- 1. Preparation for Welding: Bevel piping on both ends before welding:

- a. Use following weld spacing on all butt welds:

Nominal Pipe Wall Thickness	Spacing	Bevel
1/4-inch or less	1/8-inch	37-1/2
Over 1/4-inch, less than 3/4-inch	3/16-inch	27-1/2

- b. Before welding, remove all corrosion products and foreign material from surfaces.
 - 2. Welded Joints: Joints shall be made by the "arc-welding" process using certified welders. Port openings of fittings must match the inside diameter of the pipe to which they are welded. Use full radius welding elbows for all turns, use welding tees for all tees. Reducing fittings must be used for size reduction. "Weldolets" may be used for branches up through one-half the pipe size of the main to which they are attached. Nipples are not allowed.
 - 3. Welding Operation:
 - a. After deposition, clean each layer of weld metal to remove slag and scale by wire brushing or grinding. Chip where necessary to prepare for proper deposition of next layer.
 - b. Weld reinforcement no less than 1/16-inch not more than 1/8-inch above normal surface of jointed sections. Reinforcement crowned at center and taper on each side to surfaces being joined. Exposed surface of weld shall present professional appearance and be free of depressions below surface of jointed members.
 - c. No welding shall be done when temperature of base metal is lower than 0 degrees F. Material to be welded during freezing temperatures made warm and dry before welding is started. Metal shall be "warm to the hand" or approximately 60 degrees F.

- G. Screwed Joints: Use Teflon tape or Teflon liquid dope applied to male threads only.
- H. Flexible Couplings: Provide where indicated on the Drawings.
- I. PVC Piping: Socket weld joints with solvent cement and application method recommended by manufacturer. Use power saw and miter box to cut PVC pipe. Allow proper curing time based on temperature range during cure period before pressure testing.
- J. Polypropylene joints: Fusion welding per manufacturer's requirements.

3.05 ADJUSTING AND CLEANING

A. General:

1. Clean interior of all piping before installation.
2. Flush sediment out of all piping systems after installation before connecting mechanical equipment to the piping.
3. When placing the water systems in service during construction, each system shall be cleaned by circulating a solution with 1000 ppm of trisodium phosphate for 24 hours, then drained, flushed and placed in service.
4. Clean all strainers prior to placing in service.

END OF SECTION

**SECTION 23 2123
PUMPS FOR HVAC SYSTEMS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Base Mounted Centrifugal Pumps

1.03 QUALITY ASSURANCE

- A. Select pump impellers such that impellers shall not be greater than minimum impeller size plus 90 percent of the difference between the maximum and minimum impeller size for pump selected.
- B. Select motor to be non-overloading under all operating conditions.
- C. Select pump with a minimum efficiency as listed in schedule.
- D. Provide couplings and seals suitable for application (including temperature, pH, glycol solution concentration, and loads over full range of pump operation).
- E. Pumps and motors with flexible couplers shall be factory aligned, and realigned by manufacturer's representative after installation.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Product data for each pump including performance curves, pump efficiency, motor data, operating weights, and pressure ratings. Submit control information and wiring diagrams for packaged equipment.
 - 2. Operating and maintenance data for each product specified under this Section.

PART 2 PRODUCTS

2.01 BASE MOUNTED CENTRIFUGAL PUMPS

- A. Acceptable Manufacturers:
 - 1. Paco, Peerless, Bell and Gossett, Goulds, Armstrong, Taco, Thrush, Aurora.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: End suction centrifugal pump, motor, flexible coupling drive mounted on a common steel baseplate.
- C. Components:
 - 1. Vertical split case construction, cast iron volute, bronze fitted.
 - 2. 175 psig working pressure unless otherwise noted.
 - 3. Enclosed type, single stage, bronze impeller.
 - 4. Mechanical shaft seal, regreasable ball bearings.
 - 5. Motor: 1750 RPM maximum speed.
 - 6. Coupling drive and guard.
 - 7. Steel baseplate with open grouting area.
 - 8. Pump internals capable of being serviced without disturbing piping.
 - 9. Capacity head and power requirements as scheduled on Drawings.

PART 3 EXECUTION

3.01 BASE MOUNTED CENTRIFUGAL PUMP INSTALLATION

- A. Install pump in location shown in accordance with manufacturer's written installation instructions.
- B. Install on inertia base where located on floor.
- C. Provide flexible connections, strainers, check valves and shutoff valves on suction and discharge as shown on Drawings.
- D. Lubricate in accordance with manufacturer's instructions before operation.
- E. Support interconnecting piping independently of pump and inertia base to prevent stresses from being transmitted to the casings.

END OF SECTION

**SECTION 23 2500
HVAC WATER TREATMENT**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Treatment HVAC water systems.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings
 - 2. Product Data
 - 3. Operating and Maintenance Data

PART 2 PRODUCTS

2.01 ACCEPTABLE CHEMICAL TREATMENT MANUFACTURER/SUPPLIER

- A. ChemAqua (Tom Hubbard, 541-505-1768).

2.02 HVAC WATER TREATMENT

- A. Closed Loop Systems Chemicals: Will be provided by School District's chemical treatment provider.
 - 1. One Shot Feeder:
 - a. Description: Furnish and install one-shot chemical bypass feeders on each closed loop system where water treatment is specified.
 - b. Construction:
 - 1) Feeder: 2 quart, 4 quart, 10 quart or maximum of 5 gallon volume as required to initially treat the system served in two shots.
 - 2) Pressure Rating: 150 psig or 300 psig to match other valve and pressure vessel ratings. Provide fill funnel and valve, air vent cock and drain valve and plug.

PART 3 EXECUTION

3.01 INSTALLATION

- A. HVAC Closed Loop Systems:
 - 1. Install shot feeders across pump or appropriate restricting valve with adequate mounting to prevent piping damage and preclude transmitting vibration to structure.
 - 2. Filling may be through bypass shot feeder across pump.
 - 3. Final system treatment shall achieve 800-1200 ppm Sodium Nitrite in the system water. Tolyltriazole levels of minimum 3ppm in all closed loop water shall be applied.
 - 4. Test to confirm proper inhibitor levels.

3.02 FINAL ADJUSTMENT

- A. When the systems are accepted by the Owner the chemical treatment supplier shall make final adjustments in the required concentrations.

END OF SECTION

SECTION 23 3101
HVAC DUCTS AND CASING-LOW PRESSURE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Low pressure ductwork and fittings.
- B. Related Sections include:
 - 1. Section 23 0548, Vibration and Seismic Controls for HVAC Piping Equipment
 - 2. Section 23 0700, Insulation for HVAC
 - 3. Section 23 3300, Air Duct Accessories

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Work performed by qualified, experienced mechanics, in accordance with the manual of Duct and Sheet Metal Construction of the Sheet Metal and Air Conditioning Contractors National Association and these Specifications.
- B. Regulatory Requirements:
 - 1. Entire ductwork system, including materials and installation, installed in accordance with NFPA 90A.
 - 2. Ductwork and components shall be listed as UL 181, Class I air duct, flame rating not to exceed 25 and smoke rating not to exceed 50.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Provide catalog data on each product specified hereunder.
 - 2. Schedule of duct construction standards.
 - 3. Provide shop drawings showing construction details, support, and seismic restraint of ductwork distribution systems.

PART 2 PRODUCTS

2.01 SUPPORTS, ANCHORAGE AND RESTRAINTS

- A. General:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports and seismic restraints for ductwork are not shown on the Drawings, the contractor shall be responsible for their design.
 - 2. Seismic restraints and anchorages shall resist seismic forces as specified in the latest edition of the International Building Code for the seismic zone in which the project is constructed.
 - 3. Seismic restraints shall follow the provisions described in Section 23 0548, Vibration and Seismic Control for HVAC Piping and Equipment.
 - 4. Seismic restraints shall not introduce stresses in the ductwork caused by thermal expansion or contraction.
 - 5. Connections to structural framing shall not introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

- B. Suspended Ductwork: Seismic restraints in accordance with the latest edition of the SMACNA Seismic Restraint Manual - Guidelines for Mechanical Systems for the seismic hazard level corresponding to the seismic zone in which the project is constructed.
- C. Engineered Support Systems: The following support systems shall be designed, detailed, and bear the seal of a professional engineer registered in the State having jurisdiction:
 - 1. Supports and seismic restraints for suspended ductwork and equipment.
 - 2. Support frames for ductwork and equipment which provide support from below.
 - 3. Equipment and ductwork support frame anchorage to supporting slab or structure.

2.02 SHEETMETAL DUCTWORK

- A. Fabricate from galvanized steel, unless noted otherwise.
- B. Minimum gauge, duct construction, joint reinforcing, fittings, hangers, and supports shall be in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, Latest Edition.
- C. Duct Classification: Ducts shall be considered low pressure when design velocities are 2000 fpm or less and maximum static pressure is 2-inches wg positive or negative.
 - 1. The following ductwork shall be constructed in accordance with minimum reinforcement requirements for static pressure class of 1/2-inch wg positive or negative.
 - a. Supply ductwork downstream from terminal units.
 - b. Supply, return, or exhaust ductwork serving fans scheduled to operate at less than 1/2-inch wg.
 - c. Supply, return, or exhaust branch ductwork which serves one or two inlets/outlets.
 - 2. The following ductwork shall be constructed in accordance with minimum reinforcement requirements for static pressure class of 1-inch wg positive or negative.
 - a. Supply, return, or exhaust ductwork serving fans scheduled to operate at less than 1-inch wg. On supply fans pressure drops for louvers, coils, clean filters, and sound traps may be deleted from scheduled fan static.
 - b. Supply, return, or exhaust ductwork serving multiple duct branches where contractor can demonstrate that pressures will not exceed 1 inch W.G. positive or negative.
 - c. Boiler direct vent combustion air intake ductwork.
 - d. Water heater direct vent combustion air intake ductwork.
 - 3. The following ductwork shall be constructed in accordance with minimum reinforcement requirements for static pressure class of 2-inches wg, positive or negative.
 - a. Supply, return, or exhaust ductwork serving fans scheduled to operate at pressures greater than 1-inch wg positive or negative.
- D. Longitudinal seams on rectangular duct shall be Pittsburgh or Button punch snap lock. Snap lock seams for round duct may be used only on ducts classified for 1/2-inch wg. Longitudinal seams for round ducts using lap and rivet, spot weld, or fillet weld may be used only on ducts classified for statics 1-inch wg or less.
- E. Joining and reinforcing systems manufactured by Ductmate, Roloc, or TDC are acceptable. Ductmate 35 is equivalent to SMACNA J, and Ductmate 25 is equivalent to SMACNA F.
- F. Use of adjustable round elbows not permitted.

2.03 SINGLE WALL HOUSING PLENUMS

- A. Fabricate from galvanized steel, unless otherwise noted.
- B. Minimum gauge not less than 18 gauge except panels 10-feet-1-inch or longer 16 gauge.
- C. Housing panels constructed in accordance with the latest edition of SMACNA HVAC Duct Construction Standards – Metal and Flexible.

- D. Minimum pressure classification for single wall housing panels is 2-inches wg positive or negative.
- E. Maximum allowable panel width 24-inches with standing interlocking seams.
- F. Openings in panels for air inlets/outlets, or access doors reinforced per SMACNA standards.
- G. Provide intermediate reinforcing and/or bracing when spans are 8-feet or longer.
- H. Line all interior surfaces of single wall plenums with minimum of 2-inch thick acoustical lining.
- I. Access Doors: Construct of 20-gauge galvanized steel, double wall construction. Install in opening in plenum panel reinforced with 10-gauge channel. Doors mounted on three hinges and shall seat against neoprene gaskets. Doors in plenums at humidifiers shall have 12-inch by 12-inch double glass inserts from observation. Doors 24-inch by 60-inch height unless otherwise indicated.

2.04 FLEXIBLE DUCTS

- A. Acceptable Manufacturers:
 - 1. Thermaflex M-KE, Gen Flex IMP-25S
 - 2. Other Manufacturers: Submit substitution request.
- B. Description: Flexible air duct with CPE or metal film liner permanently bonded to coated spring steel wire helix with 1-inch thick fiberglass insulation blanket covered with fiberglass reinforced metal film vapor barrier jacket. Duct rated for 6-inch wg positive and 1-inch wg negative.

2.05 DUCTWORK, GREASE HOOD EXHAUST

- A. Materials: Stainless steel, minimum 18 gauge.
- B. Fabrication: Make all joints and seams with a continuous grease tight weld on the external surface of the duct system.
- C. Fittings: Elbows shall be the radius type with centerline radius equal to or greater than 1-1/2 times the depth of the duct in the plan of the turn.
- D. Construct and install ductwork so that grease cannot accumulate.
- E. Access Doors: 16 gauge minimum steel with gaskets and latches easily operable without the use of a tool.

2.06 EXPOSED OR VISIBLE DUCTWORK IN FINISHED SPACES

- A. Round:
 - 1. Material: Round or flat oval, machine formed, spiral lock-seam galvanized sheet metal ductwork of thicknesses as listed for sheet metal duct. Paintable surface.
 - 2. Fittings: Machine formed, shop fabricated, with welded seams, designed for easiest air flow, similar to United Sheetmetal numbers listed.
 - a. Mitered Elbow with Turning Vanes: Type EV-90-2
 - b. Radius Elbows: Type E090-5. Similar for less than 90 degree elbows.
 - c. Tees: Type Con-T-1.
 - d. Reducing Fittings: May be used unless noted otherwise.
- B. Rectangular: Same as for sheet metal ductwork but paintable surface. All reinforcing shall be inside. Use special care to prevent imperfections in the metal surface.

2.07 STAINLESS STEEL DUCTWORK

- A. Ductwork listed below and ductwork indicated on drawings constructed of 18 gauge minimum stainless steel with 2D finish concealed and No. 4 finish exposed. Type 304 or 316 as indicated.
- B. Seams: Weld and liquid tight.
- C. Accessories: Stainless steel including dampers, damper hardware, and turning vanes.

2.08 ALUMINUM DUCTWORK

- A. Ductwork listed below and ductwork indicated on drawings shall be constructed of 3003-H-14 alloy aluminum. Gauge of metal and construction details to be determined by using minimum equivalent thickness and reinforcing for galvanized steel tables in SMACNA.
- B. Longitudinal seams shall be Pittsburgh type. Button punch snap lock seams not allowed.

PART 3 EXECUTION

3.01 APPLIED LOCATIONS

- A. Supply ductwork on downstream side of terminal box: Galvanized sheet metal ductwork, lined where indicated on the Drawings or as specified in Section 23 0700, Insulation for HVAC.
- B. Supply Ductwork to Supply Outlet Collar Connection where indicated: Flexible duct, maximum 4-foot length.
- C. Return Air Trunk Ductwork from End Run to Unit Connection: Galvanized sheet metal ductwork, lined where indicated on the Drawings or as specified in Section 23 0700, Insulation for HVAC.
- D. Exhaust Ductwork: Galvanized sheet metal ductwork, lined where indicated on the Drawings or as specified in Section 23 0700, Insulation for HVAC.
- E. Ductwork between Transfer Grilles: Galvanized sheet metal ductwork, lined where indicated on the Drawings or as specified in Section 23 0700, Insulation for HVAC.
- F. Exposed or Visible Ductwork in Finished Spaces: Sheet metal as specified for application, lined where indicated on the Drawings or as specified in Section 23 0700, Insulation for HVAC.
- G. Stainless steel ducts:
 - 1. Type 304:
 - a. Kitchen dishwasher exhaust.

3.02 INSTALLATION

- A. Ductwork:
 - 1. Seal traverse joints with an approved mastic during joining procedure or tape after joining to provide airtight duct system.
 - 2. Low pressure ductwork hanger and support systems in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible. Wire supports are not allowed.
 - 3. Provide supplementary steel for support of ductwork in shafts and between building structural members.
 - 4. Fabricate changes in direction to permit easy air flow, using full 1.5D radius bends or fixed turning vanes in square elbows. Radius elbows less than 1.5D radius shall have splitter vanes.
 - 5. Change in duct size or shape necessitated by interference made using rectangular equivalents of equal velocity.
 - 6. Where pipe, structural member, or other obstruction passes through a duct, provide streamlined sheet metal collar around member and increase duct size to maintain net free area. Fit collar and caulk to make air tight.
- B. Sound Attenuation (Internal Insulation):
 - 1. Provide sound attenuation duct where shown and as specified under Section 23 0700, Insulation for HVAC.
 - 2. Duct dimensions shown are net inside attenuating material.
- C. Dampers: Install where shown and where necessary to complete final balancing of system. Install regulators as specified in Section 23 3300, Air Duct Accessories for each specific project condition. Leave all dampers locked wide open in preparation for balancing.
- D. Extractors: Install behind supply grilles and registers where shown.

- E. Flexible Connectors: Make connections to fans and other rotating equipment with flexible connectors with 2-inch minimum clearance between casing and ductwork. Not required on internally spring isolated units.
- F. Flexible Ducts:
1. Make connections at ends using draw band strap and a minimum of 2 wraps of duct tape.
 2. Suspend center spans from structure above using wire as required by code. Connect to manufacturer's eyelet on jacket or use 1-inch wide galvanized steel strap with single loop at top and smooth edges.
 3. Suspending duct by laying it on the ceiling is prohibited.
 4. Avoid crimping flex duct. All changes in direction shall be made using 2D radius. Duct connections to grilles, registers, and diffusers using less than 2D radius bends are not acceptable. Where space is constricted, use sheet metal elbows or Thermaflex Flex Boots (or equal).
- G. Ductwork, Grease Hood Exhaust:
1. Slope minimum of 1/4 inch per foot of run toward the hood. Where horizontal ducts exceed 75-feet in length, slope minimum of 1 inch per foot of run.
 2. Install access doors at every change in direction and maximum of 10-feet on center.
 3. Provide access doors and allow penetrations for sprinklers as required by Fire Protection section of these specifications.
- H. Ductwork, Exposed or Visible in Finished Areas:
1. Use extreme care in handling and installing.
 2. Replace all dented or damaged sections.
 3. Install ductwork straight and true, parallel to building lines.
 4. Make all connections with pop rivets using couplings where applicable. Grind all raw edges smooth and apply paintable sealant to cover imperfections.
 5. Remove all excess sealant to provide a finished joint.
 6. Provide floor, wall, and ceiling plates as specified in Section 23 0500, Common Work Results for HVAC.
 7. Finish, clean and prime all ductwork and hangers for painting.
- I. Single Wall Housing Plenums:
1. Install housing plenums in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, latest edition.
 2. All joints and seams sealed with high pressure duct sealer or gaskets and fastened with bolts, screws, or pop rivets.
 3. Pipe, duct, conduit, and control penetrations sealed to prevent air leakage using close off sheets and strips.
 4. Securely anchor housing panels to floor or roof curbs.
 5. Block outside air or return air dampers open to prevent damage during construction until automatic control system is operational and adjusted.
 6. Provide access doors where indicated on drawings and where required to provide access for cleaning and maintenance. Access doors installed to open against air pressure.
 7. Slope plenum and connected ductwork to drain towards the exterior louver or building exterior opening.
 8. For single wall plenums installed behind exterior louvers or wall openings, slope plenum floor and connected ductwork at 1/4-in/ft to drain towards the exterior louver or opening.

9. For single wall plenums installed below roof ventilators or roof openings, slope floor of plenum at 1/4-in/ft to drain connection. Pipe drain connection to floor drain.
- J. Stainless Steel Duct: Install stainless steel ductwork similar to galvanized ductwork per SMACNA standards.

3.03 FIELD QUALITY CONTROL

A. Coordination with Balance Agency:

1. Provide services of a sheet metal person familiar with the system ductwork to provide assistance to the balancing agency during the initial phases of air balancing in locating sheet metal dampers.
2. Install missing dampers required to complete final balancing.

END OF SECTION

SECTION 23 3000
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Low pressure duct accessories, sealants and tapes, flexible connectors, fire dampers, access doors, automatic dampers, drain pans, back draft dampers.
- B. Related Sections include:
 - 1. Section 23 3101, HVAC Ducts and Casing-Low Pressure
 - 1. Section 23 0900, Controls

1.03 QUALITY ASSURANCE

- A. Work performed by qualified, experienced mechanics in accordance with the manual of Duct and Sheet Metal Construction of the National Association of Sheet Metal and Air Conditioning Contractors and these Specifications.
- B. Install entire ductwork system, including materials and installation, in accordance with NFPA 90A.
- C. Flexible connectors, flexible equipment connections, tapes, and sealants listed as UL 181, Class I air duct. Flame spread rating not to exceed 25 and smoke developed rating not to exceed 50.

1.04 SUBMITTALS

- A. Submit the following: Product data for Duct Accessories.
 - 1. Low Pressure Duct Accessories:
 - a. Access Doors
 - b. Backdraft Dampers
 - c. Automatic Dampers
 - d. Duct Sealer.
- B. Operation and Maintenance Data: Automatic dampers.

PART 2 PRODUCTS

2.01 LOW PRESSURE DUCT ACCESSORIES

- A. Acceptable Manufacturers:
 - 1. As Indicated
 - 2. Other Manufacturers: Submit substitution request.
- B. Damper Regulators:
 - 1. Ventlok model numbers used, similar products by Young, Durodyne or approved equal are acceptable.
 - 2. Dial Regulator: Concealed or exposed duct in unfinished spaces, blade lengths 18-inch and less, 3/8-inch, Ventlok 635, or 638 for insulated duct. For blade lengths, 19 inches and above, similar except 1/2-inch shafts.
 - 3. Dial Regulator: Exposed duct finished space, 3/8-inch, Ventlok 640.

4. Dial Regulator: Concealed, not accessible, blade lengths 18-inch and less, 3/8-inch Ventlok 666 regulator with 680 mitered gear assembly where right angle turn is necessary. Blade lengths 19 inches and above, similar except 1/2-inch shafts.
5. End Bearings: For ducts rated to 1-inch wg, open end, Ventlok 607. For ducts rated above 1 inch WG, closed end, Ventlok 609. Exposed ductwork, finished spaces, Ventlock 609. Spring end bearings not allowed.

C. Volume Damper Fabrication:

1. Single blade dampers reinforced or crimped for rigidity, with pivot rod extending through duct. Dampers over 12-inches high use multiple opposed blade damper. Single blade damper no larger than 12 inches x 48 inches. Multiple blade damper factory fabricated, Ruskin MD-35 or equal.
2. Minimum gauge and duct construction in accordance with SMACNA "HVAC Duct Construction Standards", latest edition.
3. Splitter and butterfly dampers fabricated of 18 gauge galvanized steel.
4. Dampers of length suitable to close branch ducts without damper flutter.
5. Damper blade must be aligned with handle and index pointer.

D. Flexible Equipment Connections: 30 ounce. Ventfabrics Ventglas or Duro Dyne neoprene coated fire retardant glass fabric or approved equal.

E. Duct Sealer:

1. Based On: McGill Airseal Zero.
2. Description: Suitable for indoor/outdoor use, rated to 10-inch wg, Maximum Flame Spread/Smoke Developed Rating of 25/50, maximum VOC of 30 g/L less water. SCAQMD Rule 1158 compliant.

F. Duct Tape for Sheet Metal: ARNO C520 duct tape similar United, Duro Dyne, Nashua, Polymer Adhesive.

G. Tape and Adhesive/Activator System for Sheet Metal: Hardcast, Polymer Adhesive.

H. Turning Vane Assemblies:

1. Sheet Metal Vanes: Multiple radius hollow vane air foil type 2-inch (small vane) or 4-1/2-inch (large vane) inside radius, galvanized steel construction.
2. Runners: Push-on type.

I. Access Doors:

1. Manufacturer: Air Balance, Ruskin, Metco, Durodyne, Cesco, Nailor-Hart or approved equal.
2. Doors complete with steel frame, steel door with backing plate, cam latches (two on units 14-inch x 14-inch and larger), hinge and gasketing. Doors on insulated or lined ducts shall be insulated.
3. Grease Duct Access Door: Construct of metal thickness equal to metal duct, doors air and grease tight with hinge and hand operable latches. Ductmate.
4. Size:

Duct Width or Duct Diameter	Net Access Door Opening
Up to 8-inch	6-inch by 6-inch
9-inch to 12-inch	8-inch by 8-inch
13-inch to 20-inch	12-inch by 12-inch
21-inch to 30-inch	16-inch by 14-inch
31-inch to 42-inch	18-inch by 14-inch
Over 42-inch	Two 16-inch by 14-inch

J. Backdraft Dampers:

1. Manufacturer: Air Balance, Ruskin, Cesco, Advanced Air, Nailor-Hart, Pottorff, or approved equal.
2. Description: Gravity operated, vinyl edged, metal bladed backdraft dampers.

K. Drip Pans: Provide Type 304 stainless steel drip pans for cooling as indicated.

L. Louver Blank-off Panels: At air intake or exhaust louvers which are only partially active area, blank off inactive area with sheet metal closure panels caulked airtight, secured to louver frame and insulated with 2-inch rigid fiberglass insulation per Section 23 0700, Insulation for HVAC.

M. Automatic Dampers:

1. Description: Multi-blade air foil type, except where either dimension is less than 10-inches a single blade may be used. Maximum blade length to be 48-inches. Provide parallel blades for positive or modulating mixing service and opposed blades for throttling service. Blades to be interlocking, minimum 16 gauge galvanized steel.
2. Dampers shall have compression type edge seals and side seating stops. Damper blades shall be reinforced, have continuous full length axle shafts, axle to axle linkage and/or operating jackshafts as required to provide coordinated tracking of all blades. Dampers over 25 square feet in area to be in two or more sections, with interconnected blades. Dampers shall have a maximum air leakage of 3 cfm SF at 1-inch wg pressure. Provide automatic dampers except those specified to be provided with units. Tested in accordance with AMCA Standard 500. Based on Ruskin CD-60.
3. Damper Operators: Refer to Section 23 0900.
4. Manufacturers: Ruskin, Greenheck, Air Balance, Cesco, Pottorff or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all devices as shown on the Contract Drawings and per manufacturer's recommendations.
- B. Low Pressure Duct Accessory installation specified under Section 23 3301, HVAC Ducts and Casing-Low Pressure.
- C. Access Doors: Install where indicated and at all duct mounted coils, automatic control dampers to provide access for cleaning and maintenance.
- D. Kitchen Grease Duct Access Doors: Install every 10 feet and at each change in direction of kitchen exhaust duct per code.
- E. Back Draft Dampers: Install where indicated and at the discharge (or inlet) of exhaust fans where automatic dampers are not indicated.
- F. Automatic Dampers: Install where indicated and are not specified with equipment or in Section 23 0900, Controls. Coordinate damper operators with Section 23 0900, Controls.
- G. Drip Pans: Install under each cooling coil as indicated. Provide drain connection from each drip pan and pipe to nearest floor sink through trap. Drip pans over 6 feet in length require drain connections from both ends. Pitch drip pans in direction of air flow and to drain.
- H. Louver Blank-off Panels: Install blank-off panels on unused portions of louvers.

END OF SECTION

**SECTION 23 3319
DUCT SILENCERS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Duct Silencers.

1.03 SUBMITTALS

- A. Submit the following: Product data for Duct Silences.

PART 2 PRODUCTS

2.01 RECTANGULAR DUCT SILENCERS

- A. Acceptable Manufacturers:
 - 1. Industrial Acoustics Company, Semco, Ruskin, Dynasonics, Commercial Acoustics, Vibro-Acoustics
 - 2. Other Manufacturers: Submit substitution request
- B. Description:
 - 1. Galvanized sheet steel construction of not less than 22 gauge for outer casing and internal perforated sheet metal liner.
 - 2. Pressure rated airtight at 6-inch wg differential between inside and outside of silencer.
 - 3. Straight-through air passage to minimize noise regeneration due to turbulence.
 - 4. Acoustical Fill Material: Inorganic glass fiber not less than 4 pcf density, at not less than 5 percent compression, eliminating voids caused by settling.
- C. Performance:
 - 1. Ratings determined in duct to reverberant room test facility in accordance with ASTM E477.
 - 2. Static pressure losses as indicated on drawings.
 - 3. Dynamic insertion loss based on forward flow at 2000 fpm not less than the following:

Octave Band Center Frequency (HZ)								
*MODEL#	125	125	250	500	1000	2000	4000	8000
3S	6	10	15	25	34	35	28	17
5S	7	16	22	38	45	46	41	26
7S	9	17	34	44	49	49	45	35
3MS	4	7	12	19	23	23	18	11
5MS	6	10	18	30	42	34	23	14
7MS	10	14	24	36	48	44	31	18
3L	4	5	9	14	23	24	14	10
5L	6	7	13	21	29	39	20	14
7L	8	13	18	28	40	47	26	18
3LFS	8	12	21	25	25	21	17	14
5LFS	10	18	28	33	36	29	21	16
7LFS	11	21	38	46	49	39	29	19
3ES	3	7	13	23	32	34	24	18
5ES	7	12	19	33	48	49	36	25
7ES	7	16	32	46	54	51	48	34

3ML	2	5	10	17	17	13	10	8
5ML	3	8	15	28	30	21	14	10
7ML	4	12	20	36	38	28	18	12
3LFL	4	7	12	15	15	10	9	8
5LFL	6	10	16	24	25	14	11	11
7LFL	7	13	22	36	31	17	13	13
3LFM	5	7	15	18	17	12	10	10
5LFM	9	13	23	28	27	17	13	12
7LFM	13	15	29	39	38	22	17	14
*Based on Industrial Acoustics Company (IAC)								

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in ducts per manufacturer's recommendations.
- B. Seal space between each module with nosing strips and duct sealer to prevent air from passing between modules.
- C. Where attenuators are installed directly on concrete, provide 30 roofing felt or 1-inch roofing insulation under attenuators. Not required when attenuators do not come in contact with concrete.

END OF SECTION

SECTION 23 3400

HVAC FANS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Roof exhaust fans, in-line fans, dryer booster fans.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings: Showing dimensions, details of construction.
 - 2. Product Data: Showing performance of fans.
 - 3. Operation and Maintenance Data
 - 4. Submit certified sound power ratings for each fan.

PART 2 PRODUCTS

2.01 SIDE WALL EXHAUST FANS (UPBLAST MOUNTED HORIZONTALLY)

- A. Acceptable Manufacturer:
 - 1. Carnes, Penn-Barry, Greenheck, Cook, Acme, Twin City.
 - 2. Other Manufacturers: Submit substitution request.
- B. General Description: Provide centrifugal sidewall exhauster.
- C. Fans:
 - 1. Single width, single inlet, airfoil blades as indicated.
 - 2. One piece heavy gauge spun aluminum construction; Low silhouette type with arched heavy gauge galvanized hood, steel inlet bell, arranged for sidewall mounting.
 - 3. Kitchen grease exhaust fans of sidewall discharge type, with flanged, gasketed and bolted inlet connection per OMSC 506.3.2.3. Units shall be designed for use in kitchen hood applications with motor located outside the air stream. Provide non-sparking wheel assembly and scroll drain.
 - 4. Statically and dynamically balanced in the factory as an assembly within its own bearings with a maximum full amplitude shaft deflection at bearings not to exceed 0.003-inch at 1200 RPM to meet ANSI S 2.19 G6.3 balance quality grade.
- D. Motor: Integrally mounted, 1800 rpm maximum, with pre-lubricated sealed ball bearings. Provide EC motor. Refer to Section 23 0500, Common Work for HVAC for energy efficient motor requirements.
- E. Drive: Direct drive matched to fan loads.
- F. Fan wheel and motor mounted on integral double deflection neoprene isolators.
- G. Accessories: Bird screen.
- H. Provide automatic control damper with Belimo two-position electric actuator where and as scheduled, aluminum blades with felt edges.

2.02 INLINE CENTRIFUGAL FANS

- A. Acceptable Manufacturers:
 - 1. Greenheck, Penn, Cook, Acme, Carnes, Twin City.

2. Other Manufacturers: Submit Substitution Request.
- B. General Description: Inline centrifugal, belt or direct driven, cabinet fan, AMCA rated, backward inclined wheel, heavy gauge steel housing adequately braced with all edges sealed, externally mounted 1800 rpm motor or internally mounted EC motor, hinged access doors. Refer to Section 23 0500, Common Work Results for HVAC for energy efficient motor requirements.
- C. Drive:
 1. Belt: Multiple belt with fixed sheave and OSHA approved metal guard. Size drive for 150 percent of motor horsepower. For fans used as part of a life safety system, provide 1-1/2 times the number of belts required, with a minimum of 2.
 2. Direct: Beltless, with EC motor as scheduled.
- D. Vibration Isolation: Provide vibration isolation as indicated on drawings and in accordance with Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment.
- E. Provide automatic backdraft damper with Belimo two-position electric actuator where and as scheduled, aluminum blades with felt edges.

2.03 DRYER BOOSTER FAN

- A. Acceptable Manufacturers:
 1. Fantech.
 2. Other Manufacturers: Submit Substitution Request.
- B. General Description: Inline centrifugal, direct drive, statically and dynamically balanced backward inclined wheel, heavy gauge galvanized steel housing.
- C. Motor: Motorized impeller, external rotor type, Class B insulation, totally enclosed permanent split capacitor, and permanently sealed self-lubricating ball bearings, automatic reset thermal overload protection, rated for continuous duty.
- D. Switch: Positive pressure sensing switch shall be mounted on the fan and pre-wired to activate at 0.05-inch wg static pressure.
- E. Accessories: Gravity backdraft damper, status indicator panel.

2.04 ROOF VENTILATORS

- A. Acceptable Manufacturers:
 1. Greenheck, Carnes, Penn-Barry, Cook, Twin City.
 2. Other Manufacturers: Submit Substitution Request.
- B. Roll Formed: Heavy gauge galvanized steel, low silhouette, roll formed rib sections, exterior baked enamel finish with interior grey prime coat, provide with factory curb with bird screen and automatic motorized control damper as scheduled. Account for roof slope to provide level mounting service for equipment. Greenheck model FGI/FGR.
- C. Spun Aluminum: Heavy gauge windband with rolled bead. Curb cap constructed of heavy gauge aluminum with one piece spun venturi. Suitable for curb mounting, with bird screen and automatic motorized control damper as scheduled. Account for roof slope to provide level mounting service for equipment. Greenheck model GRSI/GRSR.

PART 3 EXECUTION

3.01 CENTRIFUGAL FANS

- A. Mount to outside wall as detailed.
- B. Lubricate bearings as recommended by the bearing manufacturer.
- C. Startup: After installation and before starting:
 1. Check fan isolation for freedom of motion.
 2. Perform pre-startup tasks as recommended by the manufacturer.

3.02 INLINE CENTRIFUGAL FAN

- A. Mount in ductwork using Vibration Isolation as specified in 23 0548, and as indicated on drawings.
- B. Connect ductwork using flexible connections.
- C. Arrange for unobstructed access to access door.

3.03 DRYER BOOSTER FAN

- A. Install backdraft damper at outside wall termination of dryer duct.
- B. Install fan no further than 40 feet from dryer. When fan is located closer than 15 from dryer provide a secondary lint trap upstream of fan.

3.04 ROOF VENTILATOR

- A. Mount roof vent on factory roof curb in accordance with the manufacturer's recommendations. Anchor roof vent to curb and curb to roof. Coordinate roof opening size and curb location.
- B. Make ductwork connections.

END OF SECTION

SECTION 23 3600
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Terminal Units.

1.03 QUALITY ASSURANCE

- A. Select units for sound levels, maximum pressure drops, and maximum inlet velocity as specified.

1.04 SUBMITTALS

- A. Submit the following:
 - 1. Catalog data, construction details, and performance characteristics for each type and size of terminal unit.
 - 2. Data showing compliance with discharge and radiated sound power level specified.
 - 3. Provide computer calculations for heating coils supplied with unit.
 - 4. Operating and maintenance data.

PART 2 PRODUCTS

2.01 SINGLE DUCT CONSTANT OR VARIABLE VOLUME TERMINAL UNITS

- A. Acceptable Manufacturers:
 - 1. Nailor
 - 2. Other Manufacturers: Submit substitution request.
- B. Description: Single duct, pressure independent, variable volume.
- C. Constructed of minimum 22 gauge galvanized steel. Construction to be leak proof with all joints sealed and all access doors gasketed. Leakage rate to be 15 cfm at 3-inch differential SP. Interior lined with coated dual density or matt faced insulation meeting NFPA 90A requirements with lining in accordance with UL 181.
- D. Volume Regulator Assembly (DDC Controls):
 - 1. Controller and actuator provided by Section 23 0900, Controls, field mounted in NEMA 1 enclosure.
 - 2. Provide averaging type velocity sensor utilizing multiple sensing points.
 - 3. Air valves all metal construction, non-corrosive, with bearings self-lubricating and moving parts replaceable in the field. Damper to be opposed blade type.
 - 4. Assembled unit tested, factory preset, and guaranteed to provide ± 5 percent total maximum air flow rate through an inlet pressure range to 3-inches water.
- E. Air static pressure drop across terminal unit not to exceed 0.15-inch wg without coil. Maximum inlet duct velocities shall not exceed 1600 fpm.

- F. Sound ratings shall be tested as power level 10-12W in accordance with ARI/ADC 880 standard and ASHRAE Standard 36B-72 at 1-/12-inch wg inlet static pressure. Unit discharge airborne and casing radiated sound not to exceed following rated sound power levels:

MAXIMUM AIRBORNE SOUND POWER (db)							
CFM	OCTAVE BAND AND CENTER FREQUENCY (HZ)						
	63	125	250	500	1K	2K	4K
0 - 300	--	63	64	60	60	60	52
301 – 400	68	65	65	63	60	60	52
401 – 800	71	68	67	67	60	60	52
801 – 1200	73	72	68	67	60	60	52
1201 – 2000	73	75	69	67	60	60	54
2001 and above	--	80	78	76	67	67	60

MAXIMUM RADIATED SOUND POWER (db)							
CFM	OCTAVE BAND AND CENTER FREQUENCY (HZ)						
	1	2	3	4	5	6	7
	63	125	250	500	1K	2K	4K
0-2000	71	68	61	61	55	55	50
2001 and above*							

PART 3 EXECUTION

3.01 INSTALLATION, TERMINAL UNITS

- A. Support terminal units from structure using thread rod and brackets provided. Provide vibration isolation as indicated on plans, and as specified. Make a rigid duct connection to the inlet with minimum length of straight duct upstream of unit as recommended by the manufacturer or as noted whichever is greater.
- B. Refer to Section 23 0700, Insulation for HVAC for duct lining requirements at outlet of terminal units. Maintain 3 feet clear in front of control enclosure.
- C. Arrange units for operation with control system. Coordinate with the work specified in Section 23 0900, Controls.
- D. Provide a minimum of 5-feet of ductwork prior to first outlet branch duct takeoff.
- E. Install terminal unit to allow for complete access to controls, and all items requiring maintenance or adjustment.
- F. Mount terminal unit controller, actuator to primary air valve, coil connections and control valve for remote duct-coil, and piping specialties on the same side of the terminal unit.

END OF SECTION

SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Ceiling diffusers, sidewall grilles.
- B. Related Sections include:
 - 1. Section 23 3300, Air Duct Accessories

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings: Showing dimensions and details of construction.
 - 2. Product Data.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Where only Titus figure numbers are listed, equivalent products by Carnes, Price, Krueger, Tuttle & Bailey, Anemostat, Nailor are acceptable.
- B. All such products shall be of one manufacturer.
- C. Other Manufacturers: Submit substitution Request.

2.02 PERFORMANCE

- A. Unit sizing is based on air being introduced at 20 degrees F temperature differential and being diffused at the 5-foot level to a velocity not greater than 50 fpm and a temperature differential not greater than 1.5°F. Units are also selected so as not to exceed the NC-30 curve.

2.03 DIFFUSERS AND GRILLES

- A. Ceiling Supply Diffuser (C-1): Modular diffuser with adjustable modular core, steel panel, square or rectangular neck size as indicated, discharge pattern as indicated, lay-in tee bar ceiling, or surface mounted as required (coordinate with architectural reflected ceiling plan), white baked enamel finish, Titus MCD.
- B. Ceiling Return/Exhaust Grille (C-2): 1/2-inch by 1/2-inch by 1/2-inch egg crate grille, neck size as indicated, aluminum construction, baked white enamel finish, lay-in tee bar ceiling, or surface mounted as required (coordinate with architectural reflected ceiling plan), Titus Model 50F
- C. Ceiling Supply Diffuser (C-3): Square ceiling diffuser, three cone, round neck size as indicated, 360 degree throw, steel construction, baked white enamel finish, Titus TMS.
- D. Slot Diffuser (S-1): Slot diffuser with quantity, length, and width of slots as scheduled, adjustable pattern controller, two pattern control blades per slot in lengths greater than 36-inches, inlet sizes as indicated, plenum lined with 1/2-inch insulation, unit furnished with center tee, baked enamel finish, color to match ceiling grid, Titus TBDI-10.
- E. Wall Supply Grille (H-1): Adjustable aluminum double deflection blades, horizontal front with vertical rear blades, 3/4-inch spacing, 1-1/4-inch border, gasketed around face flange, white baked enamel finish, Titus Model 272FL.
- F. Wall Return/Exhaust Grille (H-2): Aluminum 45 degree fixed single deflection, horizontal blades 3/4-inch spacing 1-1/4-inch border, gasketed around face flange, white baked enamel finish, Titus Model 3F.

- G. Wall Return/Exhaust Grille (L-1): Heavy duty bar grille, steel 38 degree fixed single deflection, horizontal 14 gauge blades, 1/2-inch spacing, 1-1/4-inch 16 gauge border, steel support bars spaced on 6-inch center. Provide intermediate mullions as required for large grilles. White baked acrylic finish, Titus 33RL or 33RS as required for blades to be parallel to floor.
- H. Drum Louver (H-3): Drum louver with 1-1/4-inch steel borders, (opposed blade dampers), counter sunk screw holes, extruded aluminum drum, rotatable 25 degrees up/down from centerline, individually adjustable blades, white baked enamel finish, Titus model DL.
- I. Duct-mount Supply Grille (H-4): Jet-type steel construction with adjustable jet (diameter as indicated on the plans), duct-mounted faceplate and aluminum enamel finish. Air Concepts Model ANC Air Nozzle, or equal.
- J. Duct Mounted Supply Grille (H-5): Aluminum orbital nozzle diffuser, 360 degree rotation, +/- 35 degree deflection, duct mounted faceplate. Air Concepts APL, Seiho PK, or equal.
- K. Wall Relief/Transfer Grille (H-6): Aluminum 0 degree fixed single deflection, horizontal blades 3/4-inch spacing 1-1/4-inch border, gasketed around face flange, white baked enamel finish, Titus Model 350ZFL.
- L. Door Transfer Grille (T-1): Steel door transfer grille, inverted V-siteproof, channelborder, white baked enamel finish, Titus Model T-700.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all diffusers tight to their respective mounting surfaces.
- B. Installed plumb and true with room dimensions and accurately centered on projections as shown on the Architectural reflected ceiling plans.
- C. Install extractors behind all duct mounted sidewall supply grilles, and where shown. Turning vanes allowable if condition is the last outlet on a branch.
- D. Set pattern control for directions of throw as shown on Drawings prior to air balancer arriving on Project.
- E. Paint ductwork behind all outlets flat black.

END OF SECTION

SECTION 23 4000
HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Air filter assemblies.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings: Details of construction and dimensional data.
 - 2. Product Data: Air filters, gauges, including performance data.
 - 3. Operation and maintenance data.

PART 2 PRODUCTS

2.01 MEDIUM EFFICIENCY PLEATED FILTERS

- A. Acceptable Manufacturers:
 - 1. Camfil-Farr 30-30, Cambridge, American Air Filter, Eco-Air Products, Flanders Precisionaire.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: 2-inch thick medium efficiency, pleated fabric media disposable type filter with support grid and enclosing frame. UL Class 2. Size as indicated on drawings.
- C. Rating: 25-30 percent MERV 7 efficiency rated on ASHRAE Standard 52.1-1992 and 52.2-1999 respectively.
- D. Performance: Filters shall be capable of maintaining rated efficiency at 500 fpm face velocity with initial pressure drop not to exceed 0.3-inch wg and final pressure drop at 0.9-inch wg.
- E. Frame: Provide complete factory assembled galvanized steel frame assembly suitable for filters, including all necessary hardware for supporting and holding filters in place with an air tight seal all around frame, side access on air handling units.

2.02 CARBON PLEATED FILTERS

- A. Acceptable Manufacturers:
 - 1. Flanders FCP, Camfill-Farr, American Air Filter, Eco-Air Products
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: 2-inch thick pleated activated carbon filled nonwoven polyester media sealed within a moisture resistant board frame. Carbon granules to be thermally bonded to the fibers.
- C. Rating: 30 by 50 US Mesh granules with carbon tetrachloride rating of 90 percent.
- D. Performance: Capable of removing toluene at an efficiency of 90 percent at inlet concentration of 10 ppm and a filter face velocity of 500 fpm.

2.03 FILTER GAUGE

- A. Acceptable Manufacturers:
 - 1. Dwyer No. 2002-ASF
 - 2. Other Manufacturers: Submit substitution request.

- B. Description: Magnehelic gauge with plastic vent valves, adjustable signal flag, external front screw for zero adjustment.
- C. Accessories: Pressure tap plugs, static pressure tips, tubing, mounting adapters with screws.
- D. Range: 0 to 2 inches wg, with 0.05-inch divisions.

2.04 EXTRUDED ALUMINUM FILTER FRAMING MODULE

- A. Acceptable Manufacturers:
 - 1. Eco-Air "K-Trac", Camfil-Farr, Cambridge.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: Factory design Type 6063-T6 mill finish extruded aluminum modules. Factory cut to length, pre-drilled and gasketed for quick field assembly. No clips or filter fasteners required.
- C. Filter Track: 2-inch wide pre-filter track with 1-1/4-inch wide final filter track in one extrusion. Permanently gasketed to eliminate air bypass. Spring loaded sealing lever shall actuate a pressure bar to positively seal final filter header in track.
- D. Performance: Capacities as shown on drawings.

2.05 SIDE ACCESS FILTER HOUSING

- A. Acceptable Manufacturers:
 - 1. Eco-Air Surepleat, Camfil-Farr, Cambridge, American Air Filter.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description: Factory assembled, 16 gauge galvanized steel construction. Z channel vertical support members on all four corners. Upstream and downstream outwardly turned flanges for connection to air handling unit.
- C. Filter Track: Extruded aluminum with a replaceable poly-pro gasket to insure sealing of filters to track. Filter track 2-inches wide.
- D. Access Doors: Provide on designated access side of housing with continuous neoprene gasketing. Equip with positive-pressure adjustable latches and easy grip knobs.
- E. Performance: Capacities as shown on drawings.

PART 3 EXECUTION

3.01 INSTALLATION, PLEATED FILTERS

- A. Arrange for access and removal of filter elements.
- B. Install filters in air handling unit filter racks, filter grilles and other locations shown on the plans.
- C. Air handling unit or fans shall not be operated without specified filters properly installed.

3.02 INSTALLATION, FILTER GAUGE

- A. Install filter gauge around each filter assembly with static pressure taps for entering and leaving side of filter.
- B. Fasten all tubing with metal fasteners.

3.03 PROTECTION

- A. Equipment Operation During Construction:
 - 1. Pleated Filters:
 - a. Install one set of filters in all air handling equipment for use during construction.
 - b. Furnish a spare set of filters for the Owner's use after initial flushout.
 - 2. Carbon Filters: Install carbon filters in each air handler before building occupancy.

END OF SECTION

SECTION 23 5100
BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Condensing Burner Breeching and Stack
- B. Related Sections include:
 - 1. Section 23 5200, Heating Boilers

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop drawings showing details of construction.
 - 2. Product data showing performance data.

PART 2 PRODUCTS

2.01 CONDENSING BURNER BREECHING AND STACK

- A. Acceptable Manufacturers:
 - 1. Heat-Fab, Saf T Vent Plus, ProTech Systems FasNSeal, Metal Fab, Schebler EVentSD.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Provide factory built modular connector, double wall, stack system.
- C. System to be Underwriters Laboratories approved for use with Category III and IV heating equipment which produce exhausted flue gases at temperature not exceeding 480 degrees F under continuous operating conditions when burning gaseous fuels. The stack system designed and installed to be gas tight to prevent leakage of combustion products. System designed to compensate for all flue gas induced thermal expansions.
- D. Stack system constructed of inner gas carrying pipe of type AL29-4C stainless steel and outer jacket of 430 stainless steel with a 1-inch air space between the walls.
- E. Inner pipe joints sealed by use of factory supplied V Bands and sealant as specified in manufacturer's installation instructions.
- F. Wall penetrations suitable for type of wall system used and according to manufacturer's detail drawings and installation instructions. Terminate through wall with downturned elbow as indicated.

PART 3 EXECUTION

3.01 APPLIED LOCATIONS

- A. Condensing Burner Breeching and Stack:
 - 1. Condensing Boilers.

3.02 INSTALLATION

- A. Install where shown on drawings and where specified in accordance with manufacturer's recommendations.
- B. Coordinate sealing of wall penetrations with work specified in Division 07.
- C. Maintain minimum clearances as required by code and by manufacturer.

- D. Support stack horizontally and vertically from structure.
- E. Provide adjustable length fittings to compensate for thermal expansion.
- F. Supports shall be braced to resist movement.
- G. Generally support stack at bottom and at changes in direction. Intermediate supports to allow for movement.
- H. Stack shall not be supported by the equipment.

END OF SECTION

SECTION 23 5200

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Gas fired condensing boiler units.
- B. Related Sections include:
 - 1. Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment
 - 2. Section 23 3101, HVAC Ducts and Casing – Low Pressure
 - 3. Section 23 5100, Breechings, Chimneys and Stacks

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop drawings showing details of construction.
 - 2. Product data showing performance data.
 - 3. Field Test Reports:
 - a. Provide copy of start-up report, including copies of combustion analyzer and efficiency printouts performed at low and high-fire during initial boiler start-up.
 - b. Provide copy of installation compliance report for ASME CSD-1.
- B. Operating and Maintenance Data.

1.04 TRAINING

- A. Provide on-site operation and maintenance training for two identical 4-hour sessions. Coordinate training times with the Owner.
- B. At the sessions include troubleshooting, repair and maintenance manuals for maintenance personnel. Coordinate quantity required with the Owner.

PART 2 PRODUCTS

2.01 NATURAL GAS FIRED CONDENSING BOILER UNIT (B-2)

- A. Acceptable Manufacturers: Lochinvar Crest Model FB
- B. Other Manufacturers: Submit Substitution Request.
- C. Furnish packaged condensing gas fired type hot water boiler complete, listed by CSA International under latest edition of ANSI Z21.13. Manufacture in accordance with appropriate ASME Heating Boiler Code, stamped for 160 psi water working pressure. Boiler shall be complete with modulating power burner, controls, insulated metal jacket, integral base supports and accessories. Furnish steel jacket with baked enamel finish and minimum of 2-inches medium density fiberglass insulation. Capacity as indicated on drawings.
- D. Heat Exchanger: 316L stainless steel, fire tube style; single pass, flow through.
- E. Combustion blower: Variable speed.
- F. Combustion chamber: Completely sealed and enclosed, independent of outer jacket assembly.
- G. Stainless steel burner shall be pre-mix design, capable of minimum (2,000 MBH unit 25:1) turndown of firing rate without loss of combustion efficiency. Boilers shall be capable of standalone operation in the event of a control system failure.

- H. Water boiler trim and accessories to include burner/flame observation port, low water cut off, drain valve, combination thermometer and pressure gauge, thermistor supply and return water temperature sensor (pre-installed), system supply header temperature sensor (furnish for field installation), flue temperature sensor, , ASME rated safety relief valve(s), drain tapping and condensate drains.
- I. Gas Train: UL/FM or CSA approved, safety shut-off valve, air/fuel valve, gas pressure regulator (2 psi is available at the gas train), and nozzle-mix stainless steel burner. Furnish flame monitoring system, and CSD-1 gas manifold control package.

2.02 CONTROLS

- A. Provide 24 volt operating controls and safety devices for automatic operation. Controls to include operating controller, touch-screen display, manual reset high temperature limit, electronic flame safeguard control, control circuit transformer, manual reset low water cutoff, and blower motor starter on forced draft units, hi/low gas pressure switch, master switch, airflow switch, water flow switch. Unit shall be factory prewired and include operating indicating light, and alarm bell, single point electrical connection in NEMA 1 enclosure. Electrical characteristics as indicated. Provide all necessary field wiring for a complete system. Microprocessor flame safeguard programmer with first-out fault annunciation and diagnostic indicator lights. Provide alarm dry contact for interface to building DDC control system. Boiler shall allow 0-10VDC input connection to DDC system. Provide BACnet card for communications.
- B. Multiple Boiler Sequencing Control Panel: Provide as part of the packaged boiler control system, a microprocessor based lead-lag sequencing system. The control shall be pre-engineered and programmed exclusively for the operation of multiple hot water full modulation boilers. The controls shall permit interface with building DDC control system. Control system shall be in U.L. listed panel.
- C. Multiple Boiler Sequence of Operation: Upon call for heating, start the primary boiler at low fire and modulate capacity to meet setpoint temperature. When the primary boiler is above its low firing capacity for 10 minutes (adjustable), the secondary boiler shall be started and both boilers shall operate in unison at the same firing capacity. As the heating load diminishes and the boilers reduce their firing rate to low fire for 10 minutes (adjustable), the sequence above is reversed with the primary boiler stopping first. Provide adjustable time delays between boiler sequencing. Alternate the primary boiler weekly to equalize run time.

2.03 DUAL-FUEL BOILER (PROPANE AND NATURAL GAS) (B-1)

- A. Boilers scheduled as dual-fuel shall be by the same manufacturer as single-fuel boiler.
- B. Boiler scheduled as dual-fuel shall be furnished capable of manual switchover from one fuel to the other without requirement of adjustment to burner, blower, or related equipment.
- C. Boiler shall have separate propane and natural gas piping connections, with independent shut off valves.
- D. Boiler control panel shall be utilized, with suitable password, to make the switchover.
- E. Boiler control panel shall include visual indicator of fuel selection.
- F. Dual fuel boiler shall be set up as the Master boiler.

2.04 AUTOMATIC SHUT OFF VALVE

- A. Manufacturer's 2-way motorized shut off valve and relay kit for each boiler
- B. Size: To match boiler connections.
- C. Ship valve loose, for field installation.

2.05 VENTING

- A. Boilers to be capable of being vented into a conventional stack or "through the wall".
- B. Vent shall be sized in accordance with manufacturer's installation recommendations.
- C. Refer to Section 23 5100, Breechings, Chimneys, and Stacks for venting material requirements.

2.06 COMBUSTION AIR

- A. Boilers to receive combustion air by direct venting.
- B. Refer to Section 23 3101, HVAC Ducts and Casing-Low Pressure for combustion air ducting material requirements.

2.07 EMISSIONS

- A. Boiler emissions must be within those allowed by the DEQ.

2.08 CONDENSATE MANAGEMENT SYSTEM

- A. Provide neutralizer kit to assure any condensate discharge is controlled to a pH range of 6.5-7 before discharge into the drainage system. Use materials approved by the authority having jurisdiction. Provide Owner with a one year supply of condensate neutralizer (reagent grade calcium carbonate). Based on: JJM Boiler Works JM Series.

2.09 WARRANTIES

- A. Provide 10 year warranty on heat exchanger and burner to include full replacement covering all parts and labor. Burner to be warranted against burner clog or burn out.
- B. Provide 1 year on all parts.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's instructions for installation.
- B. Boiler: Install in accord with manufacturer's recommendation to provide adequate clearance and accessibility. Mount on 6-inch concrete housekeeping pad. Pad size per boiler manufacturer's instructions and as indicated. Install necessary drains and safety valve, as required for a complete installation.
- C. Pipe valved drain from boiler to nearest floor sink.
- D. Pipe hot water boiler relief valve outlet to floor.
- E. Install feed water regulating valve with required piping, valves, strainer, check valve, manual bypass valve as indicated.
- F. Drawings indicate a location of boiler flue based on assumption. If boilers supplied have different flue gas location, contractor shall redesign and relocate stack at no additional cost.
- G. While Owner is responsible for all DDC controls and wiring, piping contractor shall provide raceway and cascade communication wiring between boilers, and from boilers to common supply header temperature sensor and automatic shutoff valves.

3.02 START-UP

- A. General: Comply with manufacturer's instructions for start-up.
- B. Start-up shall be provided under the direct supervision of the manufacturer's representative.
- C. At completion of start-up submit written record of startup performance including percent CO₂, CO, and O₂, stack temperature, and combustion efficiency.
- D. Manufacturer representative shall demonstrate operation of all controls, interlocking, and flame safeguard.

3.03 CLEANING

- A. After installation and before start-up thoroughly clean boilers of scale, grease, etc. and boil out in manner and for duration as recommended by manufacturer.

3.04 INSPECTION

- A. Subject boiler to hydrostatic pressure test in presence of authority having jurisdiction. Tests shall conform to ASME Boiler Code and other applicable codes.

END OF SECTION

**SECTION 23 6400
PACKAGED WATER CHILLERS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Air-cooled water chiller.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings showing complete details of construction.
 - 2. Catalog data showing performance data.
 - 3. Part load operating characteristics and application part load value calculation (APLV) per ARI Standard 550-88.
 - 4. Operating and maintenance data.

PART 2 PRODUCTS

2.01 AIR COOLED WATER CHILLER

- A. Acceptable Manufacturers:
 - 1. Daikin Applied, JCI, Carrier, Trane
 - 2. Other Manufacturers: Submit substitution request.

2.02 UNIT DESCRIPTION

- A. Factory-assembled, factory-charged air-cooled scroll compressor packaged chiller consisting of hermetic tandem or triple scroll compressor sets, direct expansion, brazed plate evaporator air-cooled condenser section, microprocessor-based control system and all components necessary for controlled unit operation.
- B. Factory run-test with water to verify full-load operation. Operating controls and refrigerant charge shall be verified for proper operation and optimum performance. Any deviation shall be remedied prior to shipment and the unit retested if necessary to confirm repairs or adjustments.

2.03 DESIGN REQUIREMENTS

- A. Performance: As scheduled. The chiller shall be capable of stable operation to a minimum percentage of full load (without hot gas bypass) of 25 percent for units 130 tons and less and 17 percent for units over 130 tons. Performance shall be in accordance with AHRI Standard 550/590.

2.04 CHILLER COMPONENTS

- A. Compressor: Sealed hermetic, scroll type with crankcase oil heater and suction strainer. Motor shall be refrigerant gas cooled, high torque, hermetic induction type, two-pole, with inherent thermal protection on all three phases and shall be mounted on RIS vibration isolator pads. The compressors shall be equipped with an internal module providing compressor protection and communication capability.
- B. Evaporator
 - 1. Type: Compact, high efficiency, dual circuit, brazed plate-to-plate type heat exchanger consisting of parallel stainless steel plates.

2. Freeze Protection: Electric resistance immersion heater, insulated with 3/4-inch thick sheet insulation protecting against water freeze-up at ambient air temperatures to -20 degrees F. A fluid thermostat shall control the heater.
3. Certification: Water side working pressure shall be minimum 653 psig. Vent and drain connections shall be provided in the inlet and outlet chilled water piping by the installing contractor. Evaporators shall be designed and constructed according to, and listed by, Underwriters Laboratories (UL).

C. Condenser

1. Coils: All aluminum alloy microchannel design with series of flat tubes containing multiple, parallel flow microchannels layered between refrigerant manifolds.
2. Fans: Single piece, composite, propeller type arranged for vertical air discharge and individually driven by direct drive fan motors. Each fan shall be in its own compartment to eliminate cross flow of condenser air during fan cycling and shall be equipped with a heavy-gauge vinyl coated fan guard.
3. Motors: Weather protected, three-phase, direct-drive, 1140 rpm, TEAO type with permanently lubricated ball bearings and inherent overload protection. External coil surfaces shall have wire mesh protective guards.
4. Fins: Rippled aluminum.

D. Refrigerant Circuit: Each refrigerant circuit shall include a replaceable-core refrigerant filter-drier, sight glass with moisture indicator, liquid line solenoid valve (no exceptions), thermal expansion valve, and insulated suction line.

E. Construction

1. Unit casing and all structural members and rails: Fabricated of steel and painted to meet ASTM B117, 500-hour salt spray test.
2. Upper condenser coil section of unit: Protective, 12 ga, PVC-coated, wire grille guards.

F. Control System

1. Control Panel: Centrally located weatherproof control panel shall contain the field power connection points, control interlock terminals, and control system. Power and starting components shall include factory circuit breaker of fan motors and control circuit, individual contactors for each fan motor, solid-state compressor three-phase motor overload protection, inherent fan motor overload protection and two power blocks (one per circuit) for connection to remote, contractor supplied disconnect switches. Hinged access doors shall be lockable. Barrier panels or separate enclosures are required to protect against accidental contact with line voltage when accessing the control system.
2. Connection: Single-point connection to a non-fused disconnect switch with through-the-door handle and compressor circuit breakers.

G. Unit Controller: DDC microprocessor unit controller with minimum 4-line by 20-character liquid crystal display. The controller shall take pre-emptive limiting action in case of high discharge pressure or low evaporator pressure.

1. Equipment Protection:
 - a. By alarms that shut the unit down and require manual reset to restore unit operation and
 - b. By limit alarms that reduce unit operation in response to some out-of-limit condition. Shut down alarms shall activate an alarm signal.
2. Shutdown Alarms
 - a. No Evaporator Water Flow - Auto-Restart
 - b. Sensor Failures
 - c. Low Evaporator Pressure

- d. Evaporator Freeze Protection
 - e. High Condenser Pressure
 - f. Outside Ambient Temperature - Auto-Restart
 - g. Motor Protection System
 - h. Phase Voltage Protection - Optional
3. Limit Alarms
 - a. Condenser pressure stage down, unloads unit at high discharge pressures.
 - b. Low ambient lockout, shuts off unit at low ambient temperatures.
 - c. Low evaporator pressure hold, holds stage 1 until pressure rises.
 - d. Low evaporator pressure unload, shuts off one compressor.
 4. Unit Enable Selection
 - a. Enables unit operation from either local keypad, digital input, or BAS
 5. Analog Inputs:
 - a. Reset of leaving water temperature, 4-20 mA
 - b. Current Limit
 6. Digital Inputs
 - a. Unit Off Switch
 - b. Remote Start/Stop
 - c. Flow Switch
 - d. Motor Protection
 7. Digital Outputs
 - a. Shutdown alarm; field wired, activates on an alarm condition, off when alarm is cleared
 8. Condenser fan control - The unit controller shall provide control of condenser fans based on compressor discharge pressure.
 9. Building Automation System (BAS) Interface
 - a. Factory mounted DDC controller(s) shall support operation on a BAC network via BACnet MS/TP master (Clause 9), BACnet IP, (Annex J), or BACnet ISO 8802-3, (Ethernet).
 - b. The information communicated between the BAS and the factory mounted unit controllers shall include the reading and writing of data to allow unit monitoring, control and alarm notification as specified in the unit sequence of operation and the unit points list.
 - c. All communication from the chiller unit controller as specified in the points list shall be via standard BACnet objects. Proprietary BACnet objects shall not be allowed. BACnet communications shall conform to the BACnet protocol (ANSI/ASHRAE135-2001). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided along with the unit submittal.

2.05 OPTIONS AND ACCESSORIES

- A. The following options are to be included:
 1. BAS interface module to provide interface with the BACnet/IP protocol.
 2. Evaporator inlet strainer, 40-mesh with extension pipe and Victaulic couplings.
 3. Separate 120V connection to factory-installed freeze prevention heaters.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Comply with manufacturer's instructions for installation.
- B. Pipe Connections: Arrange connections to chiller to prevent pipe weight or stresses from being transferred to chiller and to provide easy access for tube cleaning.
- C. Water Treatment: Treat chilled and condenser water system as specified.
- D. Strainer: Install manufacturer-supplied strainer in chilled water return line at evaporator inlet; 40-mesh on units with brazed-plate evaporators or 20-mesh on shell-and-tube evaporators.

3.02 START UP

- A. General: Comply with manufacturer's instructions for startup.
- B. Startup shall be provided under the direct supervision of the manufacturer's representative with factory trained personnel.
- C. Provide four hours of training to school district personnel.

3.03 FIELD QUALITY CONTROL

- A. Prior to installation, manufacturer's representative shall coordinate chiller control interface and verify that intended installation complies with the manufacturer's recommendations.
- B. Field Test: Except where initial chiller operation clearly shows the performance meets or exceeds the requirements, test to show compliance. Tests performed by the manufacturer's representative in the presence of the Engineer.

END OF SECTION

**SECTION 23 7000
CENTRAL HVAC EQUIPMENT**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Air handling units.
- B. Related Sections include:
 - 1. Section 23 0514, Variable Frequency Drives for HVAC Systems
 - 2. Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment: For vibration isolators
 - 3. Section 23 0700, Insulation for HVAC: For acoustical liner.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop Drawings showing details of construction, dimensions, arrangement of components, and isolation.
 - 2. Product data showing performance data.
 - 3. Operating and Maintenance Data
 - 4. Specified testing requirements.

PART 2 PRODUCTS

2.01 MODULAR INDOOR AIR HANDLING UNITS

- A. Acceptable Manufacturers:
 - 1. Aeon M2, Trane Climatechanger, Daikin-McQuay Vision, York Solution, BasX.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Description:
 - 1. Variable volume, single zone draw-through modular air handling units consisting of plenum fan section, coil section, filter section, motor and drive, and mixing box, all contained in an insulated steel casing and mounted on a common steel base. Arrange components as specified hereafter and as shown on the Drawings.
 - 2. Air Moving and Conditioning Association rated.
- C. Unit Casing:
 - 1. Casing of 16 gauge steel, properly reinforced and braced and of sectionalized construction. Support entire unit on minimum 10-inch high continuous steel support.
 - 2. Provide access doors for inspection of fan and motor.
 - 3. Manufacturer's standard factory finish.
 - 4. Insulation of entire cabinet shall be 2-inch thick minimum, R-8 minimum. Insulation shall be 3 pounds/cubic feet faced rigid fiberglass insulation or polyurethane foam.
 - 5. Drain pan under cooling coils with 1/2-inch cellular, foam-in place insulation.
 - 6. Arranged with motor and drive inside fan casing; isolated fan and motor assembly within unit casing.

D. Fans:

1. Fan type and capacity as indicated on the drawings.
2. Statically and dynamically balanced in its own bearings with a maximum full amplitude shaft deflection at bearings not to exceed 0.001 inch at 1200 rpm.
3. Grease lubricated, self-aligning, interior mounted pillow block or flanged bearings permanently sealed.
4. Provide spherical roller bearings on units of 25 hp and larger, 80,000 hour L-10 life per AFBMA Standards.

E. Motor and Drive:

1. Integrally mounted 1800 rpm motor, with pre-lubricated sealed ball bearings.
2. Direct drive.
3. Refer to Section 23 0500, Common Work Results for HVAC for energy efficient motor requirements.

F. Vibration Isolators:

1. Provide as an integral part of each unit. Refer Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment.
2. Coordinated weights and location of support points with the vibration isolation equipment supplier.

G. Water Coils: See Schedule for capacities and Section 23 8200, Convection Heating and Cooling Units for specification.

1. Provide drain pan for each level of cooling coils. Drain pans constructed from stainless steel or galvanized steel coated with asphalt or approved rust inhibitor.
2. Drain Pan: Double sloped, in direction of air flow and toward drain connection.
3. Coils: Maximum 10 fins per inch.

H. Filters: Refer to Section 23 4000, HVAC Air Cleaning Devices for specification. Provide suitable access doors, slide rack, and sealant strips for filters specified. Additional pleated and carbon filters shall be furnished loose, as described in Section 23 4000, HVAC Air Cleaning Devices

I. Flexible Connections:

1. Constructed in accordance with UL 181, Class I air duct with flanged connections.
2. Flexible, neoprene-coated glass fabric not lighter than 30 ounces/sq.yd.
3. "Ventglas" by Vent-Fabrics, Inc.

J. Mixing Boxes:

1. General: Provide multi-blade dampers as shown on Drawings and as required to provide economizer cooling and morning cool-down functions.
2. Provide minimum outside air with slotted damper crank arm adjusted so that damper is closed with the motor shaft retracted and at the minimum flow position with the motor shaft fully extended.
3. Arrange return air and minimum outside air dampers to discharge against each other for maximum mixing in the mixing box prior to the coil.
4. Provide coordinated spring-return damper actuators, Belimo low-voltage.

K. Sound Requirements:

1. The manufacturer shall furnish sound power levels at the supply air connection and return air connection for each air handling unit.

2. Sound power level (re: 10-12W) when producing scheduled airflow (CFM) at scheduled static pressure shall not exceed following in any octave band:

Octave Band Center Frequency (HZ)								
	63	125	250	500	1000	2000	4000	8000
Supply Air	91	92	96	97	94	91	86	78
Return Air	87	89	89	88	87	84	80	74

2.02 SMALL INDOOR AIR HANDLERS

A. Acceptable Manufacturers:

1. Aeon H3, BasX, Thermal Corp.
2. Other Manufacturers: Submit Substitution Request.

B. General Description

1. Include filters, supply fans, chilled water coil, mixing box, and unit controls.
2. Draw-through supply fan configuration and discharge air horizontally or vertically as indicated on drawings.
3. Factory assemble and test including leak testing of the chilled water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.

C. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 6.25. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610 degrees F.
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
4. Design unit to reduce air leakage and infiltration through the cabinet. Include sealing between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels include sealing to reduce air leakage.
5. Access to filters, cooling coil, supply fans, and electrical and controls components shall be through hinged access doors.
6. Access Doors:
 - a. Flush mounted to cabinetry.
 - b. Coil access door and supply fan access door shall include quarter-turn lockable handles.
 - c. Supply fan access door includes removable pin hinges.
7. Units with a cooling coil shall include sloped 304 stainless steel drain pan. Drain pan connection shall be on the side of unit.
8. Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.

D. Electrical

1. Provide unit with an internal control panel adjacent to blower compartment to accept low voltage and power. Adequate space shall be provided for the DDC controller to be field installed in the panel. Controller dimensions are 6-inch by 6-inch.
2. Provide with standard power block for connecting power to the unit.
3. Factory install 24V control circuit transformer, minimum 100 VA.

E. Supply Fans

1. Direct drive, unhooded, backward curved, plenum supply fan.
2. Blower and motor assembly shall be dynamically balanced.
3. Blower and motor assembly shall be isolated with neoprene gasket.
4. High efficiency electronically commutated motor (ECM).

F. Cooling Coil

1. Chilled Water Cooling Coil
 - a. Certified in accordance with AHRI Standard 410 and be hydrogen or helium leak tested.
 - b. Constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
 - c. Right hand external piping connections. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing, to minimize air leakage.
 - d. Maximum of 10 fins per inch.

G. Filters

1. Refer to Section 23 4000, HVAC Air Cleaning Devices. Additional pleated and carbon filters shall be furnished loose, as described in Section 23 4000, HVAC Air Cleaning Devices.
2. Unit includes a clogged filter switch.
3. Include factory installed Magnehelic gauge measuring the pressure drop across the filter rack.

H. Mixing Box

1. Unit shall contain a mixing box with top opening and front opening, which may be used for either outside air or return air.
2. Return air opening shall contain an adjustable, motor operated return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator. Actuator to be Belimo, low voltage.
3. Outside air opening shall contain an adjustable, motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven. Dampers shall be fixed position controlled by a fully modulating actuator. Actuator to be Belimo, low voltage.
4. Dampers on air handlers less than 2000 cfm only require a spring return actuator on the outside air damper. Return air damper may be either spring return or non-spring. Units larger than 2000 cfm require coordinated spring return actuators on all mixed air dampers.

2.03 DRAIN PAN LEVEL MONITOR

A. General: Water level monitoring device installed in cooling coil drain pan, to shut off fan if condensate drain line becomes blocked.

B. Components:

1. Low voltage solid state sensor.
2. Plenum rated probe and sensor wire
3. Spare wire for alarm or connection to DDC system.

C. Compliance with IMC 307.2.3.1

D. Manufacturer: Rectorseal Aquaguard

PART 3 EXECUTION

3.01 INSTALLATION

A. Indoor Air Handling Unit:

1. Install with air filters in place before operating unit.
2. Modular air handlers shall mount on steel base which is integral with unit.
3. Pipe drain pan to as indicated with 3-inch minimum trap seal.
4. Small air handlers shall be mounted to a minimum of two six inch high 12 gauge sheet metal sleepers that are themselves secured to floor.

B. Flexible Connections:

1. Provide flexible connections between fans and the connected ducts or plenums.
2. Install with 1-inch space between the fan and connecting duct with fabric snug but not stretched tightly.
3. Provide accurate alignment between fan and duct.
4. Secure in place with flanged connections. Do not crimp into the duct construction. Ends of the screws shall not project into the duct more than 1/8-inch.

C. Drain Pan Level Monitor

1. Install per manufacturer's instructions in each indoor air handler located on mechanical platforms.
2. Shut down unit down directly after a suitable time delay upon detecting blockage.

END OF SECTION

**SECTION 23 8100
DECENTRALIZED UNITARY HVAC EQUIPMENT**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Split-system air conditioning unit.
- B. Related Sections include:
 - 1. Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Shop drawings showing details of construction, dimensions, arrangement of components, isolation, filters, etc.
 - 2. Product data showing performance data, standard items, and accessories, operating weight.
 - 3. Operating and maintenance data.

PART 2 PRODUCTS

2.01 SPLIT-SYSTEM AIR CONDITIONING UNIT

- A. Acceptable Manufacturers:
 - 1. Carrier, Trane, Lennox, Daikin, JCI.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Indoor Unit:
 - 1. Description: Furnish complete unit including cabinet, wall mounting kit and accessories, refrigerant line set, fan and motor assembly, cooling coil and filter. Unit as scheduled on drawing, factory-tested and assembled, factory wired, refrigerant-to-air heat exchanger, fan/motor assembly, compressor, controls and safety devices, control circuit transformer, shipped in one piece with ARI certification and UL listing.
 - 2. Cabinet: 18 gauge steel, removable panels for access to components. Drain connection and air filter racks.
 - 3. Fan and Motor:
 - a. Assembly with a turbo fan direct driven by a single motor.
 - b. Statically and dynamically balanced and run on a motor with permanently lubricated bearings.
 - c. Consist of two speeds, High and Low.
 - 4. Mixing box: Provide manufacturer's standard economizer section with return air and outside air dampers. Outside air dampers to be low-leak per Oregon Energy Code. Actuators will be provided by Owner.
 - 5. Controls:
 - a. Wiring runs direct from the indoor unit to the controller with no splices.
 - b. Capable of automatic restart when power is restored after power interruption

6. Condensate Pump: Provide condensate pump when required; pipe drain to floor drain.
- C. Outdoor Unit:
 1. Description:
 - a. Provide air cooled air conditioner (outdoor unit) designed for outdoor installation with factory supplied supports, properly assembled and tested at the factory.
 - b. Completely weatherproofed and include compressor, condenser coils, condensing fans, motor, refrigerant reservoir, charging valve, all controls, and a holding charge of R410A.
 - c. Provide guards on condenser fans and coil guard.
 2. Compressors:
 - a. Furnish hermetically sealed type with isolation and sound muffling.
 - b. Overload and inherent winding thermostat protection to prevent burn out.
 - c. Provided crankcase heater.
 - d. Two-stage compressors.
 3. Refrigeration Circuits:
 - a. Include back seating service valve and gauge ports in liquid and suction lines.
 - b. Provide refrigerant filter-dryer.
 4. Condenser Fans and Motors: Direct driven propeller type fans with permanently lubricated motors.
 5. Controls:
 - a. Provide high and low pressure cutouts, contractors and internal overload protection on all motors.
 - b. Provide low ambient operation to 20 degrees F outside to maintain condensing temperature on part load operation.
 - c. Provide short cycle timer.
- D. Controls Interface: DDC system will interface with indoor/outdoor units through thermostat terminals.
- E. Electrical: Furnish all starters, contactors and disconnects. Arrange for single point electrical connections.

PART 3 EXECUTION

3.01 SPLIT-SYSTEM AIR CONDITIONING UNIT

- A. Installation:
 1. Install in location shown on the Drawings. Level unit and secure to structure.
 2. Make piping connections and unit installation per manufacturer's recommendations and installation guides.
 3. Size and run refrigerant piping between fan coil unit(s) and air-cooled condensing unit(s) per manufacturer's recommendations. Provide traps and double suction and/or discharge risers if recommended by the manufacturer.
 4. Insulate refrigerant piping as specified in Section 23 0700, Insulation for HVAC.
 5. Pipe condensate pan to floor drain per manufacturers installation guide.
 6. Make refrigerant piping connections, install refrigeration accessories, and charge system. Provide additional refrigerant as required for proper operation at design capacities.
- B. Start-up:
 1. General: Comply with manufacturer's instructions.
 2. Install filters before operating unit.

3. Insure proper refrigerant and air flow before operating unit compressor.
- C. Provide interconnecting power and control wiring, routed in conduit from the outdoor unit to the indoor unit, and control panel thermostat. Where unit provided requires separate power connections to the indoor and outdoor units, provide at no additional cost. This shall include branch circuit conduit, wiring, circuit breaker, terminations, etc. as required for complete system. Branch circuit serving indoor unit shall originate in same panelboard serving outdoor unit.
- D. Testing and Adjusting/Performance Test: Except where initial unit operation clearly shows the performance meets or exceeds the requirements, test to show compliance.

END OF SECTION

SECTION 23 8200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Heating/Cooling Coils, Water
 - 2. Cabinet Unit Heaters

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Catalog data showing dimensions and performance.
 - 2. Computer calculations for coil performance.
 - 3. Operation and Maintenance Data: Cabinet unit heaters.

PART 2 PRODUCTS

2.01 HEATING/COOLING COILS, WATER

- A. Acceptable Manufacturers:
 - 1. Aeon, USA Coil, Trane, Daikin-McQuay, JCI-York, Heatcraft, Greenheck, CES Group.
 - 2. Other Manufacturers: Submit substitution request.
- B. Description:
 - 1. Coils of nonferrous extended surface construction with continuous 16 gauge galvanized steel casing for installation in air supply unit or ductwork as shown on Drawings.
 - 2. Primary surface of seamless copper tubing rolled into headers with copper bushings or brazed into nonferrous headers.
 - 3. Nonferrous fins, mechanically bonded to tubes, with fin spacing of 10 fins per inch maximum.
 - 4. Coils tested at 300 psi hydrostatic pressure, guaranteed for 250 psi working pressure.
 - 5. Arranged for serpentine flow in continuous circuits with counterflow between air and water without turbulating means; provide air vents at each coil.
 - 6. Supply and return connections on same side, with supply on bottom, downstream of air flow.
 - 7. 0.008-inch minimum fin thickness; 0.024-inch minimum tube wall thickness; 0.035-inch straight stock for U-turns.
 - 8. Capacity certified in accordance with ARI Standard 410-72. Face velocity not to exceed 500 fpm at specified air flow, or as scheduled.

2.02 CABINET UNIT HEATERS

- A. Acceptable Manufacturers:
 - 1. JCI, Trane, Carrier, Daikin, Ted Reed, Air Therm, Dunham Bush.
 - 2. Other Manufacturers: Submit substitution request.
- B. Description: Provide cabinet unit heaters complete with heating elements, enclosures, fans, motors, and air filters. Capacity as indicated.

- C. Cabinet: Enclosure shall have 16 gauge front panels, insulated with 1-inch fiberglass, horizontal with rear or bottom return duct connection, tamper proof access doors, removable front panel. Unit shall be ceiling-mounted, recessed. Enclosure baked enamel finish color as selected by Architect. Recessed or semi-recessed units shall have four side overlap.
- D. Fans and Motor: Steel construction designed for minimum noise levels, direct drive type, EC motor, fan controls.
- E. Filters: Throwaway type, 1-inch thick fiberglass.
- F. Water Coils: 3/4-inch OD seamless copper tubes, aluminum fins, and end supports, ten fins per inch maximum. Provide shutoff valves on water lines, and unions for a complete system. Coil and heater construction shall be for 250 psi working pressure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Heating/cooling Coils: Installed in air handling units as standard with manufacturer or in ductwork as shown.
- B. Damaged Coils: Make every effort to prevent damage to both built-up coils and coils of packaged equipment. Comb damaged coil fins to be straight.
- C. Cabinet Unit Heaters:
 - 1. Install per manufacturer's instructions.
 - 2. Provide valves and specialties as detailed on Drawings.
 - 3. Refer to Drawings and Section 23 0548, Vibration and Seismic Controls for HVAC Piping and Equipment, for vibration isolation and seismic bracing requirements.

END OF SECTION

SECTION 23 8410
ELECTRIC HEATING EQUIPMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 23 0500, Common Work Results for HVAC, apply to work specified in this Section.

1.02 SUMMARY

- A. This Section includes: Electric heat trace cable.

1.03 SUBMITTALS

- A. Submit the following:
 - 1. Product Data: Showing performance data, ratings, electrical data, wiring diagrams, fusing quantity and types.
 - 2. Operating and maintenance data.

PART 2 PRODUCTS

2.01 HEAT TRACE CABLE

- A. Acceptable Manufacturers:
 - 1. Chromalox, Raychem, Nelson.
 - 2. Other Manufacturers: Submit Substitution Request.
- B. Cable: Self-regulating flat, flexible, low-heat density, parallel electric heater strip consisting of two stranded circuit conductors enclosed in a semi-conductive, polymer core insulated with a plastic jacket protected with a tinned-copper braid. Cable shall have capability of being overlapped without creating hot spots and shall be suitable for application on plastic, copper or steel pipe. Raychem XL-Trace, Chromalox SRF or approved equal.
- C. Voltage: Cable shall operate on single phase line voltage of 208 VAC without transformation. Provide power connections, end seals, splices tap-offs and tees as furnished by the manufacturer.
- D. Controls: System control for freeze protection shall include a thermostat with fixed setpoint of 40°F. Thermostat shall have a nickel-plated copper bulb at end of 36-inch capillary and shall be enclosed in a NEMA 4 enclosure. Raychem AMC-F5, Chromalox PIT or approved.

PART 3 EXECUTION

3.01 HEAT TRACE CABLE

- A. Location: Provide heat trace on all piping in unheated spaces as shown or required to prevent freezing.
- B. Install heat trace cable on pipes indicated to maintain a minimum of 35 degrees F in ambient temperature of 0 degrees F. Lay cable parallel on pipe or spiral wrap to maintain adequate temperature as required by pipe size and thermal properties of the pipe insulation to be applied.
- C. Attach heat trace cable to pipe with polyester tape at increments not exceeding 1-foot.
- D. Install thermostat capillary and bulb to pipe with polyester tape assuring a firm bulb contact with pipe. Do not contact bulb with heat cable.
- E. Install thermostat at accessible location adjacent to pipe with a minimum of exposed capillary. Tape capillary to pipe run under insulation to bulb.

- F. The installer shall be responsible for affixing an Electric Traced label to the outside of the pipe's thermal insulation on alternating sides at intervals of five to fifteen feet immediately after the piping has been insulated.
- G. Coordinate installation with work under Division 26 for adequate electrical service to each thermostat.

END OF SECTION

SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of This Section, Common Work Results for Electrical, apply to all sections in Division 26.
- C. All Sections of Division 26, ELECTRICAL, are interrelated. When interpreting any direction, material, and method specified in any section of Division 26, consider it within the entirety of Work in Division 26.

1.02 SUMMARY

- A. The intent of Division 26 Specifications and Drawings is to provide a complete and workable facility, with complete systems as required by applicable codes, as indicated, and as specified.
- B. Include all work specified in Division 26 and indicated on Drawings, including appurtenances, connections, fasteners, and accessories required to make a complete working system, whether indicated or not indicated.
- C. The Division 26 Specifications and the accompanying Drawings are complementary, and what is called for by one shall be as binding as if called for by both.
 - 1. Items shown on the Drawings are not necessarily included in the Specifications and vice versa.
 - 2. In case of conflict, Specifications supersede Drawings.
- D. Imperative language used in Division 26 Sections addresses the Contractor, as specified in Division 01 Section, Summary.

1.03 REFERENCES

- A. The latest adopted revisions of the publications listed below apply to these Specifications as referenced:
 - 1. OSSC Oregon Structural Specialty Code
 - 2. NEC National Electrical Code
 - 3. NFPA National Fire Protection Association
 - 4. NEMA National Electrical Manufacturers Association
 - 5. NECA National Electrical Contractors Association
 - 6. ANSI American National Standards Institute
 - 7. IEEE Institute of Electrical and Electronic Engineers
 - 8. UL Underwriters Laboratories
 - 9. The publications are referred to in the text by acronym or initials in parentheses above.

1.04 SYSTEM DESCRIPTION

- A. Ground Systems:
 - 1. Provide complete ground systems indicated.
 - 2. Include conduit system, transformer housings, switchboard frame, and neutral bus, motors, and miscellaneous grounds required by Contract Documents and by applicable codes.
- B. System Identification:
 - 1. Clearly identify all elements of the Project electrical system to indicate the loads served, or the function of each item of equipment, connected under this work.
 - 2. Comply with requirements of Division 26 and with applicable codes.

C. Drawings:

1. The Drawings are diagrammatic: they do not show every offset, bend, tee, or elbow which may be required to install work in the space provided and avoid conflicts with other construction.
 - a. Prior to installing work, take field dimensions, and note conditions available for, installation.
 - b. Follow the Drawings as closely as practical to do so, and install additional bends, offsets, and elbows where required by installation conditions.
 - 1) Additional offsets, bends, and other connectors are subject to approval by Project Engineer.
 - 2) Install additional offsets, bends, and other connectors without additional cost to Owner.
 - c. The right to make any reasonable changes in outlet location prior to roughing in is reserved to the Owner's Representative.
2. Luminaire Designations:
 - a. Lower case letters adjacent to devices or luminaires indicate switching arrangement or circuit grouping.
 - b. Numbers adjacent to devices indicate circuit connection.
3. Circuits and Switching:
 - a. Do not change branch circuiting and switching indicated; nor combine homeruns, without Engineer's prior approval.
 - b. Do not combine or change feeder runs.
4. Circuit Conductors:
 - a. Cross or hash marks on conduit runs indicate quantity of 12 copper branch circuit conductors, unless otherwise noted.
 - b. Where such marks do not appear, provide quantity of circuit conductors to the outlets shown to perform the control or circuiting indicated.
 - c. Include ground, travelers, and switchlegs required by the circuiting arrangement indicated.
 - d. Provide a dedicated neutral conductor with each circuit, do not use a shared neutral conductor between phases unless specifically requested or directed.

1.05 SUBMITTALS

- A. Comply with Division 01.
- B. Shop Drawings and Equipment Data:
 1. Combine electrical shop drawings and equipment data in Submittal binders.
 2. Include in Submittal binders:
 - a. A complete index of materials and equipment required by Specifications to be documented by submittals.
 - b. Manufacturer's detailed specifications and data sheets to fully describe equipment furnished.
 - c. All deviations from the Drawings and Specifications, noted on the submittals. Failure to comply will automatically void any implied approval for use of the equipment on this project.
- C. Installation Drawings:
 1. Submit prior to starting installation.

2. Show all outlets, devices, terminal cabinets, conduits, wiring, and connections required for the complete system described.

D. Submittals Procedures:

1. Review and recommendations by the Architect or Engineer are not to be construed as change authorizations.

- E. If discrepancies are discovered between the materials or equipment submitted, and the Contract Documents, either prior to or after the data is processed, the Contract Documents govern.

1.06 SUBSTITUTION REQUESTS

- A. Comply with Division 01.

1.07 RECORD DRAWINGS:

- A. Comply with Division 01.

- B. Keep record drawings up to date as the work progresses.

- C. Show all changes, deviations, addendum items, change orders, corrections, and other variations from the Contract Drawings.

- D. Keep record drawings at the jobsite and available for the Architect's review.

- E. At the completion of the work, incorporate all deviations from the installation drawings to indicate "as-built" conditions.

1.08 OPERATION AND MAINTENANCE DATA:

- A. Comply with Division 01.

- B. Provide a separate manual or chapter for each system as follows:

1. Low voltage distribution system.
2. Emergency power system.
3. Standby power system.
4. Fire alarm system.
5. Lighting system.
6. Lighting control system.
7. Power metering and monitoring system.

- C. Description of system.

- D. Operating Sequence and Procedures:

1. Step-by-step procedure for system start-up, including a pre-start checklist.
 - a. Refer to controls and indicators by nomenclature consistent with that used on panels and in control diagrams.
2. Detailed instruction in proper sequence, for each mode of operation.
3. Emergency Operation:
 - a. If some functions of the equipment can be operated while other functions are disabled, give instructions for operations under those conditions.
 - b. Include here only those alternate methods of operations (from normal) which the operator can follow when there is a partial failure or malfunctioning of components or other unusual condition.
4. Shutdown Procedure:
 - a. Include instructions for stopping and securing the equipment after operation.
 - b. If a particular sequence is required, give step-by-step instructions in that order.

E. Preventive Maintenance:

1. Schedule for preventive maintenance.
 - a. State the recommended frequency of performance of each preventive maintenance task such as cleaning, inspection, and scheduled overhauls.
2. Cleaning: Provide instructions and schedules for all routine cleaning and inspection with recommended lubricants.
3. Inspection: If periodic inspection of equipment is required for operation, cleaning, or other reasons, indicate the items to be inspected and give the inspection criteria.
4. Provide instructions for lubrication and adjustments required for preventive maintenance routines. Identify test points and given values for each.

F. Manufacturers' Brochures:

1. Include manufacturers' descriptive literature covering devices and equipment used in the system, together with illustrations, exploded views, and renewal parts lists.
2. Edit manufacturers' standard brochures so that the information applying to the actual installed equipment is clearly defined.

G. Results of performance testing, as specified in PART 3 of This Section.

1.09 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Products and equipments comply with Oregon Revised Statute (ORS) 453.005(7)(e) prohibiting pentabrominated, octabrominated and decabrominated diphenyl ethers. Where products or equipments within this specification contain these banned substances, provide complying products and equipments from approved manufacturers with equal performance characteristics.
2. Provide work and materials conforming to:
 - a. Local and State codes
 - b. Federal and State laws and regulations.
 - c. Other applicable laws and regulations.
3. Obtain and pay for all permits, licenses, and inspection certificates required by authorities having jurisdiction.
4. Pay any other fees required by governing authorities for work of this Division.

B. Install only electrical products listed by a recognized testing laboratory, or approved in writing by the local inspection authority as required by governing codes and ordinances.

1.10 SITE VISITATION

A. Visit the site prior to bidding and become familiar with existing conditions and all other factors which may affect the execution of the work. Coordination of installation of equipment with prior bid packages previously issued shall be completed. Include all related costs in the initial bid proposal.

1.11 COORDINATION

A. Coordinate Work of This Division with all other trades to ensure proper installation of electrical equipment.

1. Review Drawings of other trades or crafts to avoid conflicts with cabinets, counters, equipment, structural members, and other possible impediments to electrical work.
2. Report potential conflicts to Architect prior to rough-in.
3. Proceed with rough-in following Architect's directives to resolve conflicts.
4. In general, the Architectural Drawings govern.

- B. Verify the physical dimension of each item of electrical equipment to fit the available space. Contractor's responsibility includes:
1. Coordination of the equipment to fit into the available space.
 2. Access routes through the construction.
- C. Layout Drawings:
1. Equipment arrangement shown on Drawings is diagrammatic to indicate general equipment sizing and spatial relationship. Contractor shall include, as part of distribution equipment submittal, a scaled floor plan which includes all equipment shown with their submitted sizes. Include all feeder conduit routing, both above-ground and underground, including termination points at equipment. Submit for Engineer's review prior to commencing work.
 2. Provide additional wiring details at switchboards, motor control centers, and other areas where work is of sufficient complexity to warrant additional detailing for coordination.
 3. Submit layout drawings for approval prior to commencing field installation.
- D. Where electrical connections are required for equipment provided as Work of other Divisions, coordinate rough-in and wiring requirements for that equipment with its supplier and installer prior to commencing work. Notify Architect and Engineer of any discrepancies between the actual rough-in and wiring requirements, and those identified on Drawings for resolution prior to installation.
- E. Arrange raceways, wiring, and equipment to permit ready access to switches, motors, and control components.
1. Doors and access panels shall be kept clear.
- F. Coordinate electrical utility service with the appropriate serving utility.
1. Contractor to include all costs associated with installation and connection of new electrical service to building.
 2. It shall be the Contractor's responsibility for contacting the local utility company (EWEB) to obtain utility design drawings specific to this project, and for scheduling utility company inspections in conformance with the project schedule. Utility infrastructure shall be installed as described on EWEB design documents. Installation based on electrical plans that vary from the EWEB design documents shall be corrected by the Contractor at no additional cost. Contact EWEB service planning, or Debbie Jenkins (541)685-7117.
- G. Coordinate underground work with other contractors working on the site.
1. Coordinate particularly with contractors installing storm sewer, sanitary sewer, water, and irrigation lines to avoid conflicts.
 2. Common trenches may be used with other trades, providing clearances required by codes and ordinances are maintained.
- H. Coordinated Shop Drawings.
1. Shop drawings shall be prepared in two-dimensional format.
 2. Shop drawings shall include but are not limited to:
 - a. Superplot plans of above ground work with a colored overlay of all trades including, but not limited to, HVAC piping, HVAC equipment, plumbing piping and equipment, sprinklers, lighting, lighting controls, cable tray, fire alarm devices, electrical power conduit, and ceiling system to a minimum of 1/2-inch = 1-foot scale.
 - b. Superplot plans of below ground work with a colored overlay of all trades including, but not limited to, structural footings and foundation, HVAC piping, civil piping, plumbing piping, and power conduit to a minimum of 1/2-inch = 1-foot scale.
 - c. Beam penetration drawings indicating beam penetrations meeting the requirements indicated on the floor plans and on the structural drawings to a minimum of 1/4-inch = 1-foot scale.

- d. Slab penetration drawings of HVAC, plumbing, sprinklers, lighting and electrical to a minimum of 1/4-inch equals 1'-foot scale.
- e. Fabrication drawings of radiant ceiling panels, architectural metal ceiling, including panel penetrations for lighting, sprinkler heads, fire alarm devices, and any other penetrations.

1.12 CHANGE ORDERS

- A. All supplemental cost proposals by the Contractor shall be accompanied with a complete itemized breakdown of labor and materials. At the Architect's request, Contractor's estimating sheets for the supplemental cost proposals shall be made available to the Architect. Labor shall be separated and allocated for each item of work.

1.13 WARRANTY

- A. Provide a written warranty covering the work of this Division as required by the General Conditions.
- B. Apparatus:
 - 1. Free of defects of material and workmanship and in accord with the Contract Documents.
 - 2. Built and installed to deliver its full rated capacity at the efficiency for which it was designed.
 - 3. Operate at full capacity without objectionable noise or vibration.
- C. Include in Contractor's warranty for Work of Division 26 system damage caused by failures of any system component.

1.14 ALTERNATES

- A. Comply with Division 01.
- B. Refer to Electrical Drawings for detailed information relating to the appropriate alternates.

1.15 ELECTRICAL EQUIPMENT RATINGS AND SELECTIVE COORDINATION

- A. Electrical equipment fault current interrupting ratings and withstand ratings shall meet or exceed the available fault current shown on the drawings, or as otherwise specifically noted. Equipment ratings specifically noted shall supersede available fault current shown on panel schedules.
- B. The emergency system distribution equipment (life safety related loads served as required by OESC Article 700) provide for selective coordination. Refer to Section 26 0573, Overcurrent Protective Device Coordination Study for additional requirements. Provide selectively coordinated equipment which complies with Article 700 requirements, and with dimensions that will fit in the available space on plans with proper working clearance. Available fault current shown on the documents shall be the basis for confirming selective coordination.

1.16 SURGE PROTECTION

- A. Emergency system distribution equipment (life safety related loads served as required by OESC Article 700) shall be provided with Surge Protective Device at each distribution bus and panelboard bus, in compliance with OESC Article 700 requirements.
- B. Surge protective devices shall be integral with the electrical equipment or external mounted adjacent. Rating (kA per phase) shall be as recommended by the equipment manufacturer for the application. Refer to Section 26 4313, Surge Protective Devices for additional requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Where specified materials or methods conflict with applicable codes, the more stringent requirement applies.
- B. Provide apparatus built and installed to deliver its full rated capacity at the efficiency for which it was designed.

- C. Ensure that entire electrical system operates at full capacity without objectionable noise or vibration.
- D. Materials and Equipment:
 - 1. Use materials and equipment that are:
 - a. New
 - b. Of quality meeting or exceeding specified standards.
 - c. Free of faults and defects.
 - d. Conforming to Contract Documents.
 - e. Of size, make, type, and quality specified.
 - f. Suitable for the installation indicated.
 - g. Manufactured in accordance with NEMA, ANSI, UL or other applicable standards.
 - h. Otherwise as specified in Division 01.
 - 2. Equipment not meeting all requirements will not be acceptable, even though specified by name.
 - 3. Where two or more units of the same class of equipment are furnished, use products of the same manufacturer.
 - a. Component parts of the entire system need not be products of same manufacturer.
 - 4. Basis of Design:
 - a. Equipment scheduled or specified by performance or model number shall be considered the Basis of Design.
 - b. If other equipment is provided in lieu of the Basis of Design equipment, assume responsibility for all changes and costs which may be necessary to accommodate this equipment, including, but not limited to:
 - 1) Different sizes and locations for connections.
 - 2) Different dimensions.
 - 3) Different access requirements.
 - 4) Any other differences.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Provide a complete properly operating system for each item of equipment specified.
 - 2. Install materials in a neat and professional manner.
 - 3. Comply with equipment manufacturer's written instructions, the best industry practices, and the Contract Documents.
 - 4. Comply with latest published NECA Standard of Installation, and provide competent supervision.
- B. Clarification:
 - 1. Where there is a conflict among manufacturer's instruction, best practice, and the Documents, request clarification from the Architect prior to rough-in.
 - 2. Architect's decision will be final.
 - 3. Work installed without clarification shall be removed and corrected by the Contractor at no cost to the Owner.

3.02 INSTALLATION IN RATED CONSTRUCTION

- A. Install intumescent material around ducts, conduits, and other electrical elements penetrating rated construction.
- B. Comply with firestop materials manufacturer's written instructions to prevent spread of smoke or fire through sleeves or block-outs penetrating rated fire barriers.
- C. Provide firestop materials specified in Division 7 Section, "Through-Penetration Firestop Systems," and as follows:
 - 1. Capable of passing a 3-hour test per ASTM E-814 (UL 1479).
 - 2. Consisting of material capable of expanding nominally eight times when exposed to temperatures of 250-350 degrees F.
 - 3. An alternate method utilizing intumescent materials in caulk or putty complying with Division 7 Section, "Through-Penetration Firestop Systems" may be used.

3.03 EXCAVATION AND BACKFILL

- A. Perform all necessary excavation and backfill for the installation of electrical work in compliance with Division 31.
- B. For direct burial cable or non-metallic conduit, a minimum 3-inch cover of sand or clean earth fill shall be placed all around the cable or conduit on a leveled trench bottom. Lay all steel conduit on a smooth level trench bottom, so that contact is made for its entire length. Water shall be removed from trench while electrical conduit is being laid.
- C. Place backfill in layers not exceeding 8-inches deep and compact to 95 percent of maximum density at optimum moisture to preclude settlement.
 - 1. Interior: Bank sand or pea gravel.
 - 2. Exterior: Excavated material with final 8-inches clean soil.
- D. Following backfilling, grade all trenches to the level of surrounding soil. All excess soil shall be disposed of at the site as directed.
- E. Provide 6-inches wide vinyl tape marked ELECTRICAL in backfill, 12-inches below finished grade, above all high voltage cable or conduit runs.
- F. Coordinate patching of all asphalt or concrete surfaces disturbed by this work with General Contractor.

3.04 NOISE CONTROL

- A. Minimize transmission of noise between occupied spaces.
- B. Outlet Boxes:
 - 1. Do not install outlet boxes on opposite sides of partitions back to back.
 - 2. Do not use straight through outlet boxes, except where indicated.
- C. Conduit:
 - 1. Route conduit along corridors or other noncritical space to minimize penetrations through sound rated walls, or through non-sound-rated partitions between occupied spaces.
 - 2. Grout solid and airtight all penetrations through sound rated partitions.
 - 3. Use flexible connections or attachments between independent wall structures.
 - a. Do not rigidly connect (i.e., bridge) independent wall structures.
- D. Do not install contactors, transformers, starters, and similar noise-producing devices on walls that are common to occupied spaces, unless otherwise indicated.
 - 1. Where such devices are indicated to be mounted on walls common to occupied spaces, use shock mounts, or otherwise isolate them to prevent the transmission of noise to the occupied spaces.

- E. 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.

3.05 EQUIPMENT CONNECTIONS

A. General:

1. 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.
2. Verify the location and method for connecting to each item of equipment prior to roughing-in.
3. Check the amperage, maximum overcurrent protection, voltage, phase and similar attributes of each item of equipment before rough-in and connection.

B. Motor Connections:

1. Make motor connections for the proper direction of rotation.
2. Minimum Size Flex for Mechanical Equipment: 1/2-inch; except at small control devices where 3/8-inch flex may be used.
3. Exposed Motor Wiring: Jacketed metallic flex with minimum 6-inches slack loop.
4. Do not test run pump motors until liquid is in the system.

- C. Control devices and wiring relating to the HVAC systems are furnished and installed under Division 23; except for provisions or items indicated in Division 26 Drawings and Specifications.

3.06 EQUIPMENT SUPPORT

A. Minimum Support Capacity:

1. Provide fastening devices and supports for electrical equipment, luminaires, panels, outlets, and cabinets capable of supporting not less than four times the ultimate weight of the object or objects fastened to or suspended from the building structure.

B. Luminaire Supports:

1. Support luminaires from the building structure.
2. Use supports that provide proper alignment and leveling of luminaires.
3. Where permitted at exposed luminaires, install flexible connections neat and straight, without excess slack, and attached to the support device.

- C. Support all junction boxes, pull boxes, or other conduit terminating housings located above the suspended ceiling from the floor above, roof, or penthouse floor structure to prevent sagging or swaying.

D. Conduits:

1. Support suspended conduits 1-inch and larger from the overhead structural system with metal ring or trapeze hangers and threaded steel rod having a safety factor of four.
2. Conduits smaller than 1-inch installed in ceiling cavities, may be supported on the mechanical system supports when available space and support capacity has been coordinated with the subcontractor installing the supports.
3. Anchor conduit installed in poured concrete to the steel reinforcing with 14 black iron wire.

- E. Powder actuated or similar shot-in fastening devices will not be permitted for any electrical work except by special permission from the Architect.

3.07 ACCESS DOORS

- A. Furnishing and installation of access doors is work of Division 08.

3.08 ALIGNMENT

- A. Install panels, cabinets, and equipment level and plumb, parallel with structural building lines.

- B. Install distribution equipment and all electrical enclosures fitted neatly, without gaps, openings, or distortion.
- C. Properly and neatly close all unused openings with approved devices.
- D. Fit surface panels, devices, and outlets with neat, appropriate, trims, plates, or covers without overhanging edges, protruding corners, or raw edges.

3.09 CUTTING AND PATCHING

- A. General:
 - 1. Comply with Division 01 Section.
 - 2. Restore to original condition new or existing work cut or damaged by installation, testing, and removal of electrical Work.
 - 3. Patch and finish spaces around conduits passing through floors and walls to match the adjacent construction, including painting or other finishes.
 - 4. Clean up and remove all dirt and debris.
- B. Make additional required openings by drilling or cutting. Use of jackhammer is prohibited.
- C. Fill holes that are cut oversize so that a tight fit is obtained around the objects passing through.
 - 1. In rated construction, comply with Division 07.
- D. Obtain Architect's permission and direction prior to piercing beams or columns.
- E. Where alterations disturb lawns, paving, walks, and other permanent site improvements, repair and refinish surfaces to condition existing prior to commencement of work.

3.10 PROTECTION OF WORK

- A. Protect all electrical work and equipment installed under this Division against damage by other trades, weather conditions, or any other causes.
 - 1. Equipment found damaged or in other than new condition will be rejected as defective.
- B. Keep switchgear, transformers, panels, luminaires, and all electrical equipment covered or closed to exclude dust, dirt, and splashes of plaster, cement, paint, or other construction material spray.
 - 1. Equipment not free of all such contamination is not acceptable.
- C. Provide enclosures and trims in new condition, free of rust, scratches, and other finish defects.
 - 1. If damaged, properly refinish in a manner acceptable to the Architect.

3.11 COMPLETION AND TESTING

- A. General:
 - 1. Comply with Division 01.
- B. Upon completion, test systems to show that installed equipment operates as designed and specified, free of faults and unintentional grounds.
 - 1. Schedule system tests so that several occur on the same day.
 - 2. Coordinate testing schedule with construction phasing.
 - 3. Conduct tests in the presence of the Architect or its representative.
 - 4. Notify Architect of tests 48 hours in advance.
- C. Engage a journeyman electrician with required tools to conduct equipment tests. Arrange to have the equipment factory representative present for those test where the manufacturer's warranty could be impacted by the absence of a factory representative.
- D. Perform tests per the requirements of each of the following systems:
 - 1. Low voltage distribution system.
 - 2. Emergency power system.

3. Standby power system.
4. Fire alarm system.
5. Lighting system.
6. Lighting control system.
7. Power metering and monitoring system.

E. Provide a written record of performance tests and submit with operation and maintenance data.

3.12 COMMISSIONING

- A. Complete all phases of work so the system, equipment, and components can be checked out, started, calibrated, operationally tested, adjusted, balanced, functionally tested, and otherwise commissioned. Complete systems, including all subsystems, so they are fully functional.
- B. Perform commissioning as specified in Section 01 9100, General Commissioning Requirements, the technical sections, and Section 26 0800, Commissioning of Electrical Systems.
 1. Unless specified otherwise in the technical sections, provide factory startup services for the following items of equipment:
 - a. Transformers
 - b. Primary Switchgear
 - c. Secondary Switchgear
 - d. Emergency Power Systems
 - e. Electrical Distribution Systems
 - f. Lighting Control Systems
- C. Participation in Commissioning:
 1. Provide skilled technicians to checkout, startup, calibrate, and test systems, equipment, and components.
 2. The Engineer reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment or system.
- D. Resolution of Deficiencies:
 1. Corrective work shall be completed in a timely fashion to permit timely completion of the commissioning process. Experimentation to render system performance will be permitted.
- E. Verification and Documentation:
 1. As each test is performed, the Contractor shall have the commissioning manager observe the physical responses of the system and compare them to the specified requirements to verify the test results.
 2. Submit site observation reports for deficiencies in the system.
 3. Record the result of individual checks or tests on the pre-approved checklist, test, and report form from the commissioning plan and submit results for review.

END OF SECTION

SECTION 26 0519

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical apply to this section.

1.02 SUMMARY

- A. This Section includes:
 1. Copper conductors. Indicated sizes shall be considered minimum for ampacities and voltage drop requirements.
 2. Conductors for special systems shall be as recommended by the equipment manufacturer except as noted.
 3. Deliver conductors to the job site in cartons, protective covers, or on reels.
- B. Related Sections include:
 1. Section 26 0526, Grounding and Bonding for Electrical Systems
 2. Section 26 0533, Raceways and Boxes for Electrical Systems
 3. Section 26 0553, Identification for Electrical Systems
 4. Section 26 0580, Electrical Testing

1.03 REFERENCED STANDARDS

- A. ASTM: American Society For Testing and Materials:
 1. ASTM B 3 Soft or Annealed Copper Wire
 2. ASTM B 8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 3. ASTM B 33 Tinned Soft or Annealed Copper Wire for Electrical Purposes
- B. ICEA: Insulated Cable Engineers Association:
 1. S-95-658 Non-shielded 0-2 kV Cables
- C. IEEE: Institute of Electrical and Electronic Engineers:
 1. IEEE 383 Type Test of Class IE Electric Cables, Field Splices, and Connections
- D. UL: Underwriters Laboratories:
 1. UL 44 Rubber-Insulated Wires and Cables
 2. UL 83 Thermoplastic-Insulated Wires and Cables
 3. UL 1277 Type TC Power and Control Tray Cable

1.04 SUBMITTALS

- A. Submit product data for the following materials:
 1. Single conductor 600V power and control conductors.
 2. MC Cable
- B. Submittals of the following materials shall consist only of a listing of the manufacturer's name and the applicable catalog numbers of the items to be utilized.
 1. Connectors.
 2. Branch circuit conductor splices.
 3. Splices with compression fitting and heat-shrinkable insulator.
- C. Submit cable test data per testing requirements of PART 3.

PART 2 PRODUCTS

2.01 CONDUCTORS – 600V

- A. Type:
 - 1. Copper: 12 AWG minimum size unless noted otherwise. 12 and 10, stranded, 8 or larger, Class B concentric or compressed stranded.
 - 2. Do not use aluminum.
- B. Insulation:
 - 1. THHN/THWN-2 for conductors 6 AWG and smaller.
 - 2. XHHW-2 for conductors 4 AWG and larger.
- C. Thru wiring in fluorescent luminaires shall be rated for 194 degree F minimum.
- D. Manufacturers: General, Essex, Southwire, or equivalent.

2.02 POWER LIMITED WIRING

- A. Copper, stranded or solid as recommended by the system manufacturer.
- B. Insulation shall be appropriate for the system and location used.

2.03 MC CABLE

- A. Sheath: Steel, of the interlocking metal type, continuous and close fitting. The sheath shall not be considered a current carrying or grounding conductor.
- B. Conductors: Solid copper, of the same ampacity as the conduit/wire system indicated for the specific location. Provide separate green insulated grounding conductors in circuits where an isolated ground is called for.

2.04 CONNECTORS – 600V AND BELOW

- A. Branch Circuit Conductor Splices:
 - 1. Live spring type, Scotchlok, Ideal Wire Nut, Buchanan B-Cap, or 3M Series 560 self-stripping type.
- B. Cable Splices: Compression tool applied sleeves, Kearney, Burndy, or equivalent with 600V heat shrink insulation. Except where specifically indicated on the plans, all proposed splice locations shall be submitted for review by the Engineer.
- C. Terminator Lugs for Stranded Wire:
 - 1. 10 AWG Wire and Smaller: Spade flared, tool applied.
 - 2. 8 AWG Wire and Larger: Compression tool applied, Burndy, Anderson, or equivalent.
 - 3. Setscrew type terminator lugs furnished as an integral part of switches and circuit breakers will be acceptable.

PART 3 EXECUTION

3.01 CONDUCTORS

- A. Pulling compounds may be used for pulling all conductors. Clean residue from the conductors and raceway entrances after the pull is made.
- B. Pulleys or blocks shall be used for alignment of the conductors when pulling. Pulling shall be in accordance with manufacturer's specifications regarding pulling tensions, bending radii of the cable, and compounds.
- C. Make up and insulate wiring promptly after installation of conductors. Wire shall not be pulled in until all bushings are installed and raceways terminations are completed. Wire shall not be pulled into conduit embedded in concrete until after the concrete is poured and forms are stripped.
- D. Provide a dedicated neutral conductor with each branch circuit, do not use a shared neutral conductor between phases unless specifically requested or directed.

3.02 MC CABLE

- A. MC Cable is allowed only where concealed within wall or ceiling cavities.
- B. Do not use MC Cable for branch circuit homeruns to branch panelboards. EMT or RMC conduit shall be utilized for all branch circuit homeruns to branch panelboards.

3.03 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 retightened after an eight hour period.
- C. All tool applied compression connectors shall be applied per manufacturer's recommendations and physically checked for tightness.

3.04 COLOR CODING

- A. Secondary service, feeders, and branch circuit conductors shall be color coded. Phase color code to be consistent at all feeder terminations, A-B-C left-to-right, A-B-C top-to-bottom, or A-B-C front-to-back.

- B. Color code conductors to designate neutral, phase, and ground as follows:

CONDUCTOR	120/208	120/208
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green
Switchlegs	Pink or Tan	Pink or Tan
Travelers	Purple	Purple
Fire Alarm	Red	Red

- C. Wires shall be factory color coded by intergral pigmentation. Colored plastic tape permitted on No. 6 and larger where intergral pigmentation impractical. Apply tape in spiral half-lap over exposed portions in manholes, boxes, panels, switchboards and other enclosures.
- D. All circuit conductors shall be identified with circuit number at all terminals, intermediate outlets, disconnect switches, circuit breakers, motor control centers, etc. Both ends of a given conductor shall be indentified alike.
- E. DO NOT install wires of different voltage systems in same raceway, box, gutter of other enclosure.
- F. Radius of cable bends shall not be less than 10 times the outer diameter of the cable.
- G. Use solid color compound or solid color coating for 12 and 10 branch circuit conductors and neutral sizes.
- H. Color-coding of the flexible wiring system conductors and connectors shall be the manufacturer's standard.
- I. Exceptions to conductor color coding scheme shall be approved through the Owner prior to consideration.

3.05 FIELD TESTING

- A. 600V rated conductors shall be tested by the Contractor for continuity. Conductors 100A and over in size shall be meggered after installation and prior to termination. Provide the megger, rated 1,000V DC, and record and maintain the results, in tabular form, clearly identifying each conductor being tested.
 - 1. Replace cables when test value is less than 15 megohms.
 - 2. Cable test submittal shall include results, equipment used, and date.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Provide complete ground systems as indicated. Include conduit system, transformer housings, switchboard frame and neutral bus, motors, and miscellaneous grounds required.
 - 2. Provide 600V insulated main bonding jumper for utility company connection between ground bus in switchgear lineup and ground termination point or service ground in transformer vault as directed by the utility.
 - 3. Provide an insulated ground conductor in every conduit or raceway containing power conductors.
 - 4. Continue existing system as specified herein and shown on the Drawings.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0533, Raceways and Boxes for Electrical Systems
 - 3. Section 26 0580, Electrical Testing
 - 4. Section 26 2200, Low Voltage Transformers
 - 5. Section 26 2413, Switchboards
 - 6. Section 26 2416, Panelboards
 - 7. Section 26 2726, Wiring Devices
 - 8. Section 26 2900, Motor Controllers

PART 2 PRODUCTS

2.01 GROUND CONDUCTORS

- A. Green insulated copper for use in conduits, raceways, and enclosures.
- B. Bare copper for ground grids and grounding electrode systems.

2.02 CONNECTORS

- A. Cast, set screw or bolted type.
- B. Form poured, exothermic welds.
- C. Grounding lugs where provided as standard manufacturer's items on equipment.

2.03 GROUND PADS

- A. Provide a ground pad at each location shown on the Drawings. Pad shall be 1000A rated copper bus nominally 1/4-inch by 4-inch by 12-inch long or as shown on the plans.
- B. Provide 1/4-inch and 1/2-inch bolt holes per ANSI TIA/EIA 607 standards for telecom ground bars.
- C. Mount ground pads with stand-off devices to provide a minimum of 1-1/2 inches free space behind pad for access to lug nuts and washers.

2.04 GROUND RODS

- A. Copperclad steel, 5/8"x10'-0" long ground rods. Where ground wells are indicated, provide a 12-inch deep, 8-inch diameter precast concrete well with flush lid for accessibility and inspection of welded connections, RCP Vaults No. 12R12A with 12R12-t cover.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Grounding Conductors: Sized in accordance with Article 250, Tables 250.66 and 250.122 of the National Electrical Code.
- B. Grounding Conductor Connectors: Made up tight and located for future servicing and to insure low impedance.
- C. Ground the electrical system, the cold-water service, structural steel, and transformers to the building ground grid.
- D. All Plug-in Receptacles: Bonded to the boxes, raceways, and grounding conductor.

3.02 UFER GROUND

- A. Provide a concrete encased building grounding electrode where shown on the Drawings. Grounding electrode shall consist of a minimum of 20 feet of 4/0 bare copper conductor cast into the bottom 6 inches of an exterior concrete foundation or footing.

3.03 EQUIPMENT

- A. Provide separate green insulated equipment ground conductor in all non-metallic and flexible electrical raceways. Effectively ground all luminaires, panels, controls, motors, disconnect switches, exterior lighting standards, and noncurrent carrying metallic enclosures. Use bonding jumpers, grounding bushings, lugs, buses, etc., for this purpose.
- B. Provide grounding bushings on all feeder conduit entrances to panels and equipment enclosures and bond bushings to enclosures with minimum 10 AWG conductor. Connect the equipment ground to the building system ground. Use the same size equipment ground conductors as phase conductors, up through 10 AWG.

3.04 GROUND PADS

- A. Drill ground pads as necessary for attachment of all grounding conductors as required.
- B. Utilize 2-hole lugs for terminating 4/0 AWG and larger ground conductors.
- C. Bond ground pads to adjacent structural steel with #4/0 bare copper cable, using form poured exothermic welds.

3.05 GROUND RESISTANCE TEST

- A. Ground electrode resistance test shall be accomplished with a ground resistance direct-reading single test meter utilizing the Fall-of-Potential method and two reference electrodes. Perform test prior to interconnection to other grounding systems. Orient the concrete-encased ground electrode to be tested and the two reference electrodes in a straight line spaced 50-feet apart. Drive the two reference electrodes 5-feet deep.
- B. Test results shall be in writing and shall show temperature, humidity, and condition of the soil at the time of the tests. In the case where the ground resistance exceeds 5 ohms the Engineer will issue additional instructions.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This section describes supporting devices for electrical equipment, associated conduit, and cable.
- B. Related Sections include:
 - 1. Section 26 0533, Raceways and Boxes for Electrical Systems
 - 2. Section 26 2200, Low Voltage Transformers
 - 3. Section 26 2413, Switchboards
 - 4. Section 26 2416, Panelboards
 - 5. Section 26 5000, Lighting

1.03 REFERENCED STANDARDS

- A. IBC International Building Code
- B. SMACNA sheet Metal and Air Conditioning Contractors' National Association

PART 2 PRODUCTS

2.01 PRODUCTS

- A. Hangers: Kindorf B-905-2A channel, H-119-D washer, C105 strap, minimum 1/2-inch rod with ceiling flange, or equal.
- B. Pipe Straps: Two-hole galvanized or malleable iron.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide all electrical equipment supports.
- B. Install vertical support members for equipment, straight and parallel to building walls.
- C. Provide independent supports to structural member for electrical fixtures, materials, or equipment installed in or on ceiling, walls, or in void spaces and/or over furred or suspended ceilings.
- D. Do not use other trades' fastening devices to support electrical equipment materials or fixtures.
- E. Do not use supports and/or fastening devices to support other than one particular item.
- F. Support conduits within 18 inches of outlets, boxes, panels, cabinets, and deflections.
- G. Provide complete seismic anchorage and bracing for the vertical and lateral restraint of conduit, cable trays, bus ducts, and electrical equipment as required by IBC Chapter 16 and the most recent version of the SMACNA Seismic Restraint Manual for Seismic Hazard Level (SHL) A. Shop drawings of bracing systems shall be submitted to the Architect for review and shall bear the seal of a professional engineer registered in the State of Oregon.

3.02 LUMINAIRES

- A. Light-Duty Ceiling Systems:
 - 1. Attach 12 hanger wire from each corner of the luminaire to the structure above.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

2. Positively and securely attach luminaire within 6 inches of each corner to the suspended ceiling framing member by mechanical means.

B. Intermediate-Duty Ceiling Systems:

1. Positively and securely attach luminaire within 6 inches of each corner to the suspended ceiling framing member by mechanical means.
2. Attach No. 12 hanger wire within 3-inches of each corner of each luminaire.
3. Connect two 12-gauge slack wires from the luminaire housing to the structure above for luminaires weighing less than 56 pounds.
4. Support luminaries weighing 56 pounds or more directly from the structure above with approved hangers attached to each corner of the luminaire.

C. Heavy-Duty Ceiling Systems:

1. Positively and securely attach luminaire within 6 inches of each corner to the suspended ceiling framing member by mechanical means.
2. Connect two 12-gauge slack wires from the luminaire housing to the structure above for luminaires weighing less than 56 pounds.
3. Support luminaries weighing 56 pounds or more directly from the structure above with approved hangers attached to each corner of the luminaire.

3.03 PULL AND JUNCTION BOXES

- A. Pull and junction boxes installed within the cavity of a suspended ceiling that is not a fire rated assembly may be attached to the suspended ceiling framing members, provided the following criteria are met:

1. Installation complies with the ceiling system manufacturer's instructions.
2. Pull or junction box is not larger than 100 cubic inches.
3. The pull or junction box is supported to the main runner with two fastening devices that are designed for framing member application and positively attach or lock to the member.
4. The pull or junction box serves branch circuits and associated equipment in the area.
5. The pull or junction box is within 6 feet of the luminaires supplied.
6. The framing members are not rotated more than 2 degrees after installation.
7. Pull and junction boxes installed within the cavity of a suspended ceiling may be attached to independent support wires, provided the following criteria are met:
 - a. Independent support wires are taut and connected at both ends, one end to the ceiling framing member and the other to the structure above.
 - b. Pull or junction box is not larger than 100 cubic inches.
 - c. The pull or junction box is secured to the independent support wires by two fastening devices that are designed for the application.
 - d. Independent support wires in a fire-rated ceiling are distinguishable by color, tagging, or other effective means.

3.04 CABLES AND RACEWAY

- A. Cables and raceway installed within the cavity of a suspended ceiling may be attached to independent support wires provided the following criteria are met:

1. Independent support wires are taut and connected at both ends, one end to the ceiling framing member and the other to the structure above.
2. Raceways are not larger than one inch trade size and cables and bundled cables are not larger than one inch diameter including insulation.
3. Not more than three raceways or cables are supported by any independent support wire and are supported within the top or bottom 12 inches.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

4. Cables for Class 2 power-limited signaling systems and other power limited systems are securely fastened within 2 feet of each termination and at intervals not to exceed 5 feet or per the manufacturer's installation instructions.
 5. Raceways are secured at intervals required for the type of raceway installed.
 6. Cables and raceway are secured to independent support wires by fastening devices and clips designed for the purpose.
 7. Independent support wires are distinguishable by color, tagging, or other effective means.
- B. Cables and raceway installed within the cavity of a suspended ceiling may be supported with trapezes constructed of steel rods and channels provided the following criteria are met:
1. The size of the rods, channel, and fastening devices are suitable for the anticipated weight.
 2. The spacing of the trapezes meets that required for the type of raceway installed.
 3. Cables and raceway are secured to a trapeze by straps designed for the purpose.
 4. Cables and raceway do not support other raceway or cables.
 5. An appropriately sized seismic bracing system is installed.

END OF SECTION

SECTION 26 0533
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Raceways and conduits of specified types for all electrical system wiring, except where clearly indicated otherwise.
 - 2. All fittings, boxes, hangers, and appurtenances required for the conduits and raceways.
 - 3. Size raceways and conduits as indicated. Where no size is indicated, conduit may be the minimum code permitted size for the quantity of conductors installed, based upon NEC tables for conductors with type THW insulation.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 3. Section 26 0529, Hangers and Supports for Electrical Systems
 - 4. Section 26 0553, Identification for Electrical Systems

PART 2 PRODUCTS

2.01 METALLIC CONDUITS

- A. Rigid Metal Conduit (RMC): Smooth surfaced heavy wall mild steel tube of uniform thickness and temper, reamed and threaded at each end and protected inside and out with galvanizing, sherardizing, or equivalent process. RMC shall comply with NEC Article 344.
- B. Intermediate Metallic Conduit (IMC): Smooth surface, intermediate wall mild steel tube of uniform thickness and temper, reamed and threaded at each end, and protected inside and out with galvanizing, sherardizing, or equivalent process. IMC shall comply with NEC Article 342.
- C. Electrical Metallic Tubing (EMT): Smooth surface, thin wall mild steel tube of uniform thickness and temper, galvanized or sherardized on the outside, and enameled on the interior. EMT shall comply with NEC Article 358.
- D. Flexible Conduits (Flex):
 - 1. Flexible Metallic Conduit: Interlocking single strip steel construction, galvanized inside and out after fabrication. Flex shall comply with NEC Article 348.
 - 2. Liquid Tight: Similar to flexible metallic conduit, except encased in a liquid tight polyvinylchloride or equivalent outer jacket over the flexible steel core, and shall comply with NEC Article 350.

2.02 NON-METALLIC CONDUITS

- A. Rigid Non-Metallic Conduit: Type II PVC Schedule 40, suitable for use with 90°C rated wire. Conduit shall conform to UL Standard 651 and carry appropriate UL listing for above and below ground use.
- B. Non-metallic tubing (ENT)
 - 1. Blue polyvinyl chloride (PVC) branch wiring.
 - 2. Available in trade sizes 1/2-inch through 2-inch.

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

3. Easily cut to length using shear type cutters.
4. Hand bendable, corrugated of circular cross section. No special tools needed for bending.
5. No rust.
6. Provide protection for power wiring conductors.
7. Ambient temperature range -4 degrees F to 122 degrees F.
8. Meet requirements of NEC for Electrical Nonmetallic Tubing.
9. Single manufacture to provide ENT, Fittings, Boxes and Accessories to form a complete integrated raceway system.
10. UL Standard UL 1653 in accordance with Article 362 of the NEC and Section 12-1500 of the CEC.
11. Recognized for use with PVC rigid nonmetallic conduit fittings.
12. Rated for 90 degree C conductors.
13. Conductors: Easily push through the raceway (up to approximately 50 feet).
14. Available in sticks, coils and reels.

C. Fittings

1. Listed and/or certified.
2. One piece ENT Coupling, Threaded Terminator and RNC Transition Fittings shall be rated concrete tight without tape.
3. Vertical and 45 degree Stub Downs shall be made available in 1/2-inch through 1-inch trade sizes. (Molded part to retain ENT for concrete pour and provides clearance for attaching fittings to ENT).
4. Vertical and 90 degree Stub Down Transition Adapter shall be made available in 1/2-inch through 1-inch trade sizes (Molded part to retain ENT for concrete pour and provides threaded port for transitioning to other conduit systems).
5. Quick Connect Couplings available in 1/2-inch-1-inch trade sizes (Molded part which allows two pieces of ENT to be quickly coupled).
6. Quick Connect Male Threaded Adapter shall be available in 1/2-inch-1-inch trade sizes (Molded part which snaps onto a piece of ENT to allow it to have a male threaded end).
7. Quick Connect Male Snap-in Adapters shall be available in 1/2-inch-1-inch trade sizes (Molded part which snaps onto a piece of ENT to allow it to connect to an outlet or switch box).
8. Schedule 40 Male Terminal Adapter shall be available (molded fitting which is solvent cemented to a piece of ENT to provide a male threaded end).
9. Schedule 40 Nonmetallic Couplings shall be available (Molded part which allows two pieces of ENT to be connected together with solvent cement).
10. 10. Non-Metallic ENT Transition Adapters shall be available
 - a. Male ENT to Schedule 40 and 80 PVC Conduit
 - b. ENT to EMT
 - c. Reducers, 3/4-inch to 1/2-inch ENT and 1-inch to 3/4-inch ENT.

2.03 WIREWAYS

- A. Troughs: Steel, painted, square in cross section, preformed knock-outs on standard spacing, screw cover.
- B. Fittings: Tees, elbows, couplings as required for configuration shown on the Drawings.

2.04 FITTINGS

A. RMC and IMC:

1. Threaded Locknuts: Sealing type where used with NEMA 2, 3, 3R, 4, and 12 enclosures.
2. Threaded Bushings: 1-1/4-inch and larger, insulated, grounding type as required under Section 26 0526, Grounding and Bonding for Electrical Systems.
3. Threaded Couplings: Standard threaded of the same material and as furnished with conduit supplied. Erickson type couplings may be used where required to complete conduit runs larger than 1-inch.

B. EMT:

1. Connectors: Steel compression ring or steel set screw type for conduit termination, with insulated throat, suitable for conditions used. Use lay-in grounding type bushings where terminating grounding conductors.
2. Couplings: Steel compression ring or steel set screw type, concrete tight.

C. Threadless: RMC and IMC couplings and box connectors may be steel threadless, compression ring or set screw type for use with conduits 1 inch and smaller where installed in poured concrete locations or where limited working space makes threaded fittings impractical.

D. Weatherproof Connectors: Threaded

E. Expansion Couplings: Equivalent to O.Z. type EX with jumper.

F. Seal-Offs: With filler fiber, compound, and removable cover.

2.05 METALLIC BOXES

- A. Flush and Concealed Outlet Boxes: Galvanized stamped steel with screw ears for device ring mounting, knock-out plugs, mounting holes, fixture studs if required, RACO or equivalent.
- B. Surface Outlet Boxes: Galvanized stamped steel same as above for use on ceilings; cast steel or aluminum with threaded hubs or bosses for use on walls.
- C. Large Boxes: Boxes exceeding 4-11/16 inches square when required shall be welded steel construction with screw cover and painted, steel gauge as required by physical size, Hoffman, Circle AW or equivalent.
- D. Systems: Boxes for systems devices shall be as recommended by the systems manufacturer, suitable for the equipment installed. Equip with grounding lugs, brackets, device rings, etc., as required.

2.06 NON-METALLIC BOXES

- A. Boxes used with ENT shall be listed and/or certified.
- B. Non-metallic Mud Boxes shall be available.
- C. Mud Boxes with two 1-inch, four 1/2-inch and six 3/4-inch ports.
- D. Mud Boxes with quick connect ports shall be molded out of Polycarbonate.
- E. Mud Boxes with removable back shall be available.
- F. Mud Box types includes:
 1. Ceiling Box listed for fixture support up to 50 lbs. and ceiling fan support up to 35 pounds.
 2. One Gang
 3. Two Gang
 4. 4 Square
- G. Non-Metallic Outlet and Switch Box shall be available in Single and Two Gang
 1. Boxes shall have eccentric knockouts
 2. Two gang shall have dual voltage capability
 3. Optional dual voltage divider shall be available

- H. Non-Metallic Box Extenders shall be available.
- I. Non-Metallic Plaster Rings shall be available.
- J. Non-Metallic Blank Covers shall be available.
- K. Non-Metallic 4" Octagon Ceiling Boxes shall be available

2.07 FLOOR BOXES

- A. Concealed power floor box with flush hinged door. Nominal 7-1/2-inch by 7-1/2-inch by 3-inch stamped steel concrete tight box with multiple conduit entrances and pre-pour adjusting screws.
 - 1. Gray cast aluminum door suitable for polished concrete.
 - 2. Hubbell S1SFB series or approved equal.
- B. Combination concealed power and data floor box with flush hinged door. Nominal 7-1/2-inch by 7-1/2-inch by 3-inch stamped steel concrete tight box with multiple conduit entrances and pre-pour adjusting screws.
 - 1. Gray cast aluminum door suitable for polished concrete.
 - 2. Hubbell S1SFB series or approved equal.
- C. PVC, molded enclosures, threaded hubs.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Conceal all conduits in finished spaces. Concealed conduits shall run in a direct line with long sweep bends and offsets. RMC and IMC embedded in concrete below grade or in damp locations shall be made watertight by painting the entire male thread with Rustoleum metal primer or equivalent before assembly.
- B. Route exposed conduit parallel or at right angles to structural building lines and neatly offset into boxes. Conduits attached directly to building surfaces shall closely follow the surfaces. Submit exposed conduit routing plans and details to Architect for review and approval prior to installation. Conduit fittings shall be used to "saddle" under beams. Drilling or notching of existing beams, trusses on structural members shall be coordinated with Architect prior to commencing.
- C. Installation of conduit below roof shall be at least 18-inch below deck.
- D. RMC and IMC terminations at boxes, cabinets, and general wiring enclosures shall be rigidly secured with double locknuts and bushings or approved fittings. Conduit shall be screwed in and shall engage at least five threads in hub where conduit boxes with threaded hubs or bosses are used. Insulating bushings shall be used for conduits 1-1/4-inches or larger.
- E. Keep conduit and raceways 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.
- F. 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 moisture barriers.
- G. Exposed Ceiling Structure Areas: For spaces/rooms which do not have a finished ceiling to conceal conduit installations, underground conduit shall be provided where practical. Above-ground conduits for such areas shall have routing planned in advance. Contractor shall provide a proposed conduit routing plan in advance for review and approval by the Architect prior to rough-in and installation. Above-ground conduits shall be routed and supported parallel and perpendicular to building lines and structure, and tight to structural elements where practical.
- H. Plenum Installation: Conduit systems routing through plenum spaces shall meet code requirements for plenum installation and be suitable for such areas. Protect cabling in conduit where cabling is not suitable/listed for installation plenum spaces.

- I. Assembly Occupancy Areas: Conduits in Assembly areas shall be metallic and suited for installation in such areas. Conduit stubbing up into Assembly areas shall be RMC or IMC to 2-inch below concrete, tape-wrapped where in contact with concrete. Refer to Architectural plans for locations of Assembly areas.
- J. CMU walls: Contractor shall closely coordinate installation of conduit and boxes flush in masonry/CMU walls between the different trades. Conduit routing shall be planned and coordinated in advance of masonry/CMU wall construction. Locations of rough-ins at masonry/CMU walls shall be reviewed and approved in advance by the Architect prior to wall construction and conduit routing/box installation. Power and low-voltage system conduits routing to the same location shall be offset as required to allow proper void space for structural wall backfill.

3.02 CONDUIT

A. RMC:

- 1. RMC may be used in all areas for all wiring systems.
- 2. Install for exposed runs of medium voltage circuits outside of the electrical rooms.
- 3. Install where subject to mechanical injury.
- 4. Install with threaded fittings made up tight.

B. IMC:

- 1. Use for medium voltage circuits where concealed or where exposed in the electrical rooms.
- 2. Use for circuits rated 600V and less where not in contact with earth or fill.
- 3. Install with threaded fittings made up tight.

C. EMT:

- 1. Use in other dry protected locations for circuits rated 600V and less.
- 2. Whether exposed or concealed, shall be securely supported and fastened at intervals of nominally every 8-feet and within 24-inches of each outlet, ell, fitting, panel, etc.

D. Flex:

- 1. Use for connections to vibration producing equipment and where installation flexibility is required with a minimum 12-inches slack connection.
- 2. Limit flex length to 36-inches for exposed equipment connections and 72-inches in concealed ceiling and wall cavities.
- 3. PVC jacketed flex shall be used in wet locations, areas subject to wash down, and exterior locations.

E. PVC:

- 1. Type II Schedule 40 and 80 PVC may be used underground and in and under interior slabs, poured concrete walls, and where scheduled or noted on the Drawings.
- 2. Make connections with waterproof solvent cement.
- 3. Provide RMC at 60 degree and larger bends and where penetrating slabs.

F. ENT:

- 1. Use in walls and above non-plenum rated ceilings.

3.03 RACEWAYS

- A. Surface metal wireways may be installed at locations to serve motor starters or other control devices where required by a multitude of wiring interconnections or physical layout.

3.04 FITTINGS

- A. Metallic raceways and conduits shall be assembled continuous and secured to boxes, panels, etc., with appropriate fittings to maintain electrical continuity. All conduit joints shall be cut square and reamed smooth with all fittings drawn up tight.

B. Crimp-on, tap-on, indenter type, malleable iron or cast set screw fittings shall not be used.

3.05 BOXES

A. General:

1. Outlet boxes code required size to accommodate all wires, fittings, and devices.
2. Provide multi-gang boxes as required to accept devices installed with no more than one device per gang.
3. Equip metallic boxes with grounding provisions.

B. Size and Type:

1. Flush wall switch and receptacle outlets used with conduit systems shall be 4 inches square, 1-1/2 inches or more deep, with one or two-gang plaster ring, mounted vertically. Where three or more devices are at one location, use one piece multiple gang tile box or gang box with suitable device ring.
2. Wall bracket and ceiling surface mounted luminaire outlets shall be 4-inch octagon 1-1/2-inches deep with 3/8-inch fixture stud where required. Wall bracket outlets shall have single gang opening where required to accommodate luminaire canopy. Provide larger boxes or extension rings where quantity of wires installed requires more cubic capacity.
3. Junction boxes installed in accessible ceiling or wall cavities or exposed in utility areas shall be a minimum of 4-inches square, 1-1/2 inches deep with appropriately marked blank cover.
4. Boxes for the special systems shall be suitable for the equipment installed. Coordinate size and type with the system supplier.

C. Pull Boxes

1. Provide pull boxes where shown for installation of cable supports or where required to limit the number of bends in any conduit to not more than three 90-degree bends.
2. Use galvanized boxes of code-required size with removable covers installed so that covers will be accessible after work is completed.

D. Installation:

1. Boxes and outlets shall be mounted at nominal centerline heights shown on the drawings.
2. Adjust heights in concrete masonry unit (CMU) walls to prevent devices or finish plates from spanning masonry joints.
3. Recessed boxes shall be flush with finished surfaces or not more than 1/8-inch back and be level and plumb. Long screws with spacers or shims for mounting devices will not be acceptable. No combustible material shall be exposed to wiring at outlets.
4. Covers for flush mounted boxes in finished spaces shall extend a minimum of 1/4-inch beyond the box edge to provide a finished appearance. Finish edge of cover to match cover face.
5. Boxes installed attached to a stud in sheet rock walls shall be equipped with opposite side box supports equivalent to Caddy #760. Install drywall screw prior to finish taping. Methods used to attach boxes to studs shall not cause projections on the face of the stud to prevent full-length contact of sheet rock to the stud face.

3.06 PULL WIRES

- A. Install nylon pull lines in all empty conduits larger than 1 inch where routing includes 25-feet or more in length or includes 180 degrees or more in bends.
- B. Where conduits requiring pull lines are stubbed out and capped, coil a minimum of 36-inches of pull line and tape at termination of conduit for easy future access. Label pull lines as to conduit starting or terminations point and intended future use.

END OF SECTION

SECTION 26 0543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. This section describes conduit, ducts, duct accessories, handholes, boxes, and manholes constructed and installed to form a complete underground raceway system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03 3000, Cast-In-Place Concrete
- B. Section 31 2300, Trench, Backfilling and Compacting
- C. Section 31 2319, Dewatering

1.03 REFERENCED STANDARDS

- A. AASHTO: American Association of State Highway and Transportation Officials.
- B. ACI: American Concrete Institute.
- C. ANSI: American National Standards Institute.
- D. ASTM: American Society for Testing and Materials.
- E. NEC: National Electrical Code.
- F. NEMA: National Electrical Manufacturers Association.
- G. UL: Underwriters Laboratories.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit descriptive details of the manufacturers' proposed standard product listings, including:
 - a. Precast manholes and handholes.
 - b. Precast manhole and handhole accessories, including covers and frames.
 - c. Precast concrete 28-day compressive strength data.
 - d. Manhole and handhole cement certification.
 - e. Duct bank cement certification.
 - f. Duct spacers.
 - g. Ducts and raceways.
 - h. Conduit expansion/deflection fittings.
- B. Show drawings for manholes and handholes, including:
 - 1. Design criteria signed by professional structural engineer licensed by the State of Oregon.
 - 2. Reinforcing steel locations and concrete covers.
 - 3. Layout of inserts, attachments, and openings.
 - 4. Locations and types of joints.
 - 5. Accessories, including covers, frames, and diamond plate doors where applicable.
- C. Duct-Bank Coordination Drawings: show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
 - 2. Drawings shall be signed and sealed by a qualified professional engineer licensed by the State of Oregon.

PART 2 PRODUCTS

2.01 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Handholes and boxes shall be precast concrete, 4,000 psi strength at 28 days, with reinforcing and galvanized checker plate traffic covers designed for AASHTO loading of H-20. Wall thickness shall be 3 inches minimum.
- B. Precast units shall conform to ASTM C 478. Pulling irons shall be 7/8-inch diameter hot-dip galvanized steel bar with exposed triangular opening.
- C. Design:
 - 1. Precast structures shall be designed in accordance with AASHTO "Specification for Highway Bridges." Concrete and reinforcing shall be designed in accordance with ACI Code 318.
 - 2. Tops and walls of structures shall be designed for AASHTO H-20 highway loading, with 30 percent loading added for impact.
 - 3. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and ground water level present at the site.
 - 4. Assume ground water level is at ground surface unless a lower water table is indicated in the boring logs. Precast handhole pull boxes shall be designed and constructed not to float.
- D. All structures shall be identified with manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.
- E. Covers for handholes and boxes shall be spring-assisted galvanized diamond plate door with locking latch, and shall have 3-inch high markings in weld bead, inscribed before galvanizing with the word, "ELECTRICAL". Covers shall also have identification such as "MH-PA-1."
- F. Acceptable Manufacturers: Utility Vault Company, Hanson, Renton Concrete Products, or equal.

2.02 PRECAST CONCRETE VAULTS

- A. Vaults shall be precast concrete, minimum 4,000 psi strength at 28 days, with reinforcing and cover designed for AASHTO loading of H-20. Wall thickness shall be 3 inches minimum. Access opening shall have 36]-inch minimum clear opening.
- B. Precast units shall conform to ASTM C 478.
- C. Pulling irons shall be 7/8-inch diameter and shall have hot-dip galvanized steel bar with exposed triangular opening.
- D. Design:
 - 1. Precast structures shall be designed in accordance with AASHTO "Specification for Highway Bridges." Concrete and reinforcing shall be designed in accordance with ACI Code 318.
 - 2. Tops and walls of structures shall be designed for AASHTO H-20 highway loading, with 30 percent loading added for impact.
 - 3. Walls shall be designed to withstand all soil pressures, taking into consideration the soil to be encountered and groundwater level present at the site.
 - 4. Assume ground water level is at ground surface unless a lower water table is indicated in the boring logs. Precast manholes shall be designed and constructed not to float.
- E. All structures shall be identified with manufacturer's name embedded in, or otherwise permanently attached to, an interior wall face.
- F. Transformer Vault -
 - 1. Access cover and frame shall be steel with diamond plate finish.

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

2. The frame shall be steel with a 36-inch square opening. The cover shall have holes for lifting and have minimum 2-inch high factory label TELEPHONE, ELECTRIC, or ELECTRIC HV, as appropriate or as noted on the drawings.
3. Acceptable Manufacturers: Utility Vault Company, Hanson, Renton Concrete Products, or equal.

G. Sectionalizing Vault -

1. Access cover and frame shall be steel with diamond plate finish.
2. The frame shall be steel with a 36-inch by 72-inch opening. The cover shall be two 36-inch by 36-inch pieces and have holes for lifting and shall have minimum 2-inch high factory label "TELEPHONE," "ELECTRIC," or "ELECTRIC HV," as appropriate or as noted on the drawings.
3. Acceptable Manufacturers: Utility Vault Company, Hanson, Renton Concrete Products, or equal.

2.03 DUCT LINES

- A. Size: Except where otherwise shown on the drawings, ducts and conduits shall not be less than 4-inch trade size.
- B. Ducts (concrete-encased): Type II PVC Schedule 40, suitable for use with 90°C rated wire. Conduit shall conform to UL Standard 651 and carry appropriate UL listing for below-ground use.
- C. Ducts (direct-buried):
 1. Rigid Non-Metallic Conduit: Type II PVC Schedule 40, suitable for use with 90°C rated wire. Conduit shall conform to UL Standard 651 and carry appropriate UL listing for above- and below-ground use.
 2. Rigid Metal Conduit: UL 6 galvanized rigid steel. Where metal conduit is shown on the drawings or specified below, conduit shall have a coating of 20 mil bonded PVC, or shall be coated with bituminous asphaltic compound.
- D. Manufactured bends shall be not less than 36 inches in radius for conduits 4 inches in diameter or larger.

2.04 SPACERS

- A. Factory-fabricated rigid PVC vertical and horizontal interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum of 3 inches separation between ducts while supporting ducts during concreting or backfilling. Acceptable manufacturers: Carlon, Orangeberg, or equal.

2.05 GROUND RODS

- A. Ground rods shall be copper-clad steel, 3/4-inch diameter and 10-feet long.

2.06 GROUND WIRE

- A. Ground wire shall be stranded bare copper 6 AWG minimum.

2.07 CONDUIT EXPANSION/DEFLECTION FITTINGS

- A. Conduit expansion/deflection fittings in embedded runs shall be rated for indoor use, outdoor use, buried underground, or embedded in concrete in non-hazardous areas.
- B. Fittings shall allow axial expansion or contraction up to 3/4 inch and angular misalignment of the axes of the coupled runs in any direction to 30 degrees. Inner sleeves shall maintain constant inside diameter in any position and provide smooth insulated wireway for protection of wire insulation.
- C. Fittings shall have a watertight flexible neoprene outer jacket and tinned copper flexible braid grounding strap.
- D. Use with galvanized rigid steel conduit or PVC Schedule 40 conduit utilizing rigid metal conduit nipples and rigid metal to PVC adapters.

E. Acceptable Manufacturers: Crouse-Hinds, O-Z/Gendy, or equal.

PART 3 EXECUTION

3.01 PRECAST MANHOLES AND HANDHOLE PULL BOXES

A. Construction

1. Units may be precast monolithically or may consist of assembled sections.
2. Assembled sections shall have mating edges with tongue-and-groove joints. Joints shall be designed to firmly interlock adjoining components, and provide waterproof junctions. Joints shall be sealed watertight using preformed plastic strips installed in accordance with the manufacturer's instructions.
3. Furnish lifting devices for proper handling of units.
4. Provide ground rod and sleeve in manhole floors.
5. Install sump with grate.

B. Duct entries shall be a minimum of 14-inches above floor and below ceiling. Cable supports, clamps, or racks shall be provided. Floor shall slope 2-percent in all directions to a sump. Sump shall be a minimum of 8-inches in diameter.

C. Install pulling irons or inserts for pulling eyes, inserts for cable racks, and openings for conduit entry as required. Steel components other than reinforced steel shall be hot-dip galvanized after fabrication. Manholes and handhole pull boxes shall have concrete bottoms.

D. Install drains in electrical manholes and handhole pull boxes with a minimum 4-inch pipe set in the bottom and terminated in a minimum of 1-cubic yard of drain rock.

3.02 INSTALLATION

A. Install on a level bed of well-tamped gravel or crushed stone, well-graded from the 1-inch to 2-inch sieve.

1. The top of frame and covers shall be flush with the finished surface of pavements, and flush with finished grade in unpaved areas.
2. Set manholes and handholes plumb to limit the depth of standing water to a maximum of 2 inches. Unless otherwise specified, manhole covers shall be set at grade.
3. Construct a sufficient number of precast concrete and mortar courses between top of manhole and manhole frame to reach the required level. Grout the manhole frame to the chimney.

B. Locate underground duct lines and manholes and handholes at the approximate locations shown on the drawings with due consideration given to the location of other utilities, grades, and paving.

C. Provide windows for duct bank terminations and fill with concrete or non-shrink grout after duct placement.

D. Provide pulling irons opposite each duct and conduit entrance. Pulling irons shall be cast in the walls opposite all duct windows approximately 6 inches above the top of the window.

E. Ground Rods and Grounding:

1. Rods shall protrude approximately 4 inches above the manhole floor.
2. In precast manholes, drive a ground rod into the earth through the floor sleeve. After the manhole is set in place, fill the sleeve with sealant to make a watertight seal.

F. Ground Wires:

1. Install ground wires around the inside perimeter of the manhole and anchor them to the walls.
2. Connect the wires to the ground rods by exothermic welding or approved compression process to form solid metal joints.

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

3. Bond the ground wires to the exposed non-current-carrying metal parts of racks, etc., in the manholes. Also bond the wires to duct bank bare equipment grounding conductors.

3.03 TRENCHING

- A. Excavate trenches in accordance with Section 31 2300, Trenching, Backfilling, and Compacting.
- B. Work with extreme care near existing utilities to avoid damaging them. Cut the trenches neatly and uniformly.
- C. For Concrete-Encased Ducts:
 1. After excavation of the trench, drive stakes in the bottom of the trench at 4-foot intervals to establish the grade and route of the duct bank.
 2. Pitch the trenches uniformly toward manholes or both ways from high points between manholes for the required duct line drainage. Avoid pitching the ducts towards buildings.
 3. The walls of the trench may be used to form the side walls of the duct bank provided that the soil is self-supporting and that the concrete envelope can be poured without soil inclusions. Use forms where the soil is not self-supporting.
 4. After the concrete-encased duct has sufficiently cured, backfill the trench in accordance with Section 31 2300, Trenching, Backfilling, and Compacting.

3.04 DUCT LINE INSTALLATIONS

- A. General
 1. Duct line shall be in accordance with the NEC, as shown on the drawings, and as specified.
 2. Slope duct to drain toward manholes and away from building and equipment entrances. Pitch shall be not less than 4-inches in 100-feet. Curved sections in duct lines shall consist of long sweep bends with a minimum radius of 5-feet in the horizontal and vertical directions unless noted otherwise. The use of manufactured bends is limited to building entrances and stub-ups to equipment.
 3. Underground conduit stub-ups to equipment inside buildings shall be galvanized rigid steel and shall extend at least 10-feet outside the building foundation. Stub-ups to equipment, mounted on outdoor concrete slabs, shall be galvanized rigid steel and shall extend at least 5 feet from edge of slab. Install insulated grounding bushings on the terminations. Couple the steel conduits to the ducts with suitable adapters, and encase with 3 inches of concrete.
 4. Upon completion of the duct bank installation, pull a standard flexible mandrel through each duct. The mandrel shall be at least 12-inches long, and shall have a diameter 1/2-inch less than the inside diameter of the duct. After mandreling, pull a brush with stiff bristles through each duct to remove the loosened particles. The diameter of the brush shall be equal to or slightly larger than the diameter of the duct.
 5. Seal the ducts and conduits at building entrances and at outdoor equipment terminations with a suitable nonhardening compound.
- B. Direct Burial Duct and Conduits:
 1. Install direct burial ducts and conduits only where shown on the drawings.
 2. Ducts and conduits shall be joined and terminated with fittings recommended by the conduit manufacturer.
 3. Tops of ducts and conduits shall be not less than 24-inches below grade.
 4. Do not kink the ducts or conduits.
 5. Place a continuous strip of utility warning tape approximately 12-inches above ducts or conduits before backfilling trenches. Refer to Division 31, for tape description and installation requirements.

END OF SECTION

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes: Clearly and properly identify the complete electrical system to indicate the loads served or the function of each item of equipment connected under this scope of work.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0533, Raceways and Boxes for Electrical Systems
 - 3. Section 26 2200, Low Voltage Transformers
 - 4. Section 26 2413, Switchboards
 - 5. Section 26 2416, Panelboards
 - 6. Section 26 2726, Wiring Devices
 - 7. Section 26 2900, Motor Controllers
 - 8. Section 26 3213, Engine Generators
 - 9. Section 26 5000, Lighting
 - 10. Section 28 3000, Fire Detection and Alarm

PART 2 PRODUCTS

2.01 LABELS

- A. Pre-printed: Permanent material pre-printed with black on white, with adhesive backing, Brady, 3M or equivalent.
- B. Engraved Laminated Plastic: 3-ply laminated plastic, colors indicated herein, with beveled edges, engraved letters and stainless steel screw attachment. Nameplate length to suit engraving . Adhesive attachment is not acceptable.
- C. Clear Plastic Tape: Black (normal) or red (emergency or standby) 12 point Helvetica medium text, clear adhesive backing, field printed with proper equipment for device labeling. Brother P-Touch, Dyno-tape, Kroy, or equal.
- D. Wire Markers: White with black numbers, adhesive backed tape on dispenser roll, Brady, 3M or equivalent.
- E. Feeder Conduit Marking: Provide one-piece snap-around vinyl feeder conduit markers for feeder conduits. Provide custom label, black letters on orange background indicating destination equipment, 1.25-inch high letters (min) – Seton M440 Series. Provide additional one-piece snap-around vinyl label, black letters on orange background for voltage designation (i.e. 277/480V, 120/208V). Secure labels to conduits using plastic tie wrap – 2 per label.
- F. Marker Pen: Black permanent marker suitable for writing on metallic surfaces.

PART 3 EXECUTION

3.01 GENERAL

- A. Nameplate and text coloring:
 - 1. Normal: Black nameplate with white lettering.
 - 2. Emergency: Orange nameplate with black lettering.

3. Standby: Yellow nameplate with black lettering.
4. UPS: Blue nameplate with white lettering.

3.02 SWITCHBOARDS, DISTRIBUTION PANELS

- A. Provide engraved laminated plastic nameplates for all main and feeder protective devices indicating the function or the load served (e.g. ELEV-5, PANEL 4HA, AHU-5, or SPARE) and the protective device trip rating (i.e. 175A). Text height: 3/8-inch.
- B. Provide engraved laminated plastic nameplate for all bussed spaces indicating the maximum ampere rating of future breaker, switch or starter that may be installed (e.g. SPACE (225A)). Text height: 3/8-inch.
- C. Provide engraved laminated plastic nameplate on the face of equipment enclosure as follows:
 1. Line 1: Equipment identification (e.g. MDP, SDP, or MCC 4H). Text height: 3/4-inch.
 2. Line 2: Equipment voltage, phase and wire quantity (e.g. 480Y/277V, 3PH, 4W). Text height: 1/2-inch.
- D. Provide additional engraved laminated plastic nameplate to indicate upstream source and location of upstream source as follows:
 1. Line 1: Upstream source equipment (e.g. FED FROM MDP). Text height: 3/8-inch.
 2. Line 2: Location of upstream source (e.g. MAIN ELEC ROOM 102). Text height: 3/8-inch.
 3. Confirm final room designations with Architect and Owner prior to procurement of nameplates.

3.03 DISTRIBUTION TRANSFORMERS

- A. Provide engraved laminated plastic nameplate on the face of the equipment enclosure as follows:
 1. Line 1: Equipment identification (e.g. T-N2P). Text height: 3/4-inch.
 2. Line 2: Equipment kVA rating, primary and secondary voltages (e.g. 150kVA, PRI: 480V, SEC: 208Y/120V). Text height: 1/2-inch.
- B. Provide additional engraved laminated plastic nameplate to indicate upstream source and location of upstream source as follows:
 1. Line 1: Upstream source equipment (e.g. FED FROM MDP). Text height: 3/8-inch.
 2. Line 2: Location of upstream source (e.g. MAIN ELEC ROOM 102). Text height: 3/8-inch.
 3. Confirm final room designations with Architect and Owner prior to procurement of nameplates.

3.04 BRANCH CIRCUIT PANELBOARDS

- A. Provide engraved laminated plastic nameplate on the face of each panelboard centered above the door as follows:
 1. Line 1: Equipment identification (e.g. PANEL 4HA). Text height: 1/2-inch.
 2. Line 2: Equipment voltage, phase, and wire quantity (e.g. 480Y/277V, 3PH, 4W). Text height: 3/8-inch.
- B. Indicate feeder source, feeder wire size, and feeder breaker or fuse size with plastic tape labels on the inside of the panel door.
- C. Provide typewritten panel directories, with protective, clear transparent covers, accurately accounting for every breaker installed including spares.
 1. Schedules shall use the actual room designations assigned by name or number near completion of the work and not the space designation on the Drawings. Confirm final room designations with Architect and Owner prior to completion of work.
 2. Each load description shall include a room or area designation whether indicated on the Drawings or not.

3.05 EQUIPMENT

- A. Provide engraved laminated plastic nameplate on the face of all disconnect switches, motor starters, relays, contactors, etc. indicating equipment served (e.g. AHU-1) and equipment load (e.g. 20 hp). Provide additional engraved laminated plastic nameplate indicating serving panel designation and circuit number.
- B. Provide clear plastic tape label for all relays, contactors, time switches and miscellaneous equipment provided under this Division of work indicating equipment served

3.06 FEEDER CONDUIT

- A. Provide feeder conduit marker for all electrical feeders.
- B. Markers shall be provided when exiting source equipment and located along the entire conduit length 20ft on centers in exposed areas, above ceilings and upon entering or leaving an area or room.

3.07 DEVICES

- A. Label each receptacle plate with preprinted clear plastic tape indicating serving panel and circuit number (e.g. PANEL 2PA-5). Clean all oils, dirt and any foreign materials from plate prior to label application. Receptacles connected to a GFCI protected circuit downstream from the protecting device shall be so labeled.

3.08 RACEWAYS AND BOXES

- A. Label all pull boxes and junction boxes for systems with paint or marker pen on box cover identifying system. Where box covers are exposed in finished areas, label inside of cover. Covers shall be color labeled as follows: 480Y/277V wiring - orange; 208Y/120V wiring - black; fire alarm - red; communications - green; security - blue.
- B. Label each end of pull wires left in empty conduits with tags or tape indicating location of other end of wire.

3.09 SYSTEMS

- A. Complex control circuits may utilize any combination of colors with each conductor identified throughout, using wraparound numbers or letters. Use the number or letters shown where the Drawings or operation and maintenance data indicate wiring identification.
- B. Label the fire alarm and communication equipment zones, controls, indicators, etc., with machine printed labels or indicators appropriate for the equipment installed as supplied or recommended by the equipment manufacturer.

END OF SECTION

SECTION 26 0573

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Overcurrent protective device coordination study.
 - 2. Arc flash hazard analysis, arc flash boundary calculations and equipment labeling.
 - 3. Recommend device settings and equipment labeling.
- B. The information resulting from the requirements of this section shall not be used as a basis for electrical equipment ratings. Discrepancies or inquiries of concern shall be brought to the attention of the Owner, Architect and Engineer prior to finalizing the coordination study. Electrical equipment shall be rated to equal to or greater than the available fault current shown on the drawings, or ratings specifically noted.
- C. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 2200, Low Voltage Transformers
 - 3. Section 26 2413, Switchboards
 - 4. Section 26 2900, Motor Controllers

1.03 REFERENCES

- 1. IEEE 141 Recommended practice for electrical power distribution and coordination of industrial and commercial power systems.
- 2. IEEE 242 Recommended practice for protection and coordination of industrial and commercial power systems.
- 3. IEEE 399 Recommended practice for industrial and commercial power system analysis.
- 4. IEEE 1584 Guide for performing arc-flash hazard calculations.
- 5. NFPA 70 National Electrical Code, latest addition.
- 6. NFPA 70E Standard for Electrical Safety in the Workplace, latest addition.

1.04 SUBMITTALS

- A. Provide the following 4 weeks prior to utility power connection.
 - 1. Finalized coordination study and report.
 - 2. Device setting recommendations.
 - 3. Arc flash hazard analysis and report.
 - 4. Arc flash equipment labeling recommendations.
 - 5. Arc flash label example.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. ETI, Electrical Systems Analysis.
- B. Qualified engineers of the switchgear manufacturer.

2.02 STUDIES AND ANALYSIS

A. Coordination Study:

1. Provide a coordination study for the electrical overcurrent devices to assure proper equipment and personnel protection.
2. The study shall present an organized time-current analysis of each protective device in series from the individual device back to the source. The study shall reflect the operation of each device during normal and abnormal current conditions.
3. The Contractor shall provide all pertinent information required by the preparers to complete the study.
4. The complete study shall include a system one-line diagram and protective coordination curves.
 - a. The coordination curves shall determine the required settings of protective devices to assure selective coordination. The curves shall graphically illustrate on log paper that adequate time separation exists between series devices. Plot the specific time-current characteristics of each protective device so that all upstream devices are clearly depicted on one sheet.
 - b. Time-current curves shall be developed for both phase and ground protective devices.
 - c. The following specific information shall also be shown on the coordination curves:
 - 1) Device identification.
 - 2) Voltage and current ratio for curves.
 - 3) 3-phase and 1-phase ANSI damage points for each transformer.
 - 4) No-damage, melting, and clearing curves for fuses.
 - 5) Cable damage curve.
 - 6) Transformer inrush points.
 - 7) Maximum short circuit cut-off point.
 - 8) Motor starting locked rotor curves.
 - 9) Clearly marked short circuit current levels through each protective device and branch.
 - d. Develop a table that summarizes the settings selected for the protective devices. Included in the table shall be the following:
 - 1) Device identification.
 - 2) Circuit breaker sensor rating, long-time, short-time, instantaneous settings, and time bands.
 - 3) Fuse rating and type.
 - 4) Ground fault pickup and time delay.
 - 5) Provide characteristic time-current curves for each adjustable overcurrent protective device showing pickup settings, time delay bands and device operating times. Include trip adjustment time dials and available settings corresponding to each characteristic time-current curve.

B. Arc Flash Hazard Analysis:

1. Provide an Arc Flash Hazard Study per the requirements set forth in NFPA 70E. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E.
2. Arc flash study to determine:
 - a. Arc flash incident energies.

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

- b. Arc flash boundaries.
 - c. Shock hazard boundaries
 - d. Personal protective equipment (PPE) for energized electrical equipment.
3. Arc flash study shall provide following information for each system mode of operation and shall be documented. The study results shall include:
- a. Equipment name and voltage.
 - b. Equipment device name and ANSI function (i.e. 51/50).
 - c. Equipment type, i.e., switchgear, MCC, panel, VFD, etc.
 - d. Equipment arc gap.
 - e. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.
 - f. Trip time, opening time, and total clearing time (total Arc time) of the protective device.
 - g. Worst-case arc flash boundary for each bus/equipment in the model.
 - h. Worst-case arc flash hazard incident energy in cal/cm² for each bus/equipment in the model.
 - i. Worst-case personal protective equipment (PPE) for each bus/equipment in the model.
 - j. Working distances for up to five different distances showing items g, h, and i for each distance.
 - k. Indicate "Danger/Hazardous" areas where incident energy is greater than 40 cal/cm² and provide recommendations to reduced arc flash energy levels for these areas.
 - l. Flag results where 85% arcing current provided worst-case results.
4. Arc flash study report format:
- a. Introduction.
 - b. Methodology.
 - c. Back up information.
 - d. Key assumptions.
 - e. IEEE 1584-2002 considerations.
 - f. Arc flash reduction options: Overcurrent protective device changes.
 - g. Explanation of data in arc flash hazard report tables.
 - h. NFPA 70E Information.
 - 1) Shock hazards with covers removed.
 - 2) Shock hazard approach boundaries.
 - a) Limited approach boundary.
 - b) Restricted approach boundary.
 - c) Prohibited approach boundary.
 - 3) Arc flash hazard boundaries.
 - i. Results of arc flash hazard analysis for high voltage, medium voltage and low voltage systems, including:
 - 1) Working distances.
 - 2) Energy levels.

- 3) PPE requirements.
 - 4) Recommendations to reduce arc flash hazard energy and exposure.
 - j. Arc flash hazard report.
 - k. Electronic file.
5. Provide labels for the project.

PART 3 EXECUTION

3.01 SETTINGS AND ADJUSTMENT

- A. Set and adjust all breakers in the distribution system per the recommendations of the coordination study and settings table.
- B. Provide protective covers and locking devices on breakers to secure settings from accidental changes.

3.02 ARC FLASH WARNING LABELS

- A. Provide a 3.5 inch x 5 inch thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 - 1. Location designation.
 - 2. Nominal voltage
 - 3. Flash protection boundary
 - 4. Hazard risk category
 - 5. Incident energy
 - 6. Working distance
 - 7. Engineering report number, revision number and issue date.
- D. Labels shall be machine printed, with no field markings.
- E. One Arc flash label shall be provided for each, unit substation primary and secondary side, switchboard, switchgear section, motor control center, panelboard and busway.

3.03 ARC FLASH TRAINING

- A. The contractor of the arc flash hazard analysis shall train the owners qualified electrical personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

END OF SECTION

**SECTION 26 0580
ELECTRICAL TESTING**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Perform field tests and operational checks to assure that all electrical equipment, both contractor and Owner supplied, is operational within industry and manufacturer's tolerances and is installed in accordance with design specifications.
 - 2. The tests and operational check shall determine the suitability for energization.
 - 3. Schedule tests and give a minimum of one week's advance notice of time and date to the Architect and Owner for any major systems tests specified in this Section.
- B. Related Sections include:
 - 1. Division 01
 - 2. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 3. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 4. Section 26 2413, Switchboards
 - 5. Section 26 2416, Panelboards
 - 6. Section 26 2900, Motor Controllers
 - 7. Section 26 3213, Engine Generators
 - 8. Section 26 3623, Automatic Transfer Switches
 - 9. Section 28 3001, Fire Detection and Communications

1.03 TESTING CRITERIA

- A. General:
 - 1. The testing company shall provide the equipment and technical personnel to perform all tests and inspections. Furnish any personnel necessary to assist in the testing and inspection.
 - 2. When the tests and inspections have been completed, a label shall be attached to all devices tested. Provide name of the testing company, the date of the tests, and the initials of the Engineer who performed the tests.
- B. Responsibilities:
 - 1. The Contractor shall clean the equipment, torque down all accessible bolts according to the equipment manufacturer's instructions, perform routine insulation resistance tests on all branch and feeder circuits, continuity checks on all branch and control wiring, and rotation tests for all distribution and utilization equipment. The Contractor shall furnish a complete set of current plans and specifications to the testing company prior to commencement of any testing. At each test site, the Contractor shall provide any test control power necessary to perform the tests specified. The test organization shall be consulted as to the specific power requirements. The Contractor shall notify the testing organization when the equipment and systems are ready for their inspections and testing. After review by the testing engineer, the Contractor shall correct any deficiencies noted by the testing company.

2. Responsible for having the manufacturer of each equipment and/or system provide factory trained representatives(s) that will perform all required functional testing, checkout, and repairs in order to pronounce the equipment and/or systems meet the requirements of these specifications and Drawings and it is ready for startup testing and commissioning by the testing organization as specified hereafter.
3. The Engineer, in conjunction with the Utility, shall furnish settings of protective devices.
4. The testing organization shall notify the Engineer prior to the commencement of any testing. The testing organization shall set and adjust the protective devices and associated auxiliary timing devices in accordance with the values furnished by the Engineer. The testing organization shall maintain a written record of all tests and, upon completion of the test, include them in a final report. The report shall detail any deficiencies in the system material, workmanship, or design.

C. Implementation:

1. Safety practices shall comply with applicable state and local safety orders, as well as with the Occupational Safety and Health Act (OSHA). Compliance with the National Fire Protection Association (NFPA) standard NFPA 70E, and the Accident Prevention Manual for Industrial Operations of the National Safety Council shall be observed.
2. Tests, other than phase rotation and operational tests, shall only be performed on apparatus that is deenergized. The testing company's lead test engineer for the project shall be a designated safety representative and shall supervise testing observations and safety requirements. Work shall not proceed until he had determined that it is safe to do so.
3. Power circuits shall have conductors shorted to ground by a hotline grounding device approved for the purpose. Warning signs and protective barriers shall be provided as necessary to conduct the tests safely.

D. Reports:

1. General: Provide full documentation of all tests in the form of a report.
2. The test report shall include the following sections:
 - a. Scope of testing.
 - b. Equipment tested.
 - c. Description of test.
 - d. Test results.
 - e. Conclusions and recommendations.
 - f. Appendix, including test forms.
3. Each piece of equipment shall be recorded on a data sheet listing the condition of the equipment as found and as left. Included shall be recommendations for any necessary repair and/or replacement parts. The data sheets shall indicate the name of the engineer who tested the equipment and the date of the test completion.
4. Record copies of the completed test report shall be submitted no more than 30 days after completion of the testing and inspection.

1.04 REFERENCES

- A. The testing and inspection shall comply with all applicable sections of the applicable codes and standards listed in Section 26 0500, Common Work Results for Electrical of the project specifications.
- B. The inspection and testing shall comply with the project plans and specifications, as well as with the manufacturer's drawings, instruction manuals, and other applicable data that may be provided by the Engineer, for the apparatus tested.

1.05 QUALIFICATIONS

- A. The testing organization may be an independent division of the manufacturer of the assembled products being tested. If an outside testing organization is utilized, a representative of the manufacturer shall be under contract by the testing company. He shall be present during all testing to ensure the testing is performed properly and that any deficiencies discovered are promptly corrected.
- B. The testing organization shall be a full service company that employs factory trained test engineers capable of troubleshooting, as well as identifying power equipment problems. All work outlined shall be performed under the full time, onsite supervision of a graduate engineer with a minimum of 5 years of field testing experience. Upon request, the testing company shall submit proof of its qualifications.

PART 2 PRODUCTS

2.01 TESTING EQUIPMENT

- A. The testing agency shall have a calibration program which maintains all applicable test instrumentation within rated accuracy. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain. Instruments shall be calibrated in accordance with the following frequency schedule:
 - 1. Field Instruments: 6 months maximum.
 - 2. Laboratory Instruments: 12 months.
 - 3. Leased Specialty Equipment: 12 months (where accuracy is guaranteed by lessor). Dated calibration labels visible on test equipment.

PART 3 EXECUTION

3.01 EQUIPMENT TO BE TESTED

- A. Section 26 0519, Low Voltage Electrical Power Conductors and Cables:
 - 1. For all circuits rated 400 Amperes or higher perform tests listed in the NETA 2007 Acceptance Testing Specifications for Low-Voltage Cables, Section 7.3.2.
- B. Section 26 2413, Switchboards:
 - 1. Switchboards: Perform tests listed in the NETA 2007 Acceptance Testing Specifications for Switchgear and Switchboard Assemblies, Section 7.1.
 - 2. Circuit Breakers: Perform tests listed in the NETA 2007 Acceptance Testing Specifications for Low-Voltage Circuit Breakers, Section 7.6.1.1.
- C. Section 26 0526, Grounding and Bonding for Electrical SystemsP:
 - 1. Perform tests listed in the NETA 2007 Acceptance Testing Specifications for Grounding Systems, Section 7.13.
- D. Section 26 2416, Panelboards:
 - 1. Panelboards: Perform tests listed in the NETA 2007 Acceptance Testing Specifications for Switchgear and Switchboard Assemblies, Section 7.1. Only those tests applicable to panelboards need be performed, no electrical tests of the circuit breakers need to be performed.
- E. Section 26 2900, Motor Controllers:
- F. Section 26 3623, Automatic Transfer Switches:
 - 1. Transfer Switches: Perform tests listed in the NETA 2007 Acceptance Testing Specifications for Automatic Transfer Switches, Section 7.22.3.
- G. Section 28 3001, Fire Detection and Communications:
 - 1. Fire Alarm System: Perform tests listed in Section 28 3001, Fire Detection and Communications.

END OF SECTION

SECTION 26 0630
PHOTOVOLTAIC SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes Design-Build work.
 - 1. The intent of Division 26 Specifications and Drawings is to provide a complete and workable facility, with complete systems as required by applicable codes, as indicated, and as specified.
 - 2. Provide a complete Grid Interactive Photovoltaic (PV) System as described below and indicated on the Drawings.
 - 3. Include all work specified in Division 26 and indicated on Drawings, including appurtenances, connections, fasteners, and accessories required to make a complete working system, whether indicated or not indicated.
 - 4. Related Sections Include:
 - a. Section 26 0500, Common Work Results for Electrical
 - b. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - c. Section 26 0526, Grounding and Bonding for Electrical Systems
 - d. Section 26 0529, Hangers and Supports for Electrical Systems
 - e. Section 26 0533, Raceways and Boxes for Electrical Systems
 - f. Section 26 0553, Identification for Electrical Systems
- B. The Design Build PV electrical system shall be complete with load and system calculations, layout, and shading diagrams, meeting design criteria performed by or under the supervision of a Professional Engineer licensed in the State of Oregon. The Design Build contractor shall be responsible for providing sealed construction and permit drawings.
- C. The PV system shall consist of PV modules, mounting system, AC and DC disconnects, power inverters, conductors, conduit, wire management, monitoring devices, over current protection, and all other accessories needed for proper operation. The PV system may also consist of disconnecting combiner boxes and wiring gutters. The complete system is to be integrated into the facility electrical system without impact to the utility service or power quality.
- D. The system shall have a minimum output rating at the service voltage indicated on the drawings.
- E. Guarantee electrical Work for a period of two years following date of substantial completion.
- F. The design shall comply with the Eugene Water and Electric Board's (EWEB) Customer Generation policies.
- G. It shall be the Contractor's responsibility for contacting the local utility company (EWEB) to obtain PV system requirements specific to this project, and for scheduling utility company inspections in conformance with the project schedule. PV system interface, infrastructure, equipment and locations shall be installed as required by EWEB. Installation based on electrical plans that vary from EWEB requirements shall be corrected by the Contractor at no additional cost. Contact EWEB service planning, or Debbie Jenkins (541)685-7117.
- H. Electrical metering equipment shall be provided where required by the serving utility. Contractor shall submit metering equipment to the utility company representative for approval prior to submittals.
- I. Provide disconnect switch at each PV interface point of connection (i.e., connection to main switchboard and connection to metered service). Submit utility company required AC disconnect equipment to the utility company representative for approval prior to submittals.

1.02 WORK INCLUDED

- A. Provide a 25 KW Net Metering System, and a 30 KW Direct Customer Generation System; Grid Interactive Photovoltaic (PV) System complete as described below and indicated on the Drawings.
- B. The PV system shall consist of angled, roof mounted PV modules, perimeter support assembly, power modules, combiner boxes, power inverters, wiring, monitoring devices and over current protection and all other accessories needed for proper operation. The complete system is to be integrated into the facility electrical system without impact to the utility service or power quality.
- C. The system shall have a minimum output rating at the service voltage indicated on the drawings.

1.03 QUALITY ASSURANCE

- A. Design Build contractor shall have the following certifications:
 - 1. State of Oregon Tax Credit Certified Technician (TCCT)
 - 2. NABCEP Entry Level PV Installer (EL)
- B. Design Build contractor shall have at least two years of experience installing photovoltaic systems of equivalent size.
- C. The PV system shall be the product of a firm regularly engaged in the assembly or manufacture of this equipment. The component parts of the system shall be the product of firms regularly engaged in the manufacture of these parts.
- D. It is the intention of these specifications to furnish and install a system that can be properly maintained and serviced without the necessity of carrying expensive parts, stocks or being subjected to the inconvenience of interrupted service due to the lack of available parts.

1.04 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. Underwriters Laboratories (UL):
 - a. UL 1703 Flat Plate PV Modules and Panels Standard for Safety of Static Inverters and Charge Controllers for use in PV Power systems
 - b. UL 1741 Inverters Converters Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
 - 2. ASTM Standards:
 - a. ASTM E927 Solar Simulation for Terrestrial PV Testing
 - b. ASTM E1038 Test Method for Determining Resistance of PV Modules to Hail by Impact with Propelled Ice Balls
 - c. ASTM E1171 Test Method for PV Modules in Cyclic Temperature and Humidity Environments
 - d. ASTM E1328 Terminology Relating to PV Solar Energy Conversion
 - e. ASTM E1462 Test Methods for Solar Insulation Integrity and Ground Path Continuity of PV Modules
 - f. ASTM E1596 Test Methods for Solar Radiation Weathering of PV Modules
 - g. ASTM E1799 Test Methods for Visual Inspection of PV Modules
 - h. ASTM E1802 Test Methods for Wet Insulation Integrity Testing of PV Modules
 - 3. IEEE Standards:
 - a. IEEE 928 Recommended Criteria for Terrestrial PV Power Systems
 - b. IEEE 929 Recommended Practice for Utility Interface of PV Systems
 - c. IEEE 80 Recommended Grounding Practices

- d. IEEE P1262 Recommended Practice for Qualification of PV Modules
- e. IEEE P1373 Recommended Practice for Field Test Methods and Procedures for Grid-Connected PV Systems
- f. IEEE P1374 Guide for Terrestrial PV Power System Safety
- 4. National Electrical Code (NEC):
 - a. NEC 690 Solar PV Systems

1.05 CONTRACTOR DESIGN

- A. The equipment shown on the contract drawings indicate the general nature of the photovoltaic system, but does not show all components required. It is the responsibility of the contractor to provide a complete photovoltaic system as needed to meet all applicable codes and requirements under this section.
- B. Raceway, routing, and wiring for field devices are not shown on the drawings. Attachment points of the photovoltaic system to the building structure shall be the responsibility of the design build contractor. Provide coordination with the project architect and structural engineer. Provide calculations and details approved by a registered State of Oregon structural engineer.

1.06 SUBMITTALS

- A. Product data.
- B. Shop Drawings, to include a complete PV system design for installation by the contractor:
 - 1. Single line diagram.
 - 2. Raceway and conductor sizing.
 - 3. Grounding details.
 - 4. Plan view and layout drawings.
 - 5. Voltage drop calculations
 - 6. Individual array efficiency calculations including tilt and orientation factor, percent shading, and total solar resource fraction.
 - 7. Structural calculations, details and shop drawings for the PV system support structure and attachment to the building system, with a state of Oregon structural engineers stamp.
- C. Site test report.
- D. Operating and Maintenance Data:
 - 1. Complete instructions covering the operation and testing of the PV System and associated equipment shall be provided for the facility, together with a manual covering system operation and maintenance. Operation instructions shall include any minor adjustments necessary to obtain optimum operation of the system.
 - 2. Maintenance instructions shall include complete trouble shooting and diagnostic information, disassembly instructions, assembly instructions and preventive maintenance schedule.
 - 3. The preventive maintenance schedule shall be in outline form. Include recommended cleaners and specified all necessary service checks. Spare parts books for the array and associated equipment shall also be furnished.
 - 4. Include data in Operating and Maintenance Manuals specified in Section 260500.

1.07 DOCUMENTATION

- A. Installing contractor shall provide complete documentation necessary for permitting, construction, Oregon Business Energy Tax Credit (BETC), , Federal tax credits, additional available incentives, utility interconnection, and utility qualifying facility tariff.

1.08 WARRANTY

- A. Installation: The Contractor shall provide the Owner with a full two-year warranty on the entire PV system and all of the installed components, equipment and labor. The warranty shall provide for service at the site including the repair and/or replacement of components found to be defective for one year after project acceptance.
- B. PV Modules: The PV modules shall have a minimum 20 year warranty and to exhibit a power output of not less than 80% of rated power.
- C. Electronics: The electronic components shall have a ten year warranty. The manufacturer shall repair or replace the defect components in cases of failure due to materials or workmanship.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS & INSTALLERS

- A. Manufacturers:
 - 1. Panels: Solarworld, , Sunpower, First Solar, Suntech, , Mitsubishi, Satcon, SMA
 - 2. Inverters: Xantrex, Fronius, SMA, PV Powered.
- B. Installers/Integrators:
 - 1. Gen-Con Solar Inc. Energy Systems Division
 - 2. Advanced Energy Systems
 - 3. Frahler Electric Company
 - 4. Sunlight Solar
- C. Other Manufacturers and Installers: Submit Substitution Request including installed PV capacity, credentials, and ETO solar integrator status in accordance with these specifications. It is permissible for electrical contractors utilizing IBEW photovoltaic trained electricians to team with Solar Integrators who comply with these specifications.

2.02 PHOTOVOLTAIC MODULES (PV)

- A. Provide PV modules with quick connect wire leads and physical connections attached to an integrated structural support system.
- B. PV Module shall have an interlocking foam support structure and all required hardware to mount and secure the PV assemblies to the building structure. Structure with PV modules shall be capable of withstanding wind loads any direction 90 MPH.
- C. Photovoltaic Module: Crystal silicon construction with the following efficiencies (encapsulated cell: 18.8%, module: greater than 12.8%, less than or equal to 67.5Voc). Crystals mounted within a tempered glass envelope.

2.03 COMBINER BOXES

- A. Provide DC Combiner boxes with string disconnect and lightning protection. Boxes shall be weatherproof construction with fuses for individual module protection. Provide terminals for the connection of input and output conductors to connect the arrays indicated on plans.

2.04 POWER INVERTER

- A. Provide a DC-AC power inverter that is compatible with the PV array output and serving utility requirements. The inverter unit shall be enclosed within a single enclosure and operate unattended in an automatic programmed failsafe mode. Power modules to convert VDC to 480, 3 phase VAC using a power inverter and be UL 1741 listed. The unit shall have the following features:
 - 1. Conversion of DC source to AC without a battery storage system.
 - 2. Automatic morning wake up and evening shutdown (less than 1 watt draw at night or when off).

3. Panel status LCD display with back lighting to provide read out of operating system, input and output voltages, AC currents and wattage. Monitoring points:
 - a. PV – Input Voltage
 - b. PV – Desired Input Voltage (Set-Point)
 - c. Current to Grid
 - d. Grid Frequency
 - e. Power Fed To Grid
 - f. Grid Impedance
 - g. PV – Voltage To Earth
 - h. Current From PV-Panels
 - i. Energy Yield
 - j. Total Operating Hours
 - k. Total System Startups
 - l. Operation Mode
 - m. System Error

2.05 TRANSFORMERS

- A. Provide dry type isolation transformers as required to establish reference ground for the inverter AC output. Transformers shall be provided with over current protection and size matched with the inverter.

2.06 REMOTE MONITORING

- A. Provide two CAT6 Modbus communication link monitoring capability to connect to owner's network or owner's PC. Provide all software required to permit interface with owner's PC and facility DDC system.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Protect all modules and materials during shipping, handling, and storage to comply with manufacturer's requirements and to prevent damage to the module glass. Damage to the modules include physical, condensation, temperature changes, sun, chemical, and other. Replace any scratched or damaged modules. Store all equipment in a clean, dry environment.
- B. Furnish and install all materials required for a complete and operational system. Provide required structural components and hardware to mount the PV arrays on roof with minimum roof penetrations. Anchor all elevated equipment secure with a safety factor of 4. Coordinate PV array anchor points with building structure tie points. Install combiner box adjacent to solar array panels ground to building steel.
- C. Size electrical distribution equipment in accordance with NEC 690.64 (B).

3.02 ELECTRICAL WIRING

- A. All power wiring shall be installed in conduit. Conductors installed shall consider route, length and shall be sized to keep voltage drop below 2%. Routing of raceways between PV arrays shall be kept concealed and hid behind panel assemblies. All electrical connections required between the various items of the System shall be provided rung out and tested for continuity prior to energizing.
- B. Provide labels for all module leads to indicate negative or positive.

3.03 COORDINATION

- A. Coordinate system design with roofing system provided by other Divisions. Provide adequate slope for water drainage.
- B. Provide remote monitoring equipment with output as directed by Division 23 controls contractor.

3.04 SUPERVISION

- A. Installation and start-up shall be supervised, checked, and tested by a qualified representative of the PV System manufacturer.
- B. Caution needs to be exercised in the installation of the PV modules, in that they can generate lethal voltages when exposed to sunlight. The PV modules will go live with open circuit voltage when they are removed from their enclosed shipping containers. Contractor is responsible for instructing that "energized equipment" protocol be established for those working with and around the installation of the PV modules.

3.05 FIELD TEST

- A. After the installation and initial start-up of the PV System set is complete, a test shall be performed and logged in the presence of the Architect. The Contractor shall have the PV System integrator furnish an engineer to monitor the system during the tests, to check all details of the installation and to instruct the operators. This engineer will be required for a period of not less than 2 days for instruction and tests and all costs in connection therewith shall be included in the Contractor's bid. The Contractor shall furnish all instruments necessary to conduct the tests and shall connect all devices required to obtain data required.
- B. Field Test Requirements: Data shall be recorded for a 24 hour period. Record results in the test report. Accomplish test in the following sequence:
 - 1. Perform on a cloudless day at noon for maximum accuracy.
 - 2. Check open-circuit voltage of each of the panels to verify that it provides the manufacturer's specified voltage in full sun.
 - 3. Check open-circuit voltage of each string of panels at string combiner.
 - 4. Test polarity of all strings in the string combiner. All strings should have the same polarity.
 - 5. Test the AC line voltage at PV system AC disconnect(s) to confirm that it is within 10 percent of system rated line voltage.
 - 6. Test the continuity of all DC fuses to be installed in the DC string combiner box.
 - 7. Test open circuit voltage at DC disconnect switch to ensure it is within proper limits according to the manufacturer's installation manual.
 - 8. Test to verify system tolerance is at 90 percent. Take simultaneous measurements from calibrated solar meter, pyranometer, and inverter output energy over a one hour period in 15 min increments. Use the following formula to calculate the array tolerance:
 - a. $\text{Tolerance} = \text{Inverter Energy Output (Wh)} / \text{Pyranometer (W/m}^2) / 1000 \text{ (W/m}^2) * 0.8]$ Check islanding disconnect feature.
 - b. Under voltage shut-down and disconnection.
 - 9. Over voltage shut-down and disconnection
 - 10. Frequency shut-down and disconnection.
 - 11. Night time shut-down.
 - 12. PV Array fault condition shut-down and disconnection.

3.06 SUPERVISION

- A. Installation and start-up shall be supervised, checked, and tested by a qualified representative of the PV System manufacturer.
- B. Caution needs to be exercised in the installation of the PV modules, in that they can generate lethal voltages when exposed to sunlight. The PV modules will go live with open circuit voltage when they are removed from their enclosed shipping containers. Contractor is responsible for instructing that "energized equipment" protocol be established for those working with and around the installation of the PV modules.

3.07 ACCEPTANCE

- A. Final acceptance shall be made when the PV System set has successfully completed the onsite tests and after all defects in material or operation has been corrected.

END OF SECTION

SECTION 26 0800

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 26 0500, Common Work Results for Electrical apply to work specified in this Section.
- C. The Work of this Section is supplemental to and does not supersede any other requirements of the Contract Documents.

1.02 SUMMARY

- A. The commissioning process is described in Section 01 9100 Commissioning.
- B. Provide all labor and materials required to complete the commissioning of those Division 26 systems and equipment identified as Commissioned Systems and Equipment in Section 01 9113, General Commissioning Requirements.
- C. Related Sections include:
 - 1. Section 01 9113, General Commissioning Requirements
 - 2. Division 26 Sections

1.03 SUBMITTALS

- A. Refer to Section 01 9113, General Commissioning Requirements.

1.04 COMMISSIONING SCOPE OF WORK - COMMISSIONING AGENT

- A. Refer to Section 01 9113, General Commissioning Requirements.

1.05 COMMISSIONING SCOPE OF WORK - CONTRACTOR

- A. Refer to Section 01 9113, General Commissioning Requirements.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Refer to Section 01 9113, General Commissioning Requirements.

PART 3 EXECUTION

3.01 MEETINGS

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.02 INSTALLATION, CHECK-OUT, START-UP AND PREFUNCTIONAL CHECKS

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.03 FUNCTIONAL TESTING

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.04 TRAINING OF FACILITY OPERATING STAFF AND BUILDING OCCUPANTS

- A. Refer to Section 01 7900 Demonstration and Testing.

END OF SECTION

SECTION 26 0923
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Section includes responsibilities and participation under Division 26 in the automatic dimming system installation and commissioning process.
 - 2. Installation, connection, adjustment, and testing of the equipment.
 - 3. Provide qualified personnel for participation in commissioning tests, including seasonal testing required after the initial commissioning.
 - 4. Providing equipment, materials, and labor necessary to correct deficiencies found during the commission process which fulfill contract and warranty requirements.
 - 5. Providing Operating and Maintenance Data and Record Drawings to the Test Engineer for verification, organization, and distribution.
 - 6. Providing assistance to the Test Engineer to develop and edit descriptions of system operation.
 - 7. Providing training for the systems specified in this Division with coordination by the Test Engineer and Commissioning Agent.
- B. Related Sections include:
 - 1. Section 26 2726, Wiring Devices
 - 2. Section 26 5000, Lighting

1.03 GENERAL REQUIREMENTS

- 1. Contractor shall price the lighting control package separately from the light fixture package and shall provide a unit price breakdown of all components including all deducts (lot price and all-or-none). Pricing transparent from the factory to the owner and all quotes shall be made available to the Owner, Architect, or Engineer upon request.

1.04 SYSTEM DESCRIPTION

- A. System is provided to reduce electric energy consumption during daylight hours by reducing the light output of the electric lighting system in response to measured lighting levels provided by daylight within the building interior.
- B. Areas within daylit areas shall have full daylight integration with photocells and automatic dimming and/or switching ballasts. Dimming zones will correlate with the distribution of daylight within the space.
- C. Areas near exterior glazing shall use dimming ballasts and photocells for daylight harvesting and resultant energy conservation.
 - 1. Daylight sensing equipment will be analog, full range type.
 - 2. Photocells will measure lighting levels on an affected interior surface. Illumination contribution to this measured surface will include both daylighting and electric lighting (closed-loop system) to ensure proper lighting levels with maximum energy savings.

3. Logical zones of luminaires will be controlled independently for maximum energy savings while maintaining even task illumination across the entire area between zones. Refer to drawings for control groupings.
 4. Time delay logic will be incorporated to prevent cycling due to clouds and other short-term influences to lighting levels.
- D. The control system shall accept indoor, skylight, and outdoor photo sensing heads. Photo sensing control shall permit the user to specify the actual footcandle level where desired switching shall occur.

PART 2 PRODUCTS

2.01 PHOTOCELLS

- A. The photoelectric device for the fluorescent dimming ballasts shall be a Class 2, low voltage ambient light sensor designed to connect via 18 gauge shielded cable with the electronic dimming ballast. The sensor shall have the following modes of operation:
1. Automatic dimming of indoor fluorescent lighting in response to the availability of natural daylight. The response range shall be between 0-500 footcandles with a fixed delay of at least 30 seconds.
- B. The sensor shall have a flat Fresnel lens with a cone of response to be determined by mock-up. Quantity and location of sensors shall be determined by mock-up. The wire aperture for both the interface circuit and the sensor shall be no greater than 3/8-inch outside diameter.
- C. Acceptable Manufacturers:
1. The photoelectric sensor used to control the Dimming Electronic Ballast shall be a Wattstopper LS-301, or equivalent.
 2. Other "or equivalent" Manufacturers and Products: Submit Substitution Request, complying with requirements of Section 00 1630, Product Options and Substitutions.

2.02 BALLASTS

- A. All dimming ballasts to be of same manufacturer.
- B. All dimming ballast shall be compatible with specified photocells.
- C. See Section 26 50 00 for ballast product specification.

2.03 LOW VOLTAGE CONTROL WIRING

- A. 18 gauge shielded cable or as recommended by the manufacturer.

2.04 TEST EQUIPMENT

- A. Provide multi-function digital Illuminance meter with detachable receptor head with the following characteristics:
1. Receptor: Silicon photocell type
 2. Illuminance Units: Lux or footcandles (switchable)
 3. Measuring range: 0.1 to 19,990 lux, 0.01 to 1,999 footcandles
 4. Accuracy: $\pm 4\% \pm 1$ digit of displayed value
 5. Cosine Correction Characteristics: Within $\pm 1\%$ at 10° ; within $\pm 5\%$ at 60° .
 6. Measuring functions: Illuminance, integrated illuminance, average illuminance.
 7. Temperature/humidity drift: Within $\pm 3\% \pm 1$ digit (of value displayed at $20^\circ\text{C}/ 68^\circ\text{F}$) within operating temperature/humidity range.
 8. Operating conditions: 0 to 40°C (32 to 104°F) at less than 85% humidity.
- B. Provide proof of calibration within 12 months of use. Calibration shall be performed by an independent calibration lab approved by the manufacturer of the meter.

EXECUTION

2.05 INSTALLATION

- A. Photocell shall be installed surface mounted on recessed junction box in location best suited for accurate measurement. Avoid placement in high traffic or confined spaces.
- B. Provide to Architect prior to installation layout drawings indicating proposed location of all photocells and control groups. Proceed with installation after review and acceptance by Architect.
- C. Wiring shall be installed in conduit where running through inaccessible areas. Plenum rated wiring shall be allowed in accessible ceiling spaces.
- D. Coordinate low voltage wiring connection and location with luminaires to be controlled.

2.06 WORK PRIOR TO COMMISSIONING

- A. Complete all phases of work so the system can be powered, tested, adjusted, and otherwise commissioned. Under Division 26, complete systems, including all subsystems, so they are fully functional. This includes the complete installation of all equipment, materials, wire, controls, etc., in accordance with the contract documents and related directives, clarifications, change orders, etc.
- B. A commissioning plan will be developed by the Test Engineer and approved by the Commissioning Agent. Under Division 26, assist the Test Engineer and Commissioning Agent in preparing the commissioning plan by providing all necessary information pertaining to the actual equipment and installation. If system modifications and clarifications are in the contractual requirements of this and related sections of work, they will be made at no additional cost to the Owner. If Contractor initiated system changes have been made that alter the commissioning process, the Commissioning Agent will notify the Owner.
- C. Specific pre-commissioning responsibilities under Division 26 are as follows:
 - 1. Factory startup services for the following items of equipment:
 - a. Lighting Control System
 - 2. Normal startup services required to bring each system into a fully operational state. This includes complete installation and cleaning. The Test Engineer will not begin the commissioning process until each system is documented as being installed complete.
- D. Commissioning shall begin after installation of all interior and exterior finishes including but not limited to adjacent roofing, finished floor, wall, and ceiling systems including final painting, all furniture and book stacks in place, and all other building systems which have direct or indirect influence on the performance and distribution of the daylight and electric lighting systems. Start of commissioning before such items are complete will not relieve Contractor from completing those systems in accordance with the Construction Schedule.

2.07 SEQUENCE OF COMMISSIONING

- A. Provide to Architect prior to start of commissioning layout drawings indicating proposed location of all measurement points. Proceed with commissioning after review and acceptance by Architect.
- B. All illuminance measurements shall be oriented horizontal, facing up, at 30 inches above finished floor. All measurements for a control group shall occur at the same location. Ensure constancy of local surface reflectance conditions throughout commissioning of each control group.
- C. Ensure no personnel or outside influence affects the amount of flux striking the receptor head during the recording session.
- D. Document measurements in clearly understandable format for review by the Architect. Include time of measurement, temperature, and relative humidity.
- E. Measure illuminance at least two hours after local sunset with full output of all electric lighting. Record integrated illuminance and average illuminance for a two hour period.

- F. During daylight hours, measure illuminance with all electric lighting off, including emergency and "nightlight" circuits. Record integrated illuminance and average illuminance for a two hour period. Document in clearly understandable format for review by the Architect.
- G. Set each photocell to 150 percent of electric-only lighting contribution.
- H. After initial setpoint has been set, measure illuminance in 10 minute increments from 1 hour before to 1 hour after local sunset.
- I. Submit all recorded data to Architect for review.

2.08 SEQUENCE OF OPERATIONS FOR LIGHTING CONTROLS

A. Control Approach:

- 1. Open public spaces and exterior lighting shall be controlled via the BMS and programmed timed on/off relay controls.
- 2. Enclosed spaces shall be stand-alone, controlled via occupancy or vacancy sensors.
- 3. Electrical, mechanical, IT, MDF, and IDF and rooms where personal safety is a concern will have line voltage switches only. A large sign will be placed on the back side of all doors exiting the space with the words "TURN OFF THE LIGHTS" in large contrast font. Coordinate sign with architect prior to installation.
- 4. The gymnasium shall be controlled by a local room control with digitally distributed relays for preset scene control.

B. Sequence of Operations:

1. Exterior Lighting

- a. Building mounted lighting shall turn on and off by astronomical timeclock for dusk to dawn operation. Confirm with owner and provide timeclock schedule if requested.
- b. Parking lot lighting shall turn on and off in two sequences as defined in the relay schedule. One zone turns on/off by astronomical timeclock for dusk to dawn operation. One zone turns on by astronomical timeclock and off at 10pm. Confirm with owner and provide timeclock schedule if requested. One of the two circuits of each light pole shall tie to integral occupancy sensor.
- c. Site lighting along sidewalks and pathways shall turn on and off by astronomical timeclock for dusk to dawn operation. Confirm with owner and provide timeclock schedule if requested.
- d. Accent lighting and plaza lighting shall turn on by astronomical timeclock at dusk and off by timeclock at 10pm. Confirm schedule with owner.
- e. Local override for all exterior lighting shall be located in Custodial office. Illuminated switch by Lev-Lok.

2. Public Spaces

- a. All lighting in the open seating, circulation, elevator lobbies, entrance lobbies, and two story space will operate on the BMS that will turn lighting on 30 minutes before open and shut off 30 minutes after "closed" hours. Verify Open and Closed hours of operation with owner prior to programming.
- b. Circulation areas, hallways, and open plan work will have OS/VS overrides during closed hours. These will turn emergency egress lights on to 100 percent when occupancy is detected, but will turn them off after 10 minutes without movement. OS/VS will be inactive during the day.
- c. All open spaces and circulation have manual override, where required by code (see drawings)
- d. Public Toilets will be controlled via local occupancy sensor. Auto ON/ Auto OFF. Provide keyed override switch for maintenance

- e. Storage and support spaces will have occupancy sensors and manual switch. Room controls are to be manual on, auto off with a 15 minute time delay.
- f. Electrical and mechanical spaces will have manual switch only for safety.
- 3. Classrooms:
 - a. Stand-alone room control via non-dimming switches and vacancy sensors.
 - b. Closed loop photocell to monitor lights in the indicated daylight zone for 0-10V gradual dimming. Photocells set to 30fc with a 5 minute dead-band.
- 4. Science and Makers Labs:
 - a. Stand-alone room control via non-dimming switches and vacancy sensors.
 - b. Photocells integral in the luminaire to provide individual 0-10V gradual dimming. Photocells set to 50fc with a 5 minute dead-band.
- 5. Private Offices and Admin Areas:
 - a. Each room will have a wall box dimmer and vacancy sensor.
 - b. Lights remain off until manually engaged by an occupant. Vacancy sensors do NOT automatically turn electric lights on if someone enters the room, but will turn lights off after 30 minutes of non-occupancy. Sensitivity should be set to maximum.
 - c. In offices where daylight harvesting is required, photocells shall be set to 30fc with a 5 minute dead-band.
- 6. Conference Rooms:
 - a. Stand-alone room control via non-dimming switches per zone.
 - b. Vacancy sensor time delay shall be set to 30 minutes.
- 7. Gymnasium
 - a. Lights turn on by timeclock as defined by the owner, during normal operating hours. Locked box to contain the room controller for scene definition. Five button switch located at all entries around the room for pre-set scene control and activation of lighting after hours.
 - b. Open loop photocell to monitor lights in the indicated daylight zones for 0-10V gradual dimming. Photocells shall be set to 50fc with a 5 minute dead-band.
- 8. All other spaces
 - a. Sequence of operations will be provided upon written request for all spaces not listed. Reprogramming may be required of some spaces on site after installation to tune the system and meet the owner, daylight and energy management needs. Provide additional programming for reconfiguration up to 24 hours at no additional cost to the owner or design team.

2.09 TESTING FOR SEASONAL VARIATIONS

A. Timing of Commissioning:

- 1. Initial commissioning shall be performed to best suit the current time-of-year and cloud cover conditions.
- 2. Seasonal commissioning pertains to testing under full sunlight and full overcast conditions during summer and winter solstice, as well as similar conditions at the spring or fall equinox.
- 3. Initial commissioning shall be done as soon as contract work is completed regardless of season.
- 4. Subsequent commissioning shall be undertaken thereafter to ascertain adequate performance during the four seasons.

2.10 PARTICIPATION IN COMMISSIONING

- A. Provide skilled technicians to start up all systems within Division 26. These same technicians shall be made available to assist the Test Engineer and Commissioning Agent in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested and coordinated by the Test Engineer. Under Division 26, ensure that the qualified technician(s) are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem resolutions at no additional cost to the Owner.
- B. System problems and discrepancies may require additional technician time, Test Engineer time, Commissioning Agent time, redesign, and reconstruction of systems and system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained at no additional cost to the Owner.
- C. The Commissioning Agent reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment or system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service the commission the equipment, and a willingness to work with the Test Engineer and Commissioning Agent to get the job done. Technicians shall be removed from the project at the request of either the Test Engineer or Commissioning Agent.

2.11 RESOLUTION OF DEFICIENCIES

- A. In some systems, misadjustments, misapplied equipment, and deficient performance will result in additional work required to commission the systems. This work will be completed under the direction of the Architect, with input from the Contractor, equipment supplier, Test Engineer, and Commissioning Agent. Whereas all members will have input and the opportunity to discuss the work and resolve problems, the Architect will have final jurisdiction on the necessary work to be done to achieve performance.
- B. Corrective work shall be completed in a timely fashion to permit timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Agent deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Agent will notify the Owner, indicating the nature of the problem, expected steps to be taken, and the deadline for completion of activities.
- C. If deadlines pass without resolution of the problem, the Owner reserves the right to obtain supplementary services, equipment, or both, to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Contractor's responsibility.

2.12 TRAINING

- A. Participate in the training of Owner's engineering and maintenance staff, as required in Divisions 1 through 28, on each system and related components. Training, in part, will be conducted in a classroom setting, with system and component documentation, and suitable classroom training aids. All training classroom sessions and file demonstrations will be videotaped and copies of this material will be provided as part of closeout requirements.
- B. Training will be conducted jointly by the Test Engineer, Commissioning Agent, the Contractor, and the equipment suppliers. The Test Engineer will be responsible for highlighting system peculiarities specific to this project.
- C. Provide one video tape training session.

2.13 SYSTEMS DOCUMENTATION

- A. In addition to the requirements of Division 1, update contract documents to incorporate field changes and revisions to system designs to account for actual constructed configurations. Division 26 Record Drawings shall include architectural floor plans and the individual daylight control systems in relation to actual building layout. These Record Drawings shall also be provided in AutoCad .Dwg format for transmittal to the Test Engineer.

END OF SECTION

SECTION 26 2200
LOW VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Provide dry type transformers to provide 208Y/120V power from the 480Y/277V system.
 - 2. Size transformers as indicated.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 3. Section 26 0533, Raceways and Boxes for Electrical Systems
 - 4. Section 26 0553, Identification for Electrical Systems
 - 5. Section 26 0580, Electrical Testing

1.03 SUBMITTALS

- A. Shop drawings with nameplate data.
- B. Product Data

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Transformers shall be of the same manufacturer as the distribution equipment specified in Section 26 2413, Switchboards; or approved equivalent.

2.02 INDOOR LOW VOLTAGE TRANSFORMERS

- A. Enclosed and ventilated, air cooled type, Class H insulation, NEMA type TP-1. Equip with two 2-1/2 percent FCAN taps and four 2-1/2 percent FCBN taps. Maximum sound level NEMA Standard with vibration isolators between the core and coil assembly and case.
- B. Maximum sound level shall be NEMA standard with vibration isolators between the core and coil assembly and case. There shall be no metal-to-metal contact between core and coil and the enclosure. Sound levels shall be warranted by the manufacturer not to exceed the following:

10 to 50 KVA	45 DB
51 to 150 KVA	50 DB
151 to 300 KVA	55 DB
301 to 500 KVA	60 DB
501 to 700 KVA	62 DB

- C. Core visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and NEC Standards.
- D. The case shall be totally enclosed with louvers to prevent entry of foreign objects into the interior, manufactured in accordance with all NEMA and UL approval standards.
- E. Provide grounded isolation shields between the primary and secondary windings where noted or shown on the Drawings to attenuate source of line interference. Insulate shield from the transformer windings and core and ground to transformer enclosure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install transformers with flexible conduit connections to housing. Make all cable and ground wire connections.
- B. In general, transformers will be floor mounted. When necessary to wall or trapeze mount, securely anchor to structure as required for seismic Zone 3.
- C. Install with sound isolating vibration dampers between the transformer enclosure and the hanger or building structure.
- D. Provide nominally 3-inch deep concrete pads under all floor-mounted transformers.
- E. Provide seismic restraint for all transformers as recommended by SMACNA. Provide shop drawings sealed by a registered Structural Engineer indicating this seismic restraint.

END OF SECTION

**SECTION 26 2413
SWITCHBOARDS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Provide the materials for the complete secondary service and distribution system as indicated.
 - 2. Provide a transformer pad and ground grid for use by the serving utility. Coordinate pad size, openings, type of construction, conduit arrangement, and grounding requirements with the utility prior to construction.
 - 3. Provide utility metering facilities where indicated on the Drawings, complying with the established serving utility requirements. Provide quantity and style of meter sockets and accessories required by the utility.
 - 4. Include all metering charges or connection costs charged by the serving utility in the original proposal. Refer to Coordination of Work section of these Specifications.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 3. Section 26 0553, Identification for Electrical Systems
 - 4. Section 26 0573, Overcurrent Protective Device Coordination Study
 - 5. Section 26 0580, Electrical Testing

1.03 SUBMITTALS

- A. Shop Drawings.
- B. Product data:
 - 1. Detailed component material list.
 - 2. Voltage rating, amperage rating, bussing material, fault rating, wiring lugs capacity, mounting method, physical size, exterior finish and options.
 - 3. Equipment one-line diagram.
 - 4. Equipment elevations and dimensions.
 - 5. Conduit entry areas.
 - 6. Individual circuit breaker product data sheets.
 - 7. Panel schedules; the panel schedules shall indicate circuit breakers in the same orientation as the construction documents.
- C. Equipment test reports.
- D. Operation and Maintenance data.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Eaton, General Electric, Siemens, or Square D.

2.02 MAIN DISTRIBUTION PANEL (MDP)

A. General:

1. NEMA Standard PB-2 and UL 891 compliant.
2. Freestanding, rear-aligned, front-accessible, group-mounted circuit breaker type, fully enclosed with bussing and hardware provisions for the addition of future circuit breakers.
3. Circuit breaker trip ratings shall be as indicated on Drawings.
4. Equipment assembly shall have a short circuit current rating (SCCR) greater than the maximum available fault current expected at that point in the distribution system.
5. Panel shall be listed by Underwriters' Laboratories and shall bear a UL label as suitable for use as service equipment.
6. Refer to Drawings for maximum allowable equipment footprint.

B. Construction:

1. Equipment shall consist of the required number of vertical sections bolted together to form a rigid assembly.
2. All edges of front covers or hinged front panels shall be formed.
3. Provide adequate ventilation within the enclosure.
4. All sections of the equipment shall be rear-aligned with depth as required to accommodate devices shown and necessary conduit entrance for current and future devices.
5. All exterior and interior steel surfaces shall be properly cleaned and provide with a rust-inhibiting coating. Color and finish shall be ANSI 61 light gray.

C. Bus Work:

1. Copper or tin-plated aluminum, sized as indicated on Drawings, with a 100 percent capacity neutral bus.
2. Bus sizing shall be based on NEMA standard temperature rise criteria of 65°C above an ambient of 40°C under continuous full load current and rated to withstand the maximum available fault current expected at that point in the distribution system.
3. Include bussing provisions for mounting future devices in all spaces called for on Drawings. Where configuration provides additional spaces within a section, these spaces shall be bussed to receive future devices.
4. Provide a copper ground bus firmly secured to each vertical section and extending the entire length of the MDP.
5. All vertical sections shall be fully bussed.

D. Provide separate vertical section for service entrance conductor drip loop when Main Distribution Panel is installed below finished grade or when susceptible to water intrusion via service conduit. Contractor shall install drip loop per serving utility requirements, if applicable.

E. Utility Metering: Where indicated on Drawings, provide a separately barriered Utility Metering Compartment complete with hinged sealable door in accordance with Utility requirements. Bus work shall include provisions for mounting utility company current transformers and potential transformers or potential taps as required by the utility company.

F. Circuit Breakers:

1. Provide main and feeder circuit breakers as shown on Drawings.
2. Circuit breakers shall be molded case, bolt-on type, with inverse time and instantaneous tripping characteristics.
3. Provide with ground fault protection where indicated on Drawings or as required by NEC.
4. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position.

5. Circuit breakers shall have short circuit capacity rating to withstand the maximum short circuit duty that can be expected at the breaker location in the electrical system. Minimum short circuit rating for any circuit breaker shall be 10,000 AIC for 120/208V breakers, and 14,000 AIC for 277/480V breakers.
6. Series rating is not permitted.

G. Wiring/Terminations:

1. Small wiring, necessary fuse blocks and terminal blocks within the MDP shall be furnished as required. Control or metering components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
2. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75°C of the size as indicated on the Drawings.
3. Lugs shall be provided in the incoming line section for connection of the main grounding conductor and other grounding conductors as indicated on Drawings.

H. Where exposed to weather, provide NEMA Type 3R enclosure with interior thermostatically controlled electrical space heater with adequate wattage to prevent the accumulation of moisture. Power for space heater shall be obtained from a control power transformer within the MDP assembly.

I. Surge Protection Device (SPD):

1. SPD shall be mounted in a NEMA Type 1 enclosure external to switchboard equipment.
2. Surge protection shall use thermally protected MOV technology.
3. Surge current capacity rating shall be as recommended by manufacturer.
4. Dual-colored protection status indicators for each phase.
5. Dual-colored protection status indicators for the N-G protection mode.
6. Audible alarm with silence button.
7. Form C relay contact.
8. Provide SPD on all emergency system distribution and sub-distribution boards.

J. Electronic Customer-Metering:

1. Provide microprocessor based electronic meter to monitor electrical power distribution system in a real time mode. The system shall consist of a meter and display integral to the MDP in a separate customer-metering compartment with front-hinged door.
2. A meter shall be provided for the incoming electrical service. Where multiple meters are required, provide single LCD display capable of accepting inputs from all meters shown.
3. Current transformers for each meter shall be wiring to shorting-type terminal blocks within customer metering compartment.
4. Potential transformers including primary and secondary fuses with disconnecting means shall be provided.
5. The electronic meter shall accept input from industry standard instrument transformers (120VAC secondary PT's and 5A secondary CT's.)
6. The current and voltage signals shall be digitally sampled at a rate high enough to provide accurate RMS sensing and valid data for waveform analysis beyond the 30th harmonic (fundamental frequency of 60 HZ).
7. All setup parameters required by the meter shall be stored in nonvolatile memory (no battery backup) and retained in the event of a control power interruption.
8. The meter shall also maintain in nonvolatile memory a maximum and minimum value for each of the instantaneous values reported as well as the time and date of the highest peak for all of the peak demand readings.

9. The meter shall be accurate to +1.0 percent voltage and current sensing.
10. The following minimum readings shall be reported by the meter:
 - a. Energy: real (kWh), reactive (kVARh).
 - b. Current, per phase RMS +1.0 percent.
 - c. Current, 3-phase average RMS +1.0 percent.
 - d. Voltage, phase-to-phase and phase-to-neutral +1.0 percent
 - e. Power factor, per phase +2.0 percent.
 - f. Power factor, 3-phase total +2.0 percent.
 - g. Frequency +0.5 percent.
11. The following demand readings shall be reported by the meter:
 - a. Average demand current, per phase.
 - b. Peak demand current, per phase.
12. Communications: Provide with RS-485 and Modbus RTU output capability.

2.03 SUB-DISTRIBUTION PANELS (SDP)

A. General:

1. Similar in manufacture as the Main Distribution Panel.
2. Freestanding, rear-aligned, front-accessible, group-mounted circuit breaker type, fully enclosed with bussing and hardware provisions for the addition of future circuit breakers. Assemblies rated 800Amps or below may be wall-mounted.
3. Circuit breaker trip ratings shall be as indicated on Drawings.
4. Equipment assembly shall have a short circuit current rating (SCCR) greater than the maximum available fault current expected at that point in the distribution system.
5. Panel listed by Underwriters' Laboratories and UL label.
6. Refer to Drawings for maximum allowable equipment footprint.

B. Construction:

1. Equipment shall consist of the required number of vertical sections bolted together to form a rigid assembly.
2. All edges of front covers or hinged front panels shall be formed.
3. Provide adequate ventilation within the enclosure.
4. All sections of the equipment shall be rear-aligned with depth as required to accommodate devices shown and necessary conduit entrance for current and future devices.
5. All exterior and interior steel surfaces shall be properly cleaned and provide with a rust-inhibiting coating. Color and finish shall be ANSI 61 light gray.

C. Bus Work:

1. Copper or tin-plated aluminum, sized as indicated, with a 100 percent capacity neutral bus.
2. Bus sizing shall be based on NEMA standard temperature rise criteria of 65°C above an ambient of 40°C under continuous full load current and rated to withstand the maximum available fault current expected at that point in the distribution system.
3. Include bussing provisions for mounting future devices in all spaces called for on Drawings. Where panel configuration provides additional spaces within a section, these spaces shall be bussed to receive future devices.
4. Provide a copper ground bus firmly secured to each vertical section and extending the entire length of the SDP.
5. All vertical sections shall be fully bussed.

D. Circuit Breakers:

1. Provide main and feeder circuit breakers as shown on Drawings.
2. Circuit breakers shall be molded case, bolt-on type, with inverse time and instantaneous tripping characteristics.
3. Provide with ground fault protection where indicated on Drawings or as required by NEC.
4. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position.
5. Circuit breakers shall have short circuit capacity rating to withstand the maximum short circuit duty that can be expected at the breaker location in the electrical system. Minimum short circuit rating for any circuit breaker shall be 10,000 AIC for 120/208V breakers, and 14,000 AIC for 277/480V breakers.
6. Series rating is not permitted.

E. Wiring/Terminations:

1. Small wiring, necessary fuse blocks and terminal blocks within the SDP shall be furnished as required. Control or metering components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
2. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75°C of the size as indicated on the Drawings.
3. Lugs shall be provided in the incoming line section for connection of the main grounding conductor and other grounding conductors as indicated on Drawings.

F. Where exposed to weather, provide NEMA Type 3R enclosure with interior thermostatically controlled electrical space heater with adequate wattage to prevent the accumulation of moisture. Power for space heater shall be obtained from a control power transformer within the SDP assembly.

G. Surge Protection Device (SPD):

1. SPD shall be mounted in a NEMA Type 1 enclosure external to SDP equipment.
2. Surge protection shall use thermally protected MOV technology.
3. Surge current capacity rating shall be as recommended by manufacturer.
4. Dual-colored protection status indicators for each phase.
5. Dual-colored protection status indicators for the N-G protection mode.
6. Audible alarm with silence button.
7. Form C relay contact.
8. Provide SPD on all emergency system distribution and sub-distribution boards.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install the distribution system assemblies and equipment as shown on the Drawings, parallel and square with the building lines.
- B. Attach all distribution equipment to building structure; refer to Section 26 0529.
- C. Neatly lace and secure the conductors of the feeder circuits individually at maximum 2-foot intervals. The cable lugs shall not support the weight of the cables.
- D. Where fusible distribution panels are provided, mount a spare fuse cabinet adjacent to each fusible distribution panel. Equip cabinet with one complete set of spare fuses of each size and type installed in the panel with appropriate fuse pullers.

- E. Concrete Pads: Provide minimum 3.5-inch thick concrete housekeeping pads under all freestanding pieces of distribution equipment. Pads shall extend a minimum of 2-inches beyond the edges of the equipment.
- F. Adjust breaker settings per recommendation of coordination study and test all ground fault settings as required by NEC.
- G. Equipment Tests:
 - 1. Acceptance testing shall be provided for all equipment in accordance with NETA Acceptance Testing Specifications. Record results and submit with final warranty.
 - 2. Where ground fault protection is provided, perform tests on the ground fault protection system in accordance with the manufacturer's instructions. Record results and submit with final warranty.
 - 3. If any tested equipment is found defective during testing sequence, the contractor shall replace it without any additional cost to the Owner. All replaced equipment shall be tested until satisfactory results are obtained.
 - 4. Where included, refer to Section 26 0580, Electrical Testing for additional requirements.
- H. Cleaning: Upon completion of installation, inspect interior and exterior of distribution equipment. Remove paint splatters or other spots. Vacuum dirt and debris; do not use compressed air to clean. Repair exposed surface to match original finish.

END OF SECTION

**SECTION 26 2416
PANELBOARDS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section Common Work Results for Electrical, apply to this Section.

1.02 SUMMARY

- A. This Section includes: Provide panelboards for branch circuit distribution as indicated.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 3. Section 26 0533, Raceways and Boxes for Electrical Systems
 - 4. Section 26 0553, Identification for Electrical Systems
 - 5. Section 26 0573, Overcurrent Protective Device Coordination Study
 - 6. Section 26 0580, Electrical Testing

1.03 SUBMITTALS

- A. Shop Drawings
- B. Product Data
 - 1. Detailed component material list.
 - 2. Voltage rating, amperage rating, bussing material, fault rating, wiring lugs capacity, mounting method, physical size, exterior finish and options.
 - 3. Individual circuit breaker product data sheets.
 - 4. Panel schedules; the panel schedules shall indicate circuit breakers in the same orientation as the construction documents.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Panelboards shall be of the same manufacturer as the distribution equipment specified in Section 26 24 13.

2.02 BRANCH PANELBOARDS

- A. Branch Circuit Panels: Bolt-on circuit breaker type fitted with metallic flush lift latches and locks keyed alike. Deliver all panel keys to the Owner at completion of the project.
- B. Short Circuit Current Rating (SCCR): Fully rated at a value greater than the maximum available short circuit current that can be expected at the panelboard location in the electrical system. Series rating is not permitted.
- C. Cabinets:
 - 1. Cabinet rough-in boxes shall be code gauge steel, with dead front covers.
 - 2. Flush panels shall have flush doors with concealed hinges and mounting clamps. Surface panels shall have metal face trims with no sharp edges or corners. Surface panel cabinets shall be fabricated without knockouts and finished to match face trim.
 - 3. All panels shall have hinged trim fronts with captive screws that provides full access to wiring compartment.

- D. Wiring Gutters: A minimum of 4-inches wide except where feeder conductors enter where a minimum of 6-inches clear shall be provided. Feeder conductors to enter directly in line with lug terminals wherever practicable. Provide separate feeder studs for each feeder conductor compression lug.
- E. Bussing: Provide one continuous bus bar per phase. Provide copper or electrical grade aluminum alloy sized as indicated on the drawings and in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient temperature of 40 degrees C maximum. Full size insulated neutral bars shall be included for panels indicated to have a neutral. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices.
- F. Ground Bus: Provide in each panelboard. Ground bus shall:
1. Have the same rating as the neutral bus.
 2. Contain a ground conductor terminal for each available circuit in the panelboard.
 3. Have terminals sized for the branch circuit equipment grounding conductors.
- G. Isolated Ground Bus: Provide in each panelboard as indicated. Ground bus shall:
1. Be insulated from the panelboard enclosure.
 2. Have the same rating as the neutral bus.
 3. Contain a ground conductor terminal for each available circuit in the panelboard.
 4. Have terminals sized for the branch circuit equipment grounding conductors.
- H. Interiors: Main lug only unless otherwise indicated, with dead front shield covering the bus, and bus connectors, with all mounting hardware and bussing for all spaces indicated for future installation of devices. Interior trim shall be of dead front construction. All unused mounting spaces shall be covered with preformed knockouts.
- I. Main Circuit Breaker: Where indicated, equip panels indicated with main circuit breakers sized as scheduled and mounted behind door at top of panel for top entrance feeders, and bottom of panel for bottom entrance feeders. Where main circuit breaker size is not indicated, ampere rating shall match feeder ampacity or panelboard rating, whichever is less.
1. Molded case, thermal magnetic bolt-on type and sized as indicated on the Drawings. Circuit breaker shall have an overcenter, trip-free, toggle mechanism that shall provide quick-make, quick-break contact action. Indicate open, closed, or tripped by handle position, with common internal trip crossbar to provide simultaneous tripping for all poles.
 2. Circuit breakers shall have a permanent trip action with thermal and magnetic trip elements in each pole. Each thermal element shall be factory calibrated to operate in a 40 degrees C ambient environment. Thermal elements shall be ambient compensating above 40 degrees C.
 3. Provide with circuit breaker lock-off device to provide capability to be locked in the open position.
- J. Branch Circuit Breakers:
1. Breakers shall be provided with amperage rating, and number of poles as indicated in the Panelboard Schedules.
 2. Circuit breakers shall be bolt-on type.
 3. Circuit breakers shall have an overcenter toggle mechanism that shall provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two and three pole circuit breakers shall have an internal common trip crossbar to provide simultaneous tripping.
 4. The exposed faceplates of all circuit breakers shall be flush with one another.

5. Breakers shall have short circuit capacity rating to withstand the maximum short circuit duty that can be expected at the breaker location in the electrical system. Minimum short circuit rating for any circuit breaker: 10,000 AIC for 120V and 208V breakers, 14,000 AIC for 277V and 480V breakers unless otherwise noted on drawings.
6. Circuit breakers used for switching duty shall be UL listed for that purpose and marked SWD.
7. Circuit breakers serving heat trace circuits shall be ground fault interrupter (GFI) type with 30 ma ground fault trip rating.
8. Provide circuit breaker lock-off device for each branch circuit breaker
- K. Provide shunt trips, alarms and auxiliary switches as shown on the Drawings.
- L. Provide Arc Fault Circuit Interrupter (AFCI) breakers as shown on the Drawings or as required by Code.
- M. Provide SPD on all emergency system panelboards.

2.03 IDENTIFICATION

- A. Branch circuit breakers shall be identified with individual circuit numbers adjacent to each breaker with a typewritten card to identify the load controlled by that breaker.
- B. Contractor will be provided with complete schedules of all panelboards as designed prior to start of construction. Schedules will include circuit breaker arrangement, load schedules, and ratings for use in identification of circuits and coordination.
- C. Refer to Section 26 0553, Identification of Electrical Systems for additional requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panelboards in accordance with manufacturer's recommendations.
- B. Install panelboards plumb and level, located as shown on the Drawings up 6-feet – 6-inches to top unless noted otherwise.
- C. Area above panelboard shall be kept clear of all equipment foreign to the electrical installation including piping, ductwork, supports, etc. Coordinate installation with all other trades.
- D. Provide identification as specified in Section 26 0553, Identification of Electrical Systems.

3.02 SPARE CONDUITS

- A. Install a spare 3/4-inch conduit from flush panels for each three single pole breakers or spaces provided. Terminate conduits above accessible ceiling or as directed.

END OF SECTION

SECTION 26 2726
WIRING DEVICES

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes: Wiring devices and plates for all outlet boxes shown.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 3. Section 26 0533, Raceways and Boxes for Electrical Systems
 - 4. Section 26 0553, Identification for Electrical Systems
 - 5. Section 26 0580, Electrical Testing

1.03 SUBMITTALS

- A. Product data.
- B. Shop drawings of the occupancy sensor locations shall be prepared by the manufacturer in AutoCAD and submitted for review. The shop drawings shall be coordinated with all other trades and identify actual device locations and quantities within each space required to provide adequate sensing coverage in accordance with manufacturer's recommendations. Identify mounting configuration (i.e. ceiling or wall) and sensor technology proposed at each location.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Wiring devices shall be extra heavy duty 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. Furnish a matching plug connector for all special purpose devices that do not have the common 120V NEMA 5-20R configuration.
- B. All lighting switches and duplex receptacles installed shall have similar appearance characteristics unless noted otherwise.

2.02 WALL SWITCHES

- A. Acceptable Manufacturers: Leviton Lev-Lok or approved equal.
- B. Line Voltage Switches: 20A rated, 277 volt, quiet type, extra heavy duty, heavy duty nylon toggle handle, Leviton Lev-Lok or Hubbell Quick-Tech terminations or equal.
 - 1. As noted on the drawings provide:
 - a. Pilot light switch: lighted clear toggle.
 - b. Momentary Contact Switches: 15A, SPDT, center off.
 - c. Key Switches: 20A, 277V, back and side wired with screw terminal connections.
- C. EPO pushbutton switch: Red mushroom head push-off, pull-on with concentric guard, 2-1/4 inch diameter, non-illuminated, heavy duty operator. Provide clear hinged louver to prevent accidental operation. Provide laminated engraved nameplate attached with stainless steel screws indicating "Emergency Power Off" and load served.
- D. Dimming Switches: architectural grade, line voltage, 20A rated, single pole, slide-to-off type, slide up to brighten and down to dim, decora style, wattage rating and lamp/ballast compatibility as required. Provide 3-way type where shown on plan. Lutron Nova T, Leviton SureSlide, or Hubbell.

E. Except as noted herein, device exposed finish color shall be as follows:

1. Normal power: Gray or as selected by Architect.
2. Emergency power: Red.
3. Standby power: Red.

2.03 SENTRY SWITCHES

- A. Acceptable Manufacturers: Sentry Switch, LLC or approved equal.
- B. 20A rated, 277V heavy duty nylon toggle handle, back and side wired with screw terminal connections
- C. Mechanically resets to OFF when input power is interrupted for 5 seconds or longer, mini neon indicator light that illuminates when unit is switched off.

2.04 RECEPTACLES

- A. Acceptable Manufacturers: Leviton Lev-Lok or approved equal.
- B. Standard straight blade duplex receptacle: 3-wire, 2-pole with grounding, extra heavy duty, 10A rated, NEMA 5-20R configuration, Leviton Lev-Lok or Hubbell Quick-Tech terminations or equal.
 1. Provide tamper-resistant in all childcare facilities and as noted on the drawings or NEC required.
- C. Ground Fault Interrupting straight blade duplex receptacle: heavy duty, 3-wire, 2 pole with grounding, self-testing, green "ON" LED to indicate power, red ON LED to indicate ground fault condition, 20A rated, NEMA 5-20R configuration, Hubbell Quick-Tech or Leviton Lev-Lok terminations or equal.
 1. Provide weather-resistant rating at exterior locations as required by NEC.
- D. Special Purpose Receptacles: As noted on Drawings with NEMA configurations.
- E. Except as noted herein, device exposed finish color shall be as follows:
 1. Normal Power: Gray or as selected by Architect.
 2. Emergency Power: Red
 3. Standby Power: Red

2.05 PLATES

- A. Acceptable Manufacturers: Hubbell, Leviton, Arrow-Hart, Pass & Seymour.
- B. Flush Finish Plates: 0.04-inch thick, Type 302 stainless steel, brush finish. Surface Covers: Galvanized or cadmium plated steel, 1/2-inch raised industrial type with openings appropriate for device installed.
- C. Weatherproof: Extra-Duty while in use covers, UL 514D listed, commercial quality diecast aluminum construction, NEMA 3R rated, gasketed, built-in padlock provisions, built-in cord strain relief provisions, gray powder-coated finish, vertical mounting as required for application or other covers of similar construction for other receptacle configurations.
- D. Identification: Identify receptacle plates with a pre-printed label indicating serving panel and branch circuit number. Refer to 260553 Identification for Electrical Systems.

2.06 OCCUPANCY SENSORS

- A. Acceptable Manufacturers: Watt Stopper, Leviton, SensorSwitch, Hubbell or Lutron. Watt Stopper series numbers are identified herein to establish the minimum level of quality for each product. Comparable products that meet the requirements of the specification by other acceptable manufacturers identified herein are acceptable.
- B. Wall-box Mounted: Passive infrared type, 180 degree coverage, automatic-on operation, 3-wire type, daylight override, adjustable time-out, selectable walk-through mode and override off switch. Single or dual relay type as required or as shown on Drawings. Watt Stopper PW series.

- C. Ceiling Mounted: 360 degree coverage, automatic-on operation, light-level sensing, adjustable time-out, automatic sensing/adjustment for optimal time-out delay setting, selectable walk-through mode, low- or line-voltage as shown on Drawings or described herein, surface mounted, with power pack as required, provide auxiliary contacts.
 - 1. Combination passive infrared and ultrasonic/microphonic type: Watt Stopper DT-300 series.
 - 2. Passive infrared type: Watt Stopper CI-300 series.
 - 3. Ultrasonic type: Watt Stopper UT-300 series.
- D. Ceiling/Wall Mounted: 180 degree coverage, automatic-on operation, light-level sensing, adjustable time-out, automatic sensing/adjustment for optimal time-out delay setting, selectable walk-through mode, low-voltage with power pack, surface mounted, provide auxiliary contacts.
 - 1. Combination passive infrared and ultrasonic/microphonic type: Watt Stopper DT-200 series.
 - 2. Passive infrared type: Watt stopper #CX-100 series.
- E. Provide all ceiling mounted occupancy sensors with isolated normally open and normally closed output contacts rated at 1A at 30VDC/VAC. Coordinate interface requirements with HVAC contractor.
- F. Provide multiple contacts and/or power packs for occupancy sensors that:
 - 1. Control both normal and emergency lighting and require separation of branch circuit wiring systems. In case of occupancy sensor failure, emergency lighting shall fail to the ON state.
 - 2. Control separate lighting control zones. Unless otherwise noted, occupancy sensors are intended to control all light in a designated zone or room. Contractor is responsible for providing the required power packs to insure functionality of the system.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Devices and finish plates to be installed plumb with building lines. Wall mounted receptacles shall be installed vertically at centerline height shown on the Drawings.
- B. Finish plates and devices are not to be installed until final painting is complete. Scratched or splattered finish plates and devices will not be accepted.
- C. Switches, receptacles and/or other devices ganged into a common enclosure shall be provided with a separation barrier between devices where the combined circuit voltages within the enclosure exceeds 300V.
- D. Provide GFCI receptacles as shown on the drawings or as NEC required. Provide a GFCI type duplex receptacle in each required location, do not sub-feed normal receptacles downstream of the GFCI receptacle to obtain the GFCI rating.
- E. Provide receptacles with GFCI, tamperproof, weather-resistant or hospital grade ratings as shown on the drawings, appropriate for the installation or required by NEC.

3.02 CORD CAPS

- A. All special plugs provided with the receptacles shall be given to the Owner in their cartons with a letter stating the date and the Owner's representative that received the materials.

3.03 COORDINATION

- A. The Electrical Drawings indicate the approximate location of all devices. Refer to Architectural elevations, sections, and details for exact locations.
- B. Coordinate with equipment installer the locations and methods of connection to devices mounted in cabinets, counters, work benches, service pedestals and similar equipment.

3.04 OCCUPANCY SENSORS

- A. Line voltage occupancy sensors shall be provided when installed in inaccessible ceiling system, except when auxiliary contacts are required, in which case a low voltage occupancy sensor shall be provided. For installation of low voltage occupancy sensors in inaccessible ceiling systems, coordinate power pack locations with Architect prior to installation and provide access panels as required.
- B. Low voltage occupancy sensors shall be provided when installed in accessible ceiling systems.
- C. Sensor locations identified on Drawings are diagrammatic and are meant to indicate only that occupancy sensing within a given space is required. Locate sensors to provide maximum coverage of the room, to operate as someone enters the room, and to avoid false operation due to persons outside the room passing an open door.
- D. Provide additional sensing heads as necessary or per manufacturer's recommendation to achieve complete coverage of each room.
- E. Set sensitivity as required to provide small movement coverage throughout the room without extending coverage beyond the room.
- F. System performance testing shall be done with the sensor timing set to the minimum time delay available. Once complete coverage of a given room has been demonstrated, set the delay to 30 minutes.
- G. Upon Completion of installation and prior to turning space over to Owner, Contractor shall reset occupancy sensor automatic self-adjustment settings to insure proper time delay self-adjustment for Owner occupant schedule and room use.
- H. Allow for up to 24 hours of call-back sensor adjustments to be made by the contractor or occupancy sensor manufacturer qualified installer for up to six months after the owner has taken occupancy of the space.

3.05 TESTING

- A. Receptacles shall be tested for line to neutral, line to ground and neutral to ground faults. Correct any defective wiring.

END OF SECTION

SECTION 26 2900
MOTOR CONTROLLERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Provide manual or magnetic motor starters of the proper characteristics for equipment as indicated.
 - 2. Provide switches of proper characteristics as disconnecting means.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cable
 - 2. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 3. Section 26 0553, Identification for Electrical Systems
 - 4. Section 26 0573, Overcurrent Protective Device Coordination Study
 - 5. Section 26 0580, Electrical Testing

1.03 SUBMITTALS

- A. Shop Drawings, Including the following Information.
 - 1. Field Dimensions.
 - 2. Description of Materials And Finishes
 - 3. Component Connections
 - 4. Anchorage Methods
 - 5. Installation Procedures
- B. Product data.
- C. Operating and maintenance data.
- D. Overload (heater) Sizing: A final listing of all motors and the heater size installed for that motor.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Motor Control Centers, Motor Starters and Visible Blade Disconnects: Same manufacture as the distribution equipment specified in Section 26 2413, Switchboards, Allen Bradley or approved equivalent.
- B. Horsepower Rated Toggle Switches: Arrow Hart, General Electric, Hubbell, Pass & Seymour.

2.02 MOTOR STARTERS

- A. Manual starters: NEMA ICS 2, AC general purpose Class A manually operated toggle type full voltage controller for fractional horsepower induction motors, quick-make, quick-break, with thermal overload protection and suitable enclosures.

- B. Magnetic starters, Non-reversing: NEMA ICS 2, AC general purpose, full voltage across the line non-reversing type, 120 volt coils, overload relays in each leg, running pilot lights, one normally closed and one normally open auxiliary contacts, 120V control transformers and suitable enclosures. Overload relays shall be an ambient compensated bimetallic type with interchangeable heater packs. Overload shall be adjustable, have single-phase sensitivity, and manual or automatic reset. Starters shall be suitable for the addition of at least four auxiliary contacts of any arrangement normally open or normally closed. Each starter shall be provided with a NO and a NC auxiliary contacts. The starter shall have a minimum fault interrupting rating of 10,000A.
- C. Magnetic Starters, Reversing: NEMA ICS 2, AC general purpose. Reversing starters shall consist of two contactors and a single overload relays assembly. Include electrical interlock and integral adjustable time delay transition between FORWARD and REVERSE rotation. Starters shall be electrically and mechanically interlocked to prohibit line shorts and both starters being energized simultaneously.
- D. Magnetic Starters, Two Speed: NEMA ICS 2, AC general purpose. Include electrical interlock and integral adjustable time delay transition between SLOW and FAST speeds. Starters shall be electrically and mechanically interlocked to prohibit both starters being energized simultaneously.
- E. Combination Starter/Disconnect, (Circuit Breaker): Combine magnetic motor starter as described above and [motor circuit protector] [thermal magnetic circuit breaker] disconnect in a common enclosure.
 - 1. Motor Circuit Protector: NEMA AB 1, circuit breaker with integral instantaneous magnetic trip in each pole. Circuit protector shall have an externally operated handle, giving positive visual indication of its ON-OFF position.
 - 2. Thermal Magnetic Circuit Breaker: NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole. Circuit protector shall have an externally operated handle, giving positive visual indication of its ON-OFF position.
- F. Combination Starter/Disconnect, Disconnect Switch Type: Combine magnetic motor starter as described above and non-fused or fused disconnect switch in a common enclosure. Switch type shall be as indicated on the drawings. Switch shall have an externally operated handle that shall give positive visual indication of its ON-OFF position.
 - 1. Non-fused Switch Assemblies: NEMA KS 1, enclosed knife switch with enclosed, but visible blades. Switch shall be rated as indicated on the drawings.
 - 2. Fused Switch Assemblies: NEMA KS 1, enclosed knife switch. Fuse clips shall accept Class R fuses. Switch and fuse sizes shall be as indicated on the drawings.
- G. Starter Contacts: Totally enclosed, double break, silver-cadmium-oxide power contacts. Contact inspection or replacement shall be possible without disturbing line or load wiring.
- H. Overload Relay: NEMA ICS with one-piece thermal unit construction. Thermal units shall be interchangeable. Overload relay control circuit contact shall be replaceable. Thermal units shall be required for starter to operate.
- I. Enclosure: ANSI/NEMA ICS 6, Type 1 as indicated, or as required to meet the conditions of installation.
- J. Equip starters with H-O-A selector switches, start-stop stations, or other auxiliary control device listed. Where no auxiliary devices are listed, equip each starter with an H-O-A switch.
- K. Control circuit transformer shall be provided in each starter. Transformer shall be sized to accommodate the contactor(s) and all control circuit loads. The transformer shall include primary and secondary fuses in all ungrounded conductors.
- L. Provide one normally open and one normally closed auxiliary contacts in each starter, unless additional auxiliary contacts are required. Contacts shall be NEMA ICS 2.
- M. All starter units shall be provided with control terminal blocks. Terminal blocks shall be rated at 20-Amperes and shall be accessible from inside the unit with the unit door is opened.

- N. Push Buttons: Unguarded, recessed type
- O. Indicating Lights: LED type, color to be Green for run, Red for stopped unless otherwise indicated.
- P. BMS compatibility: Contractor shall coordinate with the Owner's controls vendor and provide motor controls and interface compatible with controls systems and equipment provided by others. Controls compatibility shall be coordinated in advance and prior to equipment submittals.

2.03 DISCONNECTS

- A. Safety and disconnect switches shall be NEMA type HD (heavy duty), quick-make, quick-break, dual rated with electrical characteristics as required by the system voltage and the load served. Switches shall be equipped with a defeatable cover interlock.
- B. Enclosures shall be NEMA I for indoor use, unless specifically noted otherwise and NEMA 3R where installed exposed to the weather or designated by the subscript WP.
- C. Disconnects shall be fusible or non-fusible as designated on Drawings.

2.04 FUSES

- A. Fuses shall be UL Class RK-5 dual element, time delay, current limiting type. The overload thermal time delay element shall be a spring actuated soldered copper assembly in a separate sand free compartment. The short circuit current limiting section shall be copper alloy links encased in quartz sand.
- B. Fuses shall be capable of holding 500 percent of rated current for a minimum of 10 seconds, and carry a UL listed minimum interrupting rating of 200,000A rms symmetrical.

2.05 POWER MODULE (ELEVATOR SHUNT TRIP)

- A. Motor rated, fused power switch (size as indicated on drawings) with integral shunt trip attachment, control power transformer, control power fuses and blocks, fuse covers, key to test, pilot lights and fire alarm interface relay to NEMA I enclosure for emergency shutdown of elevator power. Provide auxiliary contacts for elevator battery lowering device to sense if power module was manually or unintentionally turned-off. Bussmann #PS series, Littelfuse, Ferrazshaw-Mersen or approved.

PART 3 EXECUTION

3.01 MOTOR STARTERS

- A. Provide the motor starting equipment as shown on the Drawings and coordinate all motor "overload" starter relays.
- B. Install the starters at the respective equipment unless shown otherwise.
- C. Freestanding starters shall be installed on metal channel support structure.
- D. Starters that are installed on exterior walls shall be installed with minimum 1/2-inch channel on wall to allow air space between starter and wall.
- E. Where fusible units are provided, install fuses as indicated on the drawings.
- F. Thermal overloads (heaters) shall be installed in each starter in accordance with the manufacturer's recommendations for that motor and the type of associated load. Coordinate proper size when individual power factor capacitors are utilized at the motor.
- G. Provide all relays, programming, and interface equipment required to be compatible with BMS system provided by Owner's vendor. Equipment shall be provided from factory with interfaces compatible with BMS where available, or provided with equipment and programming required for successful interface.

3.02 DISCONNECT SWITCHES

- A. Provide all code required disconnect switches under this work, whether specifically shown or not.

- B. Non-fusible disconnect switches required when equipment is not in sight of the branch circuit panel or starter may be horsepower rated, toggle type in suitable enclosure, mounted at or on the equipment.

3.03 FUSES

- A. Install fuses for motor protection to best protect the motor without nuisance tripping. Should fuse sizes require changing from what is shown due to variance between the original design information and actual equipment installed, fuses shall be sized in accordance with NEC. In no case shall fuses be sized smaller than the starter heaters on motor circuits.
- B. Provide one complete set of spare fuses of each amperage used on this project. Store spare fuses in the spare fuse cabinet.

3.04 COORDINATION

- A. Verify the characteristics and the motor full load current for each motor installed, using the actual motor nameplate data. Select and install the proper running overload devices in the starter as per the manufacturer's instructions. Provide the proper overload protection is a part of this Division of the work.
- B. Prepare table of all motor full load currents and installed overload devices and submit to the Architect.

END OF SECTION

**SECTION 26 3213
ENGINE GENERATORS**

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Provide an Emergency Power Generation System complete as indicated.
 - 2. Consists of natural gas engine driven electric generator set with control panel, cooling system, governor, starter motor, structural steel skid base and all other accessories needed for proper operation, including exhaust system, fuel system, automatic battery charger, starting batteries, battery cables, and other accessories as required for operation as specified below. The complete system is intended to automatically provide continuous electric power for the duration of any failure of the normal utility electric supply.
 - 3. Minimum standby output rating as noted on the plans.
 - 4. Enclosed in a Level 3 sound-attenuating, weatherproof enclosure and contain all accessories necessary for reliable operation in outdoor ambient conditions for the project location.
 - 5. Exhaust emissions levels shall comply with requirements of the local air pollution authority, or EPA requirements; whichever is more stringent.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 3. Section 26 0553, Identification for Electrical Systems
 - 4. Section 26 0573, Overcurrent Protective Device Coordination Study
 - 5. Section 26 0580, Electrical Testing

1.03 QUALITY ASSURANCE

- A. Engine Generator Set: Product of a firm regularly engaged in the assembly or manufacture of this equipment. The component parts of the unit shall be the product of firms regularly engaged in the manufacture of these parts.
- B. It is the intention of these specifications to secure equipment that can be properly maintained and serviced without the necessity of carrying expensive parts, stocks or being subjected to the inconvenience of interrupted service due to the lack of available parts.
- C. An engine of the same model, bore, stroke, configuration and rpm as the engine submitted, shall have a minimum of 2000 hours of satisfactory operation under average rated load conditions of 75 percent or greater over a 2-year period. Satisfactory operation is defined as an availability of at least 95 percent with no period of downtime for repair in excess of 75 hours. Certification of the above equipment experience, either from field installations or laboratory testing, shall be provided. NEMA certification that the generator meets all applicable NEMA standards shall be provided. Certifications shall be included with the shop drawing submittal.

1.04 CODES AND STANDARDS

- A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.
1. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 2. NFPA70 National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
 3. NFPA110 Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
- B. The generator set and supplied accessories shall meet the requirements of the following standards:
1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.
 2. UL1236 – Battery Chargers
 3. UL2200. Generator set UL2200 or submit to an independent third party certification process to verify compliance as installed.
- C. The control system for the generator set shall comply with the following requirements.
1. EN50082-2, Electromagnetic Compatibility – Generic Immunity Requirements, Part 2: Industrial.
 2. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
 3. FCC Part 15, Subpart B.
 4. IEC8528 part 4. Control Systems for Generator Sets
 5. IEC Standard 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
 6. UL508. The entire control system of the generator set shall be UL508 listed and labeled.
 7. UL1236 –Battery Chargers.
- D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.05 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
1. Underwriters Laboratories (UL).
 - a. UL 508 Industrial Control Equipment
 - b. UL 1008 Automatic Transfer Switches
 2. National Fire Protection Association (NFPA)
 - a. NFPA 30 Flammables and Combustible Liquids
 - b. NFPA 37 Stationary Combustion Engines and Gas Turbines
 - c. NFPA 70 National Electrical Code (NEC)
 - d. NFPA110 Emergency and Standby Power Systems
 3. National Electrical Manufacturer's Association (NEMA)
 - a. ICS Industrial Controls and Systems

b. MG-1 Motors and Generators

1.06 SUBMITTALS

- A. Shop Drawings
- B. Product Data
- C. Site Test Report
- D. Operating and Maintenance Data:
 - 1. Complete instructions covering the operation and testing of the engine generator and associated equipment shall be provided for the plant, together with a manual covering engine operation and maintenance. Operation instructions shall include any minor adjustments necessary to obtain optimum operation of the set.
 - 2. Maintenance instructions shall include complete trouble shooting and diagnostic information, disassembly instructions, assembly instructions, and preventive maintenance schedule.
 - 3. The preventive maintenance schedule shall be in outline form. Include recommended lubricants and specified all necessary service checks. Spare parts books for the engine generator and associated equipment shall also be furnished.
 - 4. Include data in Operating and Maintenance Manuals specified in Section 26 0500, Common Work Results for Electrical.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Cummins, Caterpillar, Generac, Katolight, Kohler.

2.02 ENGINE

- A. Engine shall be a natural gas fueled, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Engine accessories and features shall include:
 - 1. Complete engine fuel system, including all pressure regulators, strainers, and control valves. The fuel system shall be plumbed to the generator set skid for ease of site connections to the generator set.
- B. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.
- C. Skid-mounted radiator and cooling system rated for full load operation in 104 degrees F ambient as measured at the generator air inlet, based on 0.5 in H2O external static head. Radiator shall be sized based on a core temperature that is 20 degrees F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Provide with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture. Rotating parts shall be guarded against accidental contact.
- D. Electric starter(s) capable of three complete cranking cycles without overheating.
- E. Positive displacement, mechanical, full pressure, lubrication oil pump.
- F. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
- G. Replaceable dry element air cleaner with restriction indicator.
- H. Flexible fuel lines.

- I. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.
- J. Coolant heater
 - 1. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
 - 2. The coolant heater shall be installed on the engine with high temperature silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12-inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
 - 3. The coolant heater shall be provided with a 24VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.
 - 4. Coolant Heater: Sized as recommended by the engine manufacturer to warm the engine to a minimum of 100 degrees F in a 40 degrees F ambient, in compliance with NFPA 110 requirements, or the temperature required for starting and load pickup requirements of this specification.
- K. Provide vibration isolators, spring/pad type or as recommended by the manufacturer, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.
- L. Starting and Control Batteries shall be calcium/lead antimony type, 24V DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors.
- M. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

2.03 BATTERY CHARGER

- A. Provide a wall mounted battery charger.
- B. Provide a minimum 12A battery charger for each generator set battery bank. Generator sets incorporating two battery banks shall be provided with two chargers connected together and operating in parallel, with alarm output(s) connected in parallel. The charger(s) shall include the following capabilities:
 - 1. Chargers shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.
 - 2. The charger shall be compliant with UL991 requirements for vibration resistance.
 - 3. The charger shall comply with the requirements of EN61000-4-5 for voltage surge resistance; EN50082-2 for immunity; EN61000-4-2 for ESD; EN61000-4-3 for radiated immunity; ANSI/IEEE C62.41 category B and IN61000-4-4 for electrically fast transient; EN61000-4-6 for conducted emissions; and FCC Part 15 Class A for radiated emissions.
 - 4. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL-labeled with the maximum battery amp-hour rating that can be recharged within 24 hours.

5. The charger shall incorporate a 4-state charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100 percent of charge, and a float stage to maintain a fully charge battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.
6. The DC output voltage regulation shall be within plus or minus 1%. The DC output ripple current shall not exceed 1A at rated output current level.
7. The charger shall include the following features:
 - a. two line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5 percent accuracy or better), display alarm messages, and perform programming;
 - b. LED indicating lamp(s) to indicating normal charging condition (green), equalize charge state (amber), and fault condition (red).
 - c. AC input overcurrent, over voltage, and undervoltage protection.
 - d. DC output overcurrent protection.
 - e. Alarm output relay.
 - f. Corrosion resistant aluminum enclosure.

2.04 AC GENERATOR

- A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.
- B. The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.
- C. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
- D. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300 percent of rated current for not more than 10 seconds.
- E. The subtransient reactance of the alternator shall not exceed 15 percent, based on the standby rating of the generator set.
- F. The alternator shall be capable of operation with reverse kVAR of 0.15 per unit.

2.05 INSTRUMENTS AND CONTROLS

- A. The following engine and generator instruments and controls shall be furnished and installed in a control panel mounted on the engine generator set:
 1. Lube oil pressure gauge.
 2. Water temperature gauge.
 3. Engine running time hour meter.
 4. Manual start/stop switch.

5. Engine protective alarms.
6. AC voltmeter.
7. AC ammeter.
8. Phase selector switches for voltmeter and ammeter.
9. Frequency meter.
10. Voltage adjust control.

B. The governor manual speed adjusting control may be either mechanical or electrical. All instrumentation shall be isolated to prevent damage from engine generator set vibration.

2.06 REMOTE ANNUNCIATOR

- A. Provide remote annunciators adjacent to the generator (not mounted on the generator) and in the Custodial Room. The annunciator shall include the following indicating lights:
1. Generator On Line
 2. Battery Charger Malfunction
 3. Low Lube Oil Pressure
 4. Low Coolant Temperature
 5. High Coolant Temperature
 6. Engine Overcrank Shutdown
 7. Engine Overspeed Shutdown
 8. Controls Not In Automatic
 9. Remote Emergency Stop
- B. Annunciator includes an audible alarm to sound when any of the alarm conditions above exist. Equip audible alarm with a silencing switch with ringback feature.
- C. Indicating lights shall remain ON as long as faults are uncorrected. Equip lights with lamp test device.
- D. Remote annunciator device power shall be derived from the engine starting battery/charger system.

2.07 AUTOMATIC OPERATION

- A. The engine generator set shall be equipped with an automatic control system to start and stop the unit. The automatic engine starting control shall operate from auxiliary contacts in the automatic transfer switch which close for engine run and open for engine stop. The starting control circuits shall be arranged so that cranking will commence immediately after closing of the auxiliary contact. Four cranking cycles of 10 seconds ON and 10 seconds OFF shall be provided. If the engine has not started and the completion of the 4 cranking cycles, or if any safety device should operate while the engine is in operation, the unit shall be stopped immediately and the starting controls locked out, requiring manual resetting. The starting control equipment shall be capable of operating at 75 percent normal DC voltage. The overcrank indicating light shall indicate that the engine has not started at the completion of the 4 cranking cycles. After the engine successfully starts, the starting control shall automatically disconnect the cranking controls.
- B. Selector switch provides the following positions:
1. Manual or Handcrank
 2. OFF or Stop
 3. Automatic
 4. Engine Test

- C. Load shedding controls shall be integral with the generator controller, capable of being programmed for varying load-shedding inputs. Provide minimum two independently programmable load-shedding output contacts for interface with transfer switch equipment. Generator shall come from factory with one load shedding output factory-programmed to send load shedding signal to Standby Transfer Switch dropping the load when generator is at 80 percent load capacity. This factory setting shall be field adjustable.

2.08 WEATHERPROOF HOUSING

- A. Provide a weatherproof housing which shall completely enclose the engine-generator set. Provide weatherproof housing with noise abatement insulation. Quiet type housing shall attenuate generator noise emission to 70 - 72dBa at 7 meters. The housing shall contain all louvers and controls to automatically open upon engine start-up and close after shutdown. Engine silencer shall be installed inside of the enclosure.
- B. The side panels shall be lockable and removable for servicing of the engine-generator. Provide 2 sets of keys to the owner at completion of the project. Housing shall have baked enamel finish in color as selected by Architect.
- C. Provide two 12VDC luminaires with switch on control panel to light the engine-alternator for use in maintaining the generator set. Connect to engine starting system. Include overcurrent protection for the luminaire circuit.
- D. Provide one weatherproof GFCI 20A duplex receptacle mounted to skid base for connection to 120V field wiring.

PART 3 EXECUTION

3.01 ANCHORING

- A. Generator to be anchored to concrete slab per structural requirements. Coordinate anchorage requirements on approved manufacturer shop drawings with structural requirements. Discrepancies shall be brought to the attention of the Architect and Structural Engineer prior to rough-in and concrete pad installation.

3.02 ELECTRICAL WIRING

- A. All conduit, wiring, and electrical connections required between the various items of the System shall be provided and installed complete.

3.03 SUPERVISION

- A. Installation and start-up shall be supervised, checked, and tested by a qualified representative of the engine generator manufacturer.

3.04 FIELD TEST

- A. After the installation and initial start-up of the engine generator set is complete, a test shall be performed and logged in the presence of the Architect. The Contractor shall have the engine generator manufacturer furnish an engineer to operate the engine during the tests, to check all details of the installation and to instruct the operators. This engineer will be required for a period of not less than 2 days for instruction and tests and all costs in connection therewith shall be included in the Contractor's bid. The Contractor shall furnish all fuel, lubricants, load banks and instruments necessary to conduct the tests and shall connect all devices required to obtain data required below. The resistor load bank shall be connected to load side of the automatic transfer switch and the Contractor shall make any necessary temporary connections to obtain full load for the test.
- B. Field Test Requirements: Data shall be recorded every 15 minutes and at the beginning and end of every separate test and shall include all electrical and temperature information. Testing shall be accomplished in the following sequence:
 - 1. Check all engine and generator mounting bolts. Check alignment of engine generator and realign if not within manufacturer's limits.
 - 2. Test generator and exciter insulation resistance with a megger. Take generator readings at circuit breaker or at leads to switchboard. Record all results in the test report.

3. Perform engine manufacturer's recommended prestarting checks. Include a check of water, fuel and lube oil levels within the engine.
 4. Start engine and make engine manufacturer's after starting checks during a reasonable run-in or warmup period.
 5. Operate engine generator set for one hour at 50 percent of rated load.
 6. Operate engine generator set for one hour at 75 percent of rated load.
 7. Operate engine generator set for two hours at 100 percent of rated load.
 8. Measure sound level to assure that the sound spectrum does not exceed the criteria specified.
 9. Increase engine speed by manually overriding the governor. Speed shall be measured by a tachometer. Record speed at which overspeed trip operates.
 10. Demonstrate functioning of high temperature coolant circuit by restricting air flow through the radiator.
 11. Shutdown engine and observe operation of low oil pressure control. Record pressure at which trip operates. NOTE: If safety conditions of the Safety System are not met during any of the preceding three steps, the necessary readjustments shall be made and the step repeated until satisfactory results are obtained.
 12. Ensure proper operation of the automatic exercising system by setting system for automatic operation then manually initiating an exercise period of at least 30 minutes.
 13. A battery starting test shall be performed with the charger disconnected, consisting of four four cranking cycles of 10 seconds ON and 10 seconds OFF. The engine fuel supply shall be shut off to prevent starting.
 14. Document all test results and furnish to Owner upon successful completion.
- C. Checks to be made during on-site testing:
1. Proper operation of all controls.
 2. Proper operation of all gauges and instruments throughout operation.
 3. Proper operation of all auxiliary and accessory equipment. All valves, including pilot valves and injection pump, shall be checked during the tests to assure proper operation.
- D. Inspection: Upon completion of the on-site tests, a general inspection shall be made for:
1. Proper anchorage.
 2. Leaks in the engine, piping systems, tanks, etc.
 3. Excessive blowby.
 4. Any other deficiency which may impair proper operation.

3.05 ACCEPTANCE

- A. Final acceptance shall be made when the generator set has successfully completed the onsite tests and after all defects in material or operation has been corrected.

END OF SECTION

SECTION 26 3623
AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes: Provide Automatic Transfer Switches as indicated.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0526, Grounding and Bonding for Electrical Systems
 - 3. Section 26 0533, Raceways and Boxes for Electrical Systems
 - 4. Section 26 0553, Identification for Electrical Systems
 - 5. Section 26 0573, Overcurrent Protective Device Coordination Study
 - 6. Section 26 0580, Electrical Testing
 - 7. Section 26 3213, Engine Generators

1.03 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
 - 1. Underwriters Laboratories (UL).
 - a. UL 508 Industrial Control Equipment
 - b. UL 1008 Automatic Transfer Switches
 - 2. National Fire Protection Association (NFPA)
 - a. NFPA 70
 - 3. National Electrical Code (NEC)
 - a. NEC 110 Emergency and Standby Power Systems
 - 4. National Electrical Manufacturer's Association (NEMA)
 - a. ICS Industrial Controls and Systems

1.04 SUBMITTALS

- A. Shop drawings.
- B. Product data.
- C. Operating and Maintenance Data:
 - 1. Complete instructions covering the operation and testing of the automatic transfer switches.
 - 2. Maintenance instructions shall include complete trouble shooting and diagnostic information, disassembly instructions, assembly instructions, and preventive maintenance schedule.
 - 3. Include data in Operating and Maintenance Manuals specified in Section 26 0500, Common Work Results for Electrical.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Automatic transfer switches shall be the same manufacturer as the engine generator equipment specified in Section 26 3213, Engine Generators.
- B. Cummins, Asco, GE Zenith Controls, Russelectric or approved.

2.02 AUTOMATIC TRANSFER SWITCHING SYSTEM

- A. Each switch shall be furnished with full load current rating, voltage, phase, poles and AIC ratings as shown on the drawings. AIC rating shall match the rating of the normal power distribution equipment upstream of the ATS, or as otherwise specified. Transfer switches shall be capable of switching all classes of load and shall be rated for continuous duty when installed in non-ventilated enclosures.
- B. Transfer switches shall be 4-pole type provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar.
- C. Relays and control circuits shall be provided to obtain fixed preferential control with transfer switch connected to the normal source of power under normal conditions. Upon a sustained drop in voltage of 30 percent in any phase of the normal power source from rated voltage and after a delay of 2 seconds, switch shall close a circuit to automatically start the alternate power source and transfer the load to the alternate power source provided the voltage and frequency of that source are at least 90 percent of rated value. The switch shall be electrically operated but mechanically held in both the normal and standby positions and shall include an electrically continuous neutral position. The operator shall be momentarily energized from the source to which the load is being transferred. Upon return of normal power to within 10 percent of rated voltage on all phases, and after a preset time delay adjustable from 2 to 25 minutes, the switch shall automatically transfer the load to the normal source. If the standby power source should fail during the delay period prior to return to normal source, the time delay shall be bypassed and the switch shall return immediately to the normal source. A test switch shall be provided to simulate failure of the normal power source and to test the operation of a transfer switch. A manual operator shall be provided for maintenance servicing of the transfer switch in accordance with UL-1008. An override switch shall be provided to bypass the automatic transfer controls so that the transferred switch will remain indefinitely connected to the standby power source, regardless of the condition of the normal power source.
- D. Each automatic transfer switch shall be furnished with voltage sensing relays for each phase. Connection of these sensing relays shall be made to the normal power input terminals of the transfer switch. Voltage range shall be field adjustable.
- E. Delayed Transition: The controls shall include a time delay, adjustable from 0-60 seconds, to control the switching time from source to source, to allow load generated voltages to decay before connecting to an energized source.
- F. High intensity LED lamps shall be provided to indicate Source 1 and Source 2 Available, Source 1 and Source 2 Connected, exercise mode, and test mode. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control. These signals shall be transmitted to the remote annunciator. Provide one set Form C auxiliary contacts indicating transfer switch position, rated 10 amps 250 VAC.
- G. The automatic transfer switch shall be installed in a NEMA Type I wall mounted enclosure conforming to NEMA ICS and comply with the requirements of UL-508.
- H. Provide a field-configurable exerciser clock, displaying real time in hours and minutes, with provisions for selection of testing interval at 7, 14, 21, or 28-day intervals in either with-load or without-load configuration. Exercise period duration shall be field configurable.
- I. Transfer switch shall be provided with AL/CU mechanical lugs sized for the full output rating of the switch, and capable of accepting the number of cables indicated on the drawings.

- J. The automatic transfer switch shall be suitable for satisfactory performance when installed for operation at 200-foot altitude, 40°C high and 5°C low ambient temperature, 90 percent relative humidity.
- K. All surfaces to be painted shall be thoroughly cleaned to insure that they are free from all oil, grease, welding slag and spatter, all mill scale, products of corrosion, dirt or other foreign products. Painting shall consist of at least one coat of rust inhibiting primer and one coat of finish enamel. The rust inhibiting primer shall be applied to a clean, dry surface as soon as practicable after cleaning. Painting shall be with manufacturer's current materials according to manufacturer's current process except that the total dry film thickness shall be not less than 2.5 mils. The paint shall be free from runs, sags, orange peel or other defects. Color of the finish coat of paint shall be manufacturer's standard.
- L. Load shedding controls: Standby transfer switch shall be capable of receiving load shed controls from the generator controller to connect or disconnect the transfer switch load based on contact input.
- M. The automatic transfer switch shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship. The warranty shall be comprehensive, including parts, labor, and travel to the site.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Transfer Switches shall be mounted square and plumb, with top of switches 6 feet – 0 inches above finish floor.
- B. All conduit, wiring, and electrical connections required between the various items of the System shall be provided and installed complete.
- C. Engage a factory-authorized service representative to inspect the equipment, verify installation meets the manufacturer's requirements, and perform manufacturer recommended start-up testing.
- D. Engage a factory-authorized representative to provide training of the Owner's personnel to adjust, operate, and maintain the automatic transfer switch equipment.

END OF SECTION

SECTION 26 4313
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SCOPE

- A. This Section describes the materials and installation requirements for Surge Protective Devices (SPD). SPD's are used for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.
- B. This specification also describes the mechanical and the electrical requirements for the SPD. The SPD shall be suitable for application in both category B and C environments as described in ANSI/IEEE C62.41- 2002.
- C. The Contractor shall furnish and install the Surge Protective Devices having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract documents. Related hardware (i.e. flush mounting kits, mounting brackets, etc.) shall be provided as required for the installation of the SPD system suitable for the application.

1.02 RELATED DOCUMENTS

- A. This Section includes: Surge Protective Devices (SPD) for low voltage power equipment and shall provide effective high energy protection against transient surges, temporary over-voltages, voltage swells and high frequency noise attenuation.
- B. Related Sections include:
 - 1. Section 26 2313, Switchboards
 - 2. Section 26 2416, Panelboards

1.03 REFERENCE STANDARDS

- A. ANSI/UL 1449 (Underwriters Laboratories) Third Edition - Standard for Safety for Surge Protective Devices.
- B. ANSI C84.1 (American National Standards Institute) - American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hertz).
- C. IEEE C62.41.1 (Institute of Electrical and Electronics Engineers) - Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits.
- D. IEEE C62.41.2 (Institute of Electrical and Electronics Engineers) - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
- E. IEEE C62.45 (Institute of Electrical and Electronics Engineers) - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- F. IEEE 142 (Institute of Electrical and Electronics Engineers) - IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (Green Book).
- G. IEEE 1100 (Institute of Electrical and Electronics Engineers) - IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (Emerald Book).
- H. ISO 9001 (International Organization for Standardization) Quality Systems – Quality Management System
- I. MIL Standard 220 (Department of Defense) - Test Method Standard, Method of Insertion-loss Measurement.
- J. NFPA 70 (National Fire Protection Association) - National Electrical Code.
- K. UL 1283 (Underwriters Laboratories) - Standard for Safety for Electromagnetic Interference Filters.

1.04 SUBMITTALS

- A. Submittals shall include written specification response referencing each specification section and sub-section indicating compliance or non-compliance. If manufacturer cannot fully comply with specification section, this must be stated in the response along with a full description of the variance.
- B. Submit the following information, indexed by response and test results. Submittal shall be received a minimum of 2 weeks in advance of the date the submittal evaluation needs to be completed for the project.
 - 1. Specification compliance response sheet referencing each specification section.
 - 2. Proof of UL1449 Third Edition compliance from Nationally Recognized Test Lab (NRTL) accepted by local authority having jurisdiction. UL1449 Third Edition Nominal Discharge Current Rating and Voltage Protection Ratings shall be provided.
 - 3. UL1283 filter compliance documentation.
 - 4. Published specifications, cut sheets & product data with appropriate IEEE C62.41 & UL1449 Third Edition performance ratings for intended installation locations.
 - 5. Electrical and mechanical shop drawings.
 - 6. Installation requirements/instructions.
 - 7. Operations & maintenance manuals.
 - 8. Performance / warranty information.
- C. The Engineer reserves the right to accept or reject any or all submittals, to request additional information as deemed necessary or to request submittals for a different unit deemed more appropriate for this installation.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Manuals
- B. Warranty Documentation
- C. Notes to Record Drawings

1.06 QUALIFICATIONS

- A. Manufacturer's SPD's shall have UL1449 Third Edition compliance & listing from Nationally Recognized Test Lab (NRTL) accepted by local authority having jurisdiction. Type 1 compliance required for SPD intended for installation before (or after) Main Service Disconnect or Type 2 compliance for installation after Main Service Disconnect. Provide published UL1449 Third Edition Nominal Discharge Current Rating and Voltage Protection Rating.
- B. Manufacturer shall have local representation and distribution within 400 miles of the project location to provide technical, warranty claim, and installation support for the project.
- C. Manufacturer/vendor must be capable of supplying SPD for project within 30 days of receipt of order for orders of 25 units and less for models submitted in response to this specification.
- D. Manufacturers shall be certified to latest ISO 9001 standard and shall be registered for the design and manufacturing of SPD devices.
- E. Manufacturer shall provide access to a readily available factory engineer for answering questions about this product.
- F. Only firms regularly engaged in the manufacture of SPD products for category C locations (ANSI/IEEE C62.41.1-2002), and whose products have been providing satisfactory service for not less than five years, shall be considered. Upon request, provide a customer reference list, with a minimum of five contact names and current phone numbers.
- G. Manufacturer qualifications shall be provided as part of the submittal.
- H. The successful manufacturer/vendor shall assign a technical contact person for SPD application, installation and warranty questions. This contact shall be available to provide a response to a technical question within a maximum of two business days.

- I. Single manufacturer shall be capable of providing all power system SPD's.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Inspect for damage and replace any damaged device.
- B. Store in a clean, dry space suitable for equipment and protect against damage.
- C. Clean equipment and touch up minor scratches using suitable materials.

1.08 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 APPROVED PRODUCTS

- A. Current Technology Inc. SPE Series, Leviton, Square D or of the same manufacture as the distribution equipment specified in Section 26 2413.
- B. The listing of specific manufacturers above does not imply acceptance of their products which do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to the bid date. Provide complete submittals for review as described above.

2.02 GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

- A. SPD Design:
 - 1. SPD shall be compatible with the electrical system voltage, current, system configuration and intended applications and shall be NRTL listed for such application.
 - 2. Parallel design only with individual protection components:
 - a. Line to Ground and Line to Line for Delta and High Resistance Grounded systems.
 - b. Line to Ground, Line to Neutral and Neutral to Ground for Wye and Single Phase distribution systems.
 - 3. Metal-Oxide Varistors (MOV) components shall be utilized as primary energy mitigation. Selenium cell, air gaps, gas tubes are not allowed.
 - 4. Maximum continuous operating voltage (MCOV) of all components (based on ANSI C84.1 standard voltages), not less than 125% for 120/208 volt systems and 115% for other systems.
 - 5. Short Circuit Current Ratings (SCCR) shall be suitable for location SPD is to be installed.
 - 6. Visual indication of protection status on each phase, visible from the front of the equipment.
 - 7. Protection Status:
 - a. Normally open and normally closed contacts for remote monitoring.
 - b. Rated a minimum of .5 amps, AC or DC.
 - c. Shall change state upon device failure or loss of power.
 - 8. As a minimum, Branch Panel, Sub-Panel and series installed (branch circuit) SPD shall include a passive circuit which allows the SPD to actively follow the voltage waveform and provide a clamping envelope to limit low level IEEE C62.41 Category A ring waves (of either polarity) at all locations on the sine wave. This circuit shall also perform in the Neutral to Ground Mode.
 - 9. Complete, comprehensive installation instructions shall be provided for the SPD.

10. Enclosure:
 - a. NEMA rated metal enclosure appropriate for environmental conditions and exposure at point of installation.
 - b. Designed to allow connection of the SPD without sharp bends in the conductors.
 - c. Metal flush kits for flush mount installations (external devices) on new and retrofit applications for panels. Kits shall include supports for fastening to structural members and shall include a face plate matching SPD finish. Retrofit kits shall be capable of being installed next to the panel after drywall has been installed without the need for patching or refinishing of the wall.

B. Performance and Ratings:

1. Minimum durability and performance requirements are described below in accordance with test procedures outlined in ANSI/IEEE C62.45 & UL1449 Third Edition. Test documentation shall be provided as part of the submittal package. Information shall be provided in a format which is easily to analyze and review. The following test data shall be submitted as manufacturer published literature:
 - a. Provide Peak Surge Current (Single Pulse Rated, 8/20 μ S, by mode, Amperes) with submittals document for each SPD proposed. For all electrical equipment located at Service Entrance or Category C locations, Surge current rating shall be a minimum of 160kA per phase / 80kA per mode for IEEE C62.41.1-2002 - Category C Low Exposure locations and 300kA per phase / 150kA per mode for IEEE C62.41.1-2002-Category C High Exposure locations or critical locations.
 - b. Provide surge current ratings for each applicable protection mode (L-L, L-N, L-G & N-G) with submittals.
 - c. Surge current rating shall be a minimum of 80kA per phase / 40kA per mode in low exposure locations or 120kA per phase / 60kA per mode for distribution switchboards or motor control centers in medium and high exposure / critical equipment locations and for IEEE C62.41.1-2002 - Category B & C Switchboard and Motor Control Center Locations.
 - d. Provide surge current ratings for each applicable protection mode (L-L, L-N, L-G & N-G) with submittals.
 - e. Surge current rating shall be a minimum of 80kA per phase / 40kA per mode for branch panel models in low, medium and high exposure areas and for IEEE C62.41.1-2002 - Category B & C Panel and Sub-Panel Locations.
 - f. Provide surge current ratings for each applicable protection mode (L-L, L-N, L-G & N-G) with submittals.
 - g. For each SPD proposed, provide published durability test data utilizing the ANSI/IEEE C62.41-1991, Category C3, 20kV/10kA, 1.2 x 50 μ S - 8x20 μ S combination waveform for SPD durability tests with (as a minimum), the ANSI/IEEE C62.41-1991, Category C1, 6kV/3kA, 1.2 x 50 μ S - 8x20 μ S combination waveform used for pre and post test measurement of let through performance variation. Provide test data with submittals, including test setup information.
 - h. All SPD devices (including branch panel) shall withstand a minimum of 15,000 IEEE C3 20kV/10kA hits delivered at a rate not exceeding one pulse per minute without failure or degradation exceeding 5% using IEEE B3 6kV/3kA combination waveform for pre and post durability let through measurement evaluation. Lead length for testing and let through measurements shall be 6".
 - i. UL Third Edition Nominal Discharge Current Ratings shall be a minimum of 20kA per mode for SPD's to be installed at the Service Entrance (or where direct lightning strike potential exists on outdoor feeder or branch circuit conductors serving electrical equipment) and a minimum of 10kA per mode for all other locations.

j. Provide EMI/RFI Attenuation as per Mil Std-220. Attenuation 40dB at 100kHz.

Maximum SPD voltage let through values are provided in Table 1 and 2 below. Provide published performance test data for the test configurations and waveforms listed in Tables with submittals. Table 1 - Peak Voltage Let Through Voltage Table for > 160 kA Units (at/ near Service Entrance locations) *Peak Let Through Voltages (measured from zero reference) shall not exceed:						
Voltage / Configuration	Test / IEEE Wave	L-N	L-G	L-L	N-G	Phase Angle
120/208 Wye	C3 – 20 kV/10ka	1050	1225	1350	1150	90
120/208 Wye	B3/C1 – 6 kV/3kA	565	590	925	550	90
120/208 Wye	A1 – 2kV/67A	260	390	360	250	90
120/208 Wye	A1 – 2kV/67A	75	115	90	100	180
120/208 Wye	UL1449 SVR	400	400	800	400	-----
120/208 Wye	UL1449 VPR	600	700	900	600	-----
*Testing shall be completed with a minimum of 6” of lead length outside of device enclosure and shall be measured from zero voltage crossing.						
Note: Category A1 Ringwave applicable for locations where Active Tracking units are to be installed, including 120/208 and 120/240 Branch Panels and protection for dedicated equipment loads (where noted).						

Table 2 – Peak Limiting (Let Through) Voltage Table for > 80 kA Units (Branch/Sub Panel, MCC, etc.) *Peak Let Through Voltages (measured from zero reference) shall not exceed:						
Voltage / Configuration	Test / IEEE Wave	L-N	L-G	L-L	N-G	Phase Angle
120/208 Wye	C3 – 20 kV/10ka	1050	1225	1350	1150	90
120/208 Wye	B3/C1 – 6 kV/3kA	560	585	920	540	90
120/208 Wye	A1 – 2kV/67A	260	400	370	250	90
120/208 Wye	A1 – 2kV/67A	75	100	75	75	180
120/208 Wye	UL1449 SVR	400	400	800	400	-----
120/208 Wye	UL1449 VPR	600	700	900	600	-----
*Testing shall be completed with a minimum of 6” of lead length outside of device enclosure and shall be measured from zero voltage crossing.						
Note: Category A1 Ringwave applicable for locations where Active Tracking units are to be installed, including 120/208 and 120/240 Branch Panels and protection for dedicated equipment loads (where noted). Please note the phase angle is 90 degrees and measurement is positive peak voltage measured from zero reference. Measurements at 180 degrees will show significantly lower let through voltages (sine wave peak voltage is zero at 180 degrees).						

2.03 WARRANTY

A. Minimum requirements:

1. Period: 20 years from the date of substantial completion of service and activation of the system to which the SPD is attached.
2. Full replacement of a suppressor which is damaged or fails to meet manufacturers published specifications and specifications provided within, without pro-rating value.

3. No exclusions from failure or damage from any system anomaly (over-voltage, single phasing, lightning strike, etc. (IEEE 62.41.1). Exceptions: failure caused by wiring error, loose or missing Neutral to Ground Bond or Meggar Testing with SPD connected to power system.
4. Factory or third party testing shall not be required.
5. Warranty shall apply independent of facility ownership / purchaser.
6. Replacement unit to be at facility within 7 business days of receipt of written notification of failure at no cost to the customer (exception – custom configuration or special order units).
7. Replacements: same make, model and configuration as original unit unless otherwise requested or approved.
8. Manufacturer site visit for validation of warranty claim: manufacturer/vendor must visit site within 3 days of notification at no cost. This section does not modify 1.12 (A) (6).
9. No shipping, handling, examination or other fees are allowed.

PART 3 EXECUTION

3.01 GENERAL

- A. General Application and Installation Requirements
 1. Per the manufacturer's installation instructions.
 2. Per Installation Checklist.
 3. NFPA 70 (NEC) Requirements.
 4. Per IEEE C62.41.2, 141, 142 and 1100.
 5. Local authority having jurisdiction
 6. Project engineer.
- B. Emergency distribution and panelboards: Provide SPD at each emergency distribution bus and at each emergency panelboard, in compliance with NEC 700.8. SPD ratings and tiered protection shall be provided as recommended by the SPD manufacturer, suitable for the application.
- C. Units shall not tap directly to the bus without upstream over-current protection unless tap conductors are protected at their termination by NRTL listed Disconnect, Over-current and Short Circuit Protective Devices (Fuse with Disconnect and/or Circuit Breaker) properly rated for conductor and SPD Device Protection as per NRTL listing and NEC requirements.
- D. Manufacturer shall provide qualified personnel to provide 1 hour of on-site installation training for contractor.
- E. Clean SPD units and flush mount covers and touch up with matching paint as necessary.
- F. Inspect and test SPD devices as per manufacturer specification and installation guidelines.
- G. Project Engineer or their appointed representative may perform inspection of the installed suppressors. Engineer reserves the right to require corrections to the installation to comply with manufacturer installation requirements and project specifications.

3.02 TESTING

- A. Complete installation checks according to the manufacturers written instructions.
- B. Remove and replace malfunctioning units and retest.

3.03 SERVICE ENTRANCE

- A. Service Entrance Installation Requirements
 1. One primary suppressor at each utility service entrance to the facility or as indicated on the drawings.

2. Suppressors shall be connected to properly rated disconnect with overcurrent and short circuit protective device connected on the load side of the service entrance disconnecting means in accordance with NEC requirements.
3. Conductors between suppressor and point of attachment shall be kept as short and straight as possible and shall be grouped together (via tie wrap) where possible. Lead length of connecting conductor shall not exceed 2-feet without written permission of the Engineer.
4. Suppressor's ground shall be bonded to enclosure frame and the service entrance ground bus, and conduit between the SPD and the switchboard must provide secure electrical/mechanical connections.

END OF SECTION

SECTION 26 5000

LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

A. General Requirements:

- 1. Provide all lighting outlets indicated on the Drawings with a luminaire of the type designated and appropriate for the location.
- 2. Where a luminaire type designation has been omitted and cannot be determined by the Contractor, request a clarification from the Architect in writing and provide a suitable luminaire type as directed.
- 3. Coordinate installation of luminaires with the ceiling installation and all other trades to provide a total system that is neat and orderly in appearance.
- 4. Luminaires located in fire rated assemblies shall be rated for use in such assemblies or shall have the assembly maintained by the installer through the use of appropriate construction techniques to maintain the assembly rating. It is the responsibility of the contractor to maintain the assembly rating and provide all required components during construction. Coordinate luminaires impacted with Division 01 and life safety documents.
- 5. Install all remote ballasts in enclosures as required by luminaire specified. Locate remote ballasts as shown on drawings; where no location is shown, provide recommendation for approval prior to commencing field installation. Remote mounted ballasts shall be located within the distance limitations specified by the ballast manufacturer.
- 6. Coordinate voltage requirements to each luminaire as indicated on drawings.
- 7. Contractor is responsible for verifying all luminaires carry a valid UL or ELT listing.
- 8. All luminaires shall be procured through a distributor located within 200 miles of the project site with a valid business license in the state the project is located.
- 9. Contractor shall price the lighting control package separately from the light fixture package and shall provide a unit price breakdown of all components including all deducts (lot price and all-or-none). All pricing shall be transparent from the factory to the owner and all quotes shall be made available to the owner, architect or engineer upon request.
- 10. Lighting related change orders shall include all back-up pricing noted above for review by the engineer and lighting designer.

B. Related Sections include:

- 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
- 2. Section 26 0526, Grounding and Bonding for Electrical Systems
- 3. Section 26 0923, Lighting Control Devices
- 4. Section 26 2726, Wiring Devices

1.03 QUALITY ASSURANCE

- A. The lighting design for this project was based on luminaire types and manufacturers as specified.

- B. Specified manufacturers are pre-qualified to bid on products where specified. Inclusion of manufacturer and product series does not relieve specified manufacturer from providing product as described in luminaire schedule; modifications to standard product, if required, shall be included with initial bid.
- C. Items noted or equivalent do not require prior approval but shall be included with the shop drawing submittal.
- D. Other Or Approved Manufacturers and Products: Submit Substitution Request prior to bid, complying with requirements of Division 01. Approval shall be determined by review of the following luminaire characteristics where applicable. Lack of pertinent data on any characteristic shall constitute justification for rejection of the submittal.
 - 1. Performance
 - a. Distribution.
 - b. Utilization.
 - c. Average brightness/maximum brightness.
 - d. Spacing to mounting height ratio.
 - e. Visual comfort probability.
 - 2. Construction
 - a. Engineering.
 - b. Workmanship.
 - c. Rigidity.
 - d. Permanence of materials and finishes.
 - 3. Installation Ease
 - a. Captive parts and captive hardware.
 - b. Provision for leveling.
 - c. Through-wiring ease.
 - 4. Maintenance
 - a. Relamping ease.
 - b. Ease of replacement of ballast and lamp sockets.
 - 5. Appearance
 - a. Architectural integration.
 - b. Light tightness.
 - c. Neat, trim styling.
 - d. Conformance with design intent.

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 26 0500, Common Work Results for Electrical:
 - 1. Shop Drawings, to include:
 - a. Product Data. Provide manufacturer's published product data information.
 - b. Luminaire dimensions on a fully dimensioned line drawing.
 - c. Lamp information.
 - d. Lamp socket information.
 - e. Ballast information using ballast manufacturers published product data information. Multiple ballasts may be submitted for single luminaire if compatible with ballast specification included in contract documents. Include certification of lamp and ballast compatibility for all submitted ballasts.

- f. Mounting details including clips, canopies, supports, and methods for attachment to structure.
 - g. U.L. Labeling information.
 - h. Photometric Reports consisting of:
 - 1) Candlepower distribution curves: Provide five plane candlepower distribution data at no more than 5 degree vertical angle increments.
 - 2) Coefficient of utilization table.
 - 3) Zonal lumen summary including overall luminaire efficiency.
 - 4) Luminaire luminance: Provide measured maximum brightness data for luminaires with reflectors and average brightness data for luminaires with refractors.
 - 5) Spacing to mounting height ratio. If parallel and perpendicular ratios differ, provide data on each plane.
 - 6) VCP calculations (where applicable): For general office lighting luminaires, provide typical VCP calculations for ceiling heights between 9-feet and 12-feet at 1-foot increments, for room sizes 20-foot by 20-foot and 30-foot by 30-foot.
 - i. Special requirements of the specification.
2. Operation and maintenance data. Prepare two copies of a Lighting Systems Maintenance Manual consisting of the following in a hard-cover binder for review. After review, Architect will deliver one copy to Owner.
- a. One complete set of final submittals of actual product installed, including product data and shop drawings. Include product data for actual ballast installed where applicable.
 - b. List of lamps used in Project, cross-referenced to fixture types, with specific manufacturer's names and ordering codes.
 - c. Relamping instructions for lamps that require special precautions (tungsten halogen, metal halide, etc.).
 - d. Lighting fixture cleaning instruction, including chemicals to be used or avoided.

PART 2 PRODUCTS

2.01 GENERAL

- A. Luminaires new and complete with mounting accessories, junction boxes, trims and lamps.
- B. Luminaire assemblies U.L. listed.
- C. Luminaires U.L. listed appropriate to mounting conditions and application.
- D. Each luminaire family type (downlights, parabolics, etc.) supplied by only one manufacturer.
- E. Recessed luminaires installed in fire rated ceilings and using a fire rated protective cover shall be thermally protected for this application and shall carry a fire rated listing.
- F. Luminaires installed under canopies, roofs or open areas and similar damp or wet locations shall be UL listed and labeled as suitable for damp or wet locations.

2.02 LENSES

- A. Prismatic Acrylic:
 - 1. As specified in the Luminaire Schedule.
- B. Opal acrylic:
 - 1. Extruded or injection molded of virgin acrylic plastic, 0.08-inch minimum overall thickness.
 - 2. As specified in the Luminaire Schedule.
- C. Opal acrylic overlay: High transmittance type, extruded of virgin acrylic plastic, 0.04-inch overall thickness, with minimum 80% light transmittance.

2.03 REFLECTOR CONES

- A. Spun of uniform gauge aluminum, free of spinning marks or other defects.
- B. Shall have an integral trim flange.
- C. Color and finish as specified in Luminaire Schedule.
- D. All reflectors shall be of the Alzak® process, and shall be of the low iridescent type.
- E. All luminaires using Alzak® reflector cones shall be supplied by the same manufacturer unless directed otherwise in Luminaire Schedule.

2.04 LED LUMINAIRES

- A. Sheet metal housings: Minimum 22 gauge cold-rolled steel, with welded joints. Exposed weld marks and seams filled and ground smooth.
- B. Door Frames for lensed luminaires: White painted, flat aluminum with mitered corners, rotary cam spring assisted latches to hinge from either side.
- C. Finish: Baked white dry polyester powder, unless otherwise specified, with a minimum average reflectance of 85 percent on all exposed and light reflecting surfaces. Steel components shall be prepared for finishing with a 5-step zinc phosphating process prior to painting. Luminaire (including all painted component parts) shall be painted after fabrication unless specifically noted in the Luminaire Schedule.
- D. Linear Luminaries:
 - 1. Extruded Aluminum Housing: One piece housing of AA 6063 T5 extruded aluminum with 0.14 minimum thickness smooth and free of tooling lines in one uninterrupted section of 1-foot to 24-foot with the cross sectional dimensions as indicated in the Luminaire Schedule. Section lengths shall be as shown on the drawings and shall be such that the luminaire shall be able to be transported into and out of the installation location after final construction without any building demolition being required.
 - 2. Steel Housing: 20 gauge minimum, free of dents, scratches, or other defects. Exposed weld marks, joints and seams shall be filled and sanded smooth before finishing. All edges shall be cleaned and dressed to remove sharp edges or burrs. Section lengths shall be as shown on the drawings comprised of 1-foot to 12-foot lengths.
 - 3. End Plates: Die cast end plates shall be mechanically attached without exposed fasteners. End caps shall be minimum 0.125-inch thick.
 - 4. Where housing sections are joined together to form a continuous row, an internal alignment spline shall be provided.
 - 5. Finish:
 - a. All exposed aluminum surfaces shall be treated with an acid wash and clear water rinse prior to painting. Electrostatically painted or powder coated and oven baked in the color indicated in the Luminaire Schedule.
 - b. All exposed steel surfaces shall be treated with an acid wash and clear water rinse, then prime coated. Electrostatically painted or powder coated and oven baked in the color indicated in the Luminaire Schedule.
 - 6. Lens: Mechanically secured from within the housing. Lens shall have interior linear prisms with smooth exterior.
 - 7. Louvers and Reflectors:
 - a. White Reflectors shall be steel or aluminum, minimum 22 gauge, with hard baked white enamel finish with minimum 85% reflectance.
 - b. Alzak reflectors shall be low iridescent semi-specular or as indicated in the Luminaire Schedule, Alzak® or Coilzak® with minimum reflectance of 90 percent.

8. Suspension:
- a. Suspension Devices, type as specified in the Luminaire Schedule:
 - 1) Aircraft Cable: Stainless steel type - 3/32-inch nominal diameter, stranded, with positive pressure, field adjustable clamp at fixture connection.
 - 2) Rigid Pendant: 1/2-inch nominal diameter or as specifically shown on drawings. Supplied by fixture manufacturer when available as standard product. At fixture end of stems, provide earthquake type swivel fitting to permit 45 degree swing in any direction away from vertical. Flat canopy to permit splice inspection after installation.
 - 3) Chain hangers: Length to suit fixture mounting height if shown or as field conditions dictate. Use two heavy duty chains with S hooks at each suspension point. Length to suit mounting height as shown on Drawings.
 - 4) Suspension system must permit $\pm 1/2$ -inch minimum vertical adjustment after installation.
 - b. Supports:
 - 1) Provide internal safety cable from fixture body to stud in outlet box.
 - 2) Carry fixture weight to structure and provide horizontal bracing from suspension points to ceiling framing to prevent sideways shifting. Provide diagonal seismic restraint wires per code.
 - c. Feed Point:
 - 1) Flat-plate canopy to cover outlet box, with holes for support cable and power cord, concealed fasteners to permit splice inspection after installation.
 - 2) At the electrified connection provide straight cord feed. Where emergency feed is required, a separate feed point shall be provided.
 - 3) Power cord: white multi-conductor cord, parallel to support cable (aircraft cable); within pendant (rigid pendant); or flexible conduit (chain hanger).
 - 4) Where emergency feed is required, a separate feed point shall be provided.
 - d. Non-feed Points:
 - 1) 1/2-inch OD polished chrome end sleeve, inside threaded 1/4-inch-20, with 2-inch diameter. Flat white plate to cover hole in ceiling. Top of cable with ball swaged on end, to fit inside sleeve.
 - 2) Contractor to provide support above ceiling as required.
 - e. Suspension method shall allow adjustment to be made in hanging length to allow for variance in ceiling height.
 - f. All exposed paintable suspension components shall have the same finish and color as the luminaire housing.
- E. Dimensions: Proper for the various wattage noted on the plans and as recommended by the luminaire manufacturer or as specified.
- F. Recessed luminaires: Must be rated for use in recessed applications. If required by the owner or design team, the manufacturer must produce test data proving the product is rated for use in recessed applications.
- G. CRI: luminaires shall have a minimum Color Rendering Index (CRI) of 80 or higher.
- H. Color temperature shall be per the luminaire schedule. The color temperature shall not exceed a +/- tolerance of greater than 2 McAdam Ellipses. Over the life of the luminaire.
- I. Adjustable Lamp Mechanisms: To have aiming stops which can be permanently set to position lamp vertically and rotationally.

- J. Power Supply
 - 1. Integral:
 - a. Rated for use with the LED array specified. Warranty array and driver as an assembly. 5 year full replacement, non-prorated warranty is required on all electronic components.
 - 2. Remote:
 - a. Rated for use with the LED array specified. Warranty array and driver as an assembly. 5 year full replacement, non-prorated warranty is required on all electronic components.
- K. Finish: All visible surfaces to be of color and texture as directed in Luminaire Schedule. All concealed interior and exterior luminaire surfaces to be matte black or as recommended by the luminaire manufacturer.
- L. Testing: LED luminaires must meet the IES LM-79-08 and LM 80-08 testing requirements. The manufacturer shall provide verification of testing compliance upon request of the design team, contractor, or owner.
- M. Disposal and replacement: LED manufacturer is responsible for the disposal of expired LED arrays and heat sinks. Fixture must be clearly labeled with return information, disposal procedures and manufacturer disposal contact information. All shipping will be paid for by the owner.
 - 1. The manufacturer is required to inform the owner of new power requirements and /or lumen output values if new replacement components prior to shipping replacement parts.
 - 2. Disposal and replacement information will be labeled inside the luminaire and in the project operation and maintenance manuals along with all O&M requirements listed in Division 1 of the specifications.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Installation shall meet the general requirements of NFPA 70, National Electric Code.
- B. Mounting heights specified on drawings:
 - 1. Wall mounted luminaires: shall be to centerline of luminaire.
 - 2. Pendant mounted luminaires: shall be to bottom of luminaire unless specifically identified in the Luminaire Schedule or on drawings.
- C. Support:
 - 1. The luminaires shall be supported by separate means from the building structure and not from the ceiling system, ductwork, piping, or other systems.
 - 2. The final decision as to adequacy of support and alignment will be given by the Architect.
- D. Level luminaires, align in straight lines, and locate as shown on the architectural elevations and reflected ceiling plan.
- E. Manufacturer's labels or monograms shall not be visible after luminaire is installed, but must be included for future reference.
- F. Recessed luminaires shall have trims which fit neatly and tightly to the surfaces in which they are installed without light leaks or gaps. Where necessary, install heat resistant non-rubber gaskets to prevent light leaks or moisture from entering between luminaires trim and the surface to which they are mounted.

3.02 COORDINATION OF WORK

- A. The Architectural Reflected Ceiling Plans shall take preference as to the exact placement of the luminaires in the ceiling.

- B. Determine ceiling types in each area and provide suitable accessories and mounting frames where required for recessed luminaires. Luminaire catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a luminaire may be installed.

3.03 AIMING

- A. Aim luminaires with proper lamps installed.
- B. Aim all directional luminaires, including but not limited to luminaires described in the Contract Documents or by the luminaire manufacturer as aimable, adjustable, or asymmetric as follows:
 - 1. Provide the lighting pattern for which the luminaire is designed.
 - 2. Provide the lighting pattern as shown on the drawings.
 - 3. Predetermined aiming points as shown on the drawings.
 - 4. Where aiming cannot be determined, request, in writing, clarification from the Architect, indicating luminaires needing clarification.
- C. Re-aim luminaires as determined by Architect during final project walkthrough.
- D. Adjustable luminaires shall be installed with dead zone of rotation away from intended aiming point.

3.04 PROJECT CLOSEOUT

- A. Leave luminaires clean at the time of acceptance of the work. If luminaires are deemed dirty by the Architect at completion of the work, the Contractor shall clean them at no additional cost. Protective plastic wrap is to be removed from parabolic luminaires just prior to owner acceptance.

END OF SECTION

**SECTION 27 0000
COMMUNICATIONS**

PART 1 - GENERAL

1.01 SUMMARY

- A. Division 27 – Communications governs the infrastructure for the low-voltage information transport systems, which include voice and data and their pathways.
- B. Description of Work:
 - 1. Furnish and install materials for the communications infrastructure systems as specified herein and as shown on the Drawings. Upon completion, the systems shall be functioning in compliance with performance requirements specified.
 - 2. The cabling specified and shown on the Drawings is for complete, performance based, workable systems. Deviations from the cabling shown due to a particular manufacturer's requirements shall be made only with the written approval of the Architect and the Owner, and at no additional cost to the Owner.
 - 3. This division also includes telecommunications cabling, connections, and equipment needed for the A/V projection and sound reinforcement and Wireless Access Points (WAP). Refer to "T" series Drawings for locations, quantities and additional requirements.

1.02 SECTION INCLUDES

- A. Definitions
- B. Quality Assurance
- C. Submittal Requirements

1.03 RELATED DOCUMENTS

- A. Comply with the referenced codes and standards and with the Contract Documents. Where conflicts occur, the more stringent shall apply.
- B. The following codes, associations, acts and agencies, as required by law:
 - 1. Federal Communications Commission (FCC)
 - 2. National Electric Code[®] (NEC[®])
 - 3. National Electrical Safety Code (NESC)
 - 4. National Fire Protection Association (NFPA)
 - 5. Occupational Safety and Health Administration (OSHA)
- C. The following standards:
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical manufacturers Association (NEMA)
 - 3. Telecommunications Industries Association (TIA)
 - 4. Electronic Industries Association (EIA)
 - 5. Institute of Electrical and Electronics Engineers (IEEE)
 - 6. Underwriters Laboratories (UL[®])
 - 7. American Standards Association (ASA)
- D. The following guidelines:
 - 1. BICSI, Telecommunications Distribution Methods Manual (TDMM)

1.04 RELATED SECTIONS

- A. Section 01 7900 – Demonstration and Training
- B. Section 01 9113 – General Commissioning Requirements
- C. Section 27 0005 – Common Work Results for Communications
- D. Section 27 0513 – Communications Services
- E. Section 27 0526 – Grounding and Bonding for Communications Systems
- F. Section 27 0528 – Pathways for Communications Systems
- E. Section 27 0528.29 - Hangers and Supports for Communications Systems
- F. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- G. Section 27 0528.36 - Cable Trays for Communications Systems
- H. Section 27 0528.39 - Surface Raceways for Communications Systems
- I. Section 27 0553 – Identification for Communication Systems
- J. Section 27 0800 – Commissioning of Communications
- K. Section 27 1100 – Communications Equipment Room Fittings
- L. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
- M. Section 27 1123 – Communications Cable Management and Ladder Rack
- N. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
- O. Section 27 1313 – Communications Copper Backbone Cabling
- P. Section 27 1323 – Communications Optical Fiber Backbone Cabling
- Q. Section 27 1513 – Communications Copper Horizontal Cabling
- R. Section 27 1543 – Communications Faceplates and Connectors
- S. Section 27 1619 – Communications Patch and Station Cords
- T. Section 27 2133 – Wireless Access Points
- U. Section 27 4100 - Audio-Video Systems
- V. Section 27 4119 – Classroom Audio-Video Systems
- W. Section 27 5113 – Paging Systems
- X. Section 27 5313 – Clock Systems

1.05 DEFINITIONS

- A. Advanced System Warranty – an extended warranty held either by the connectivity or cabling manufacturer directly with the Owner for this project that guarantees product and performance of the entire cabling system for the warranty period.
- B. Conveniently Accessible - being capable of being reached from floor or use of 8' step ladder without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.
- C. Entrance Room – A space in which the joining of campus and building telecommunications backbone facilities takes place.
- D. Equipment Room – An environmentally controlled centralized space for telecommunications equipment that usually houses a main or intermediate crossconnect, as well as video surveillance and security equipment.
- E. IDF – Intermediate Distribution Frame, also known as a Telecommunications Room (TR) or Communications Room.

- F. Lead Telecommunications Installer –the project manager for the Telecommunications Subcontractor for all telecommunications work in the construction documents (T-series Drawings and specification Section 27), who shall be on-site at all times while Division 27 work is being performed. This individual shall attend all construction project meetings.
- G. Listed Communications Cable – A cable listed by the Underwriters Laboratory (UL[®]) and accepted by the local authority having jurisdiction as having met appropriate designated standards or has been tested and found suitable for installation in specific spaces. Refer to *NEC*[®] Section 800 for listing types and additional requirements.
- H. MDF – Main Distribution Frame, also known as the Main Equipment Room.
- I. Plenum – A compartment or chamber to which one or more air ducts is connected and that forms part of the air distribution system. Assume space above suspended/accessible ceilings is a plenum.
- J. Plenum-rated – listed by the Underwriters Laboratory as being suitable for installation into a plenum space. Communications cabling routed through plenum-rated space shall be plenum-rated and identified as Type CMP.
- K. Point of Entrance (Building Entrance) - The point within a building at which the Outside Plant (OSP) communications wire or cable emerges from an external wall, from a concrete floor slab, or from a rigid metal conduit (Type RMC) or an intermediate metal conduit (Type IMC) connected by a grounding conductor to an electrode in accordance with the *NEC*[®].
- L. Subcontractor, Telecommunications – company responsible for all telecommunications work in the construction documents (T-series Drawings and specification sections 27 0000 through 27 5313).
- M. Telecommunications – in general, telecommunications refers to infrastructure/equipment needed for the voice, data, and video communications and transport systems.
- N. Telecommunications Consultant – As defined for sections referring to telecommunications work only, this Consultant shall be the telecommunications design consultant employed by the Owner for the purpose of observing the work of the Communications Subcontractor(s).
- O. Telecommunications Room - An environmentally enclosed architectural space designed to contain telecommunications equipment, cable terminations, or crossconnect cabling. The Main Equipment Room may also be known as the MDF, and may be co-located with the building's Entrance Room and Equipment Room. Telecommunications Rooms will also house equipment for additional systems, such as security, cable television, and audio/video.
- P. UL[®] – Underwriters Laboratory

1.06 QUALITY ASSURANCE

- A. Project Submittal Compliance – The Project Architect shall be responsible for receiving and compiling all submittal information. As such, all such data pertaining to Section 27 shall conform to the following Division 1 Sections:
 - 1. Section 01 6000 – Substitutions
 - 2. Section 01 3300 – Submittals
 - 3. Section 01 7823 – Operations and Maintenance Data
 - 4. Section 01 7839 – Project Record Drawings
- B. Telecommunications Subcontractor Qualifications
 - 1. Company Requirements
 - a) The Telecommunications Subcontractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications.

- b) Telecommunications Systems specified shall be assembled and installed under the direction of a qualified Telecommunications Subcontractor. Qualification requirements shall include submittal by the Telecommunications Subcontractor to the Architect of the following:
 - 1) List of previous projects of this scope and nature, including names and sizes of projects (to include square footage and construction cost – overall and that of the Telecommunications Subcontractor), description of work, times of completion, and names of contact persons for reference.
 - 2) Installers shall certify that they are manufacturer-authorized or trained for work to be performed.
- 2. Lead Telecommunications Installer Requirements:
 - a) Lead Communications Installer shall be a current member of BICSI in good standing and have completed (at a minimum) BICSI ITS Installer 2 Training (for both copper and fiber).
 - b) Submit certificate of ITS Installer 2 Training (or higher) with bid and preconstruction submittal package.
 - c) Advanced training from connectivity manufacturer may be submitted in lieu of BICSI ITS Installer 2 Training. Submit manufacturer training certificates for review by Owner as substitution request as part of Pre-Bid questions. This training must be by the same manufacturer that will hold the Advanced System Warranty.
- 3. General Telecommunications Installer Requirements:
 - a) For all work associated with Specification Sections 27 all installers are to have a minimum of BICSI ITS Installer 1 Training or equivalent training from the connectivity manufacturer.
 - b) Submit a list with bid of names of all installers and appropriate copies of certificates verifying training with pre-construction submittal package.
- C. Warranty Requirements
 - 1. Project Warranty
 - a) Equipment and materials required for installation under these specifications shall be the current model and new (less than one year from date of manufacture), unused and without blemish or defect, and are to be guaranteed to be free from defect.
 - b) When a defect or problem is observed within the first year after substantial completion, the Owner will notify the governing subcontractor through the proper channels. The appropriate Subcontractor then has 48 hours to fix the defect or furnish and install a replacement part/system, all at no cost to the project or Owner.
 - 2. Advanced System Warranty for Telecommunications (Copper and Fiber Systems)
 - a) Beyond the initial one year project warranty, the Telecommunications Systems shall be warranted for a minimum of 20 years by a national and reputable connectivity or cabling manufacturer.
 - 1) This warranty shall cover any material defect, as well as the performance of the cabling system. (Example: A Category 6A cabling system is to deliver 10,000BASE-T speed, or 10 gigabit performance for the entire length of the warranty period.)
 - 2) This warranty shall cover both material and labor for the full length of the warranty period.

- b) The Telecommunications Subcontract shall be certified by this manufacturer.
- c) The following manufacturers are conditionally approved to provide the system warranties (subject to specific project requirements):
 - 1) Copper Connectivity Manufacturers
 - i. CommScope
 - ii. Panduit
 - 2) Fiber Connectivity Manufacturers
 - i. CommScope
 - ii. Panduit
 - 3) Cabling Manufacturers
 - I. CommScope
 - II. General (for Panduit product Set)
- D. When articles, materials, operations or methods related to execution of communications work are noted, specified, or described in the specifications or are indicated or reasonably implied on Drawings and schedules, execute work as required or appropriate to provide complete and proper function, operation and installation.
- E. The Drawings utilize symbols and schematic diagrams to indicate items of work. These symbols and diagrams will not typically identify dimensions nor will they identify inclusion of specific accessories, appurtenances and related items necessary and appropriate for a complete and proper installation and operation. The Telecommunications Subcontractor shall install work complete and ready for proper operation, including related items not specifically identified, shown, indicated or specified. The work shall be installed, in accordance with the intent diagrammatically expressed on the Drawings, and in conformity with the dimensions indicated on architectural Drawings and on shop Drawings approved by the Telecommunications Consultant.
- F. The Drawings include details for various items, which are specific with regard to the dimensions and positioning of the work. These details are intended only for the purpose of establishing general feasibility; they do not obviate field coordination for the indicated work. Work shall not proceed until actual field conditions and requirements are verified by the Telecommunications Subcontractor.
- G. The Drawings are diagrammatic and indicate the general arrangement of systems and equipment unless indicated otherwise by dimensions.

1.07 SUBMITTALS

- A. General Requirements
 - 1. Provide Submittals in accordance with Section 01 3300
 - 2. Architect shall receive and Telecommunications Consultant is to review all submittals related to Division 27 work. This includes, but is not limited to, relevant:
 - a) Pre-bid questions,
 - b) Contractor and personnel qualifications with bid,
 - c) Voluntary alternates and unit pricings with bid,
 - d) Pre-construction product submittals and shop Drawings,
 - e) Change order requests, requests for information (RFIs), design change directives (DCDs), and any other changes as directed by the architect/engineer.

3. Record Drawings and warranty certificates/letters shall be in accordance with Section 01 7839.
 4. Allow a minimum of one week (five working days) for the Telecommunications Consultant to review.
- B. The following submittals are due at the Pre-Bid deadline for questions:
1. Requests for product substitution shall be in accordance with Section 01 6000
 - a) All products seeking approval either as "approved equivalent" or otherwise, shall be submitted as a product substitution request prior to bid. Failure to submit product substitution request in a timely manner (before pre-bid questions are due) may preclude product from being utilized on the project. Requests made with bid or post-bid will not be considered without a significant cost savings realized to the Owner.
 - b) The burden of proof is on the contractor to provide documentation that equivalent product meets the specifications and project requirements. Include in substitution request:
 - 1) Product being replaced
 - 2) Reason for product substitution
 - 3) Full manufacturer specification sheet clearly indicating that all requirements in project documents have been met
 - c) Failure to meet these requirements will result in the product substitution request being returned without review.
 - d) All product substitution requests are to be reviewed and approved by the Telecommunications Consultant. Not all requests will be approved, and all decisions are final, without recourse.
- C. The following submittals are due with the Bid:
1. Proof of Telecommunications Subcontractor and personnel qualifications
 - a) Provide a typed list with the following information:
 - 1) Company name of Telecommunications Subcontractor
 - 2) List of connectivity or cabling manufacturers that the Telecommunications Subcontractor is certified to install and provide advanced warranty for.
 - 3) List of previous projects (minimum of 3) of this scope and nature, including:
 - I. Project name and date of completion
 - II. Project size (square feet of building, total construction cost, total cost of telecommunications scope)
 - III. Name and contact information for building owner or IT Manager
 - 4) Name and contact information for Lead Telecommunications Installer
 - b) Provide certificates or letter(s) from BICSI and / or manufacturers verifying by name these qualifications have been met.
 - c) Refer to Quality Assurance subsection in this specification section for additional requirements and qualifications.
 2. Voluntary alternatives (that realize substantial cost savings)
 3. Unit pricing for the following items:

- a) All unit pricing relating to Division 27 as identified in Section 01 2200.
- D. The following submittals are due at the Pre-Construction Phase (to be delivered to the Project Architect with copies to Telecommunications Consultant):
1. General Requirements:
 - a) Follow submission guidelines as outlined in Division 1. At a minimum, provide the requirements as outlined in this section. Where Division 1 requirements are more stringent, follow those in addition to the requirements in this section.
 - 1) Strictly electronic submission to Telecommunications Consultant is acceptable. General contractor, architect, and engineering requirements may differ.
 - b) Ensure a cover page with Project Title, Telecommunication Subcontractor Company, and point of contact is included for all physical submittals.
 - c) Updated Personnel Qualifications
 - 1) Provide a list of names of all telecommunications installers with appropriate certificates from BICSI or the manufacturer.
 2. Product Information, divided by Specification Section and in order as listed in specification. Identify the start of each specification section.
 - a) Provide manufacturer's product information cutsheet or specifications sheet with the specific product number identified or filled out.
 - 1) Submitted cutsheets without specific product identified will result in the whole submittal being returned without review.
 - 2) No product substitutions will be considered post bid without a significant cost savings to the project to be realized by the owner – a minimum of \$1000, either in material or labor savings. For any product substitution requests post-bid, Telecommunications Subcontractor shall submit an RFI through the proper channels with the requested documentation from the Pre-bid requirements above. Also, include realized cost savings. The project team may issue a change order (or its equivalent) for the product change at their discretion.
 - I. One exception to this is if the specified product goes out of production and is unavailable before submitted shop Drawings are approved. Telecommunications or Subcontractor is to submit an RFI explaining the situation and recommending an equivalent product with the same features at no cost change to the project or Owner.
 - II. Other exceptions may be considered. Telecommunications Subcontractor is to submit an RFI explaining the situation.
 3. Shop Drawings
 - a) Conform to all requirements of Section 01 3300. In addition, generate electronic shop Drawings in AutoCAD®, dwg file format, version 2010 (or newer), saved to disk (CD-R or DVD+/-R) or USB Flash Drive with project name and number clearly indicated [or uploaded to project website]. Shop Drawings shall include Telecommunications or Subcontractor title block and included readily printable Plot/Drawing tabs

with mview-window at a scale to not be less than 1/8"=1'-0" unless otherwise noted. The scale shall also be indicated on the Drawings.

- 1) Acceptable electronic shop drawing sizes include: 8.5"x11", 11"x17", 22"x34" or 24"x36".
 - b) Refer to individual sections for additional requirements.
 - c) Communications pathways
 - 1) Hangers and Supports – indicate proposed routing of all cabling supported by J-hooks.
 - 2) Cable Trays - indicate size and proposed routing of all communications cable trays; should any of those locations or sizes differ from the construction Drawings due to minor coordination issues, cloud the affected area and note why the change is necessary. (For major coordination issues, please submit an RFI.)
 - 3) Firestopping – indicate manufacturer, product/assembly, and UL system for all firestop penetrations required for communications cabling.
- E. The following submittals are due during Construction (project closeout), in accordance with the requirements in Sections 01 7839 and 27 0000 - Communications:
1. 3 weeks prior to Substantial Completion:
 - a) Record Drawings
 - 1) Modify reviewed and accepted AutoCAD® shop Drawings to include revisions based upon completion of work.
 - 2) Provide (1) printed set of record Drawings to scale (not less than 1/8" = 1'-0").
 - 3) This set is to include system function diagrams and details not on original construction documents.
 - b) Test Results, in accordance with section 27 0800.
 - c) With the exception of the (1) printed set of record Drawings, submit these files electronically either on disk (CD or DVD) or USB Flash Drive, with project name and number clearly indicated.
 2. Within two weeks after Substantial Completion:
 - a) Warranty Certificates for the Advanced Telecommunications System Warranty for the copper and fiber systems with point of contact for any warranty claims.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.
- B. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer and part number.
- C. All products and materials shall be new and unused prior to their installation as part of this project. Refurbished items are not allowed.

PART 3 - EXECUTION

3.01 GENERAL

- A. Coordinate with all other trades prior to installation.

1. Telecommunications Subcontractor shall meet with Electrical, Mechanical, and General Contractors prior to construction to identify pathway and infrastructure space requirements.
 - a) At a minimum, the following items shall be discussed:
 - 1) Cable tray locations and clearance space above (12" if possible, with proper coordination)
 - 2) Placement for sleeving and wall penetrations
 - 3) In-ceiling projection screens and other audio/video equipment.
 - b) Failure to coordinate sufficient space for telecommunications infrastructure shall result in relocation of various systems by the contractor at no additional cost to owner.
2. Prior to the start of work, the Telecommunications Subcontractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where Division 27 work may properly commence. Start of work indicates acceptance of conditions.
3. Coordinate location of equipment and conduit with other trades to minimize interference.
 - a) Holes through concrete and masonry structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base building. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the General Contractor as required by limited working space.
 - b) Holes shall be located so as not to affect structural sections such as ribs or beams.
 - c) Holes shall be laid out in advance. The General Contractor shall be advised prior to drilling through structural sections, for determination of proper layout.
 - d) Structural Penetrations: Where conduits, wireways and other raceways pass through fire partitions, fire walls or walls and floors, provide an effective barrier against the spread of fire, smoke and gases.
- B. Follow all manufacturers' instructions and install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.
 1. In the event of discrepancy, immediately notify the Telecommunications Consultant through the proper channels. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.
- C. Protection of Systems and Equipment
 1. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.
 2. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering them on sides with securely fastened protective rigid or flexible waterproof coverings.
 3. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum-cleaned both inside (as appropriate) and outside before testing, operating or painting.
 4. As determined by the Telecommunications Consultant, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully

comply with requirements of the Contract Documents. Decision of the Telecommunications Consultant shall be final.

5. Painted surfaces shall be protected with removable heavy kraft paper, sheet vinyl or equal, installed at the factory and removed prior to final inspection.
 6. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with same quality of paint and workmanship as used by manufacturer.
- D. Access to Equipment
1. Equipment shall be installed as per the scaled detail on the T-series Drawings. .
 2. Working spaces shall be not less than specified in the National Electrical Code[®] for voltages specified.
 3. Where the Telecommunications Consultant determines that the Telecommunications Subcontractor has installed equipment not “conveniently accessible” for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Telecommunications Consultant, at no additional cost to the Owner.
- E. Cleaning
1. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by communications work.
 2. Remove dust and debris from interiors and exteriors of telecommunications equipment (including electrical rough-in). Clean accessible current carrying elements prior to being energized.
- F. Completion
1. General:
 - a) Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
 2. Results Expected:
 - a) Systems shall be complete and operational.
Cleaning work shall be complete.
 3. Testing and Verification – General Requirements
 - a) Refer to individual sections for additional testing and verification requirements.
 - b) The Telecommunications Subcontractor shall verify that requirements of this specification are met. Verification shall be through a combination of analyses, inspections, demonstrations and tests, as described below.
 - c) Verification by Inspection: Verification by inspection includes examination of items and comparison of pertinent characteristics against the qualitative or quantitative standard set forth in the specifications.
 - d) Verification by Test and Demonstration: The Telecommunications Subcontractor shall verify by formal demonstrations or tests that the requirements of this Specification have been met. The Communications Subcontractor shall demonstrate that the communications systems components and subsystems meet specification requirements in the "as-installed" operating environment during the "System Operation Test".
 - e) Perform system operation tests after full enclosure of walls.

- f) System Operation Tests Conducted Upon Completion of Work: Upon completion of the Telecommunications Subcontractor's Work, subject the system to functional and operational tests. When required corrections determined by initial test results have been completed, fully retest the system. The Owner shall be notified in writing not less than seven days in advance of date of proposed final testing and inspection. The advance notice shall include certification that the installation is complete and operable and that the Telecommunications Subcontractor has satisfactorily performed the final tests specified herein. The acceptance testing and final inspection shall be accomplished in the presence of the Owner and the Telecommunications Consultant. At least 10 days prior to scheduled system completion, the Telecommunications Subcontractor shall submit, for approval by Owner and Telecommunications Consultant, a test plan to completely test the telecommunications system. The Telecommunications Subcontractor shall include in test plan, for acceptance by the Owner and Telecommunications Consultant, a complete and detailed final acceptance test check-off list ("punch list"). The list shall be a complete representation of specified functions and conditions.

4. Commissioning

- a) There shall be three phases of commissioning:
- 1) Rough-in inspection
 - 2) Above-ceiling inspection (after cables are placed)
 - 3) Final inspection
- b) At a minimum, the Telecommunications Consultant shall check the following items:
- 1) Accurate location and height above finished floor for all outlet boxes.
 - 2) Accurate dimensions (particularly depth) of all outlet boxes and diameter of in-wall conduit serving outlet boxes.
 - 3) Cable tray size, location, and clearance.
 - 4) Location and size of all other communications conduits or pathways
 - 5) That power receptacles within the communications rooms meet the design requirements.
 - 6) The Telecommunications Consultant is then to issue a written report to the Architect identifying all items which currently do not meet the construction document requirements. This report is to be forwarded to the appropriate subcontractor(s) and all items are to be addressed.

This report is not necessarily all inclusive; should issues be discovered later in the project, the appropriate communications subcontractor is still responsible for corrections/repairs.
- c) Once all communication cabling has been installed and properly supported and walls have been painted, but prior to the installation of ceiling tiles/material, the Telecommunications Consultant shall schedule a time to be on-site to conduct above-ceiling inspection.
- 1) At a minimum, the Telecommunications Consultant shall check the following items:

- i. That all items from the previous inspection have been corrected.
 - ii. That communications cabling is routed correctly and adequately supported.
 - iii. That communications cabling is not painted or over sprayed.
 - iv. That the installed communications cabling matches what was specified / submitted.
 - v. That there are no kinks, splices, or other damage to the installed communications cabling.
- 2) The Telecommunications Consultant is then to issue a written report to the Architect identifying all items which currently do not meet the construction document requirements. This report is to be forwarded to the appropriate subcontractor(s) and all items are to be addressed. This report is not necessarily all inclusive; should issues be discovered later in the project, the appropriate communications subcontractor is still responsible for corrections/repairs.
- d) Once all communications work has been completed, contractor shall request final inspection. This request shall be made 3 weeks before substantial completion. The Telecommunications Consultant shall then schedule a time to be on-site to conduct this inspection; the Telecommunications Consultant shall also invite the Owner to attend this inspection.
- 1) At a minimum, the Telecommunications Consultant shall check the following items:
 - I. That all items from the previous inspections have been corrected
 - II. That all faceplates are installed, with the correct modules, quantity of modules, and approved labeling scheme
 - III. That all equipment and cabling within communications rooms is installed per the contract documents, including all patch panels and wall blocks (with specified spare capacity), horizontal and backbone cabling labeling, and telecommunications grounding.
 - IV. And all other items necessary to guarantee contract documents are met and complete and functioning communications systems are installed.
 - 2) The Telecommunications Consultant is then to issue a written report to the Architect identifying all items which currently do not meet the construction document requirements. This report is to be forwarded to the appropriate subcontractor(s) and all items are to be addressed prior to substantial completion. This report is not necessarily all-inclusive; should issues be discovered within one year after substantial completion, the appropriate communications subcontractor is still responsible for corrections/repairs.

END OF SECTION

INTEGRATED AUDIO VIDEO SYSTEMS

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawing Basics: Drawings and general provisions of Contract, including Revised General Conditions, Special Conditions and other Division 01 Specification sections apply to this section.

1.2 SUMMARY

- A. Content: Various audio and video systems, equipment and installation includes, but is not limited to:
 - 1. Gym, Cafeteria, Music Room and Media video and sound systems
- B. Nomenclature: The systems shall be called the "sound system", "audio/visual system", "sound field system" and the installer the "AV system installer" or "AV contractor".
- C. Equipment:
 - 1. Audio Mixers, Equalizers, Amplifiers, Program Sources, and other audio processing equipment.
 - 2. Loudspeakers, custom coated enclosures and speaker mounting or support hardware including speaker mounting frames and incidental steel support members.
 - 3. Video Projectors and associated routing and switching equipment.
 - 4. Equipment Racks and portable cabinets.
 - 5. Control Equipment, remote power switching
 - 6. Cables, connectors, plates and wiring.
- D. Related Sections: Division 01 and applicable Sections under Division 26.

1.3 REFERENCES:

- A. Sound System Engineering (2nd Edition), Davis and Davis, Howard W Sams, 1987
- B. Audio system – Design and Installation, Giddings, Howard W Sams, 1990
- C. ANSI S4.48-1992
- D. EIA Standard RS-160
- E. EIA Standard RS-219
- F. EIA Standard RS-460

1.4 SUBMITTALS

- A. Comply with Section 01 33 00, unless otherwise indicated.
- B. Provide simultaneously thirty (30) days after issuance of Notice to Proceed.
- C. Complete schedule of submittals.
 - 1. Chronological schedule: of Work in bar chart form (using Microsoft Project or similar program). Revise and resubmit schedule as required to reflect construction progress.

INTEGRATED AUDIO VIDEO SYSTEMS

2. Product Data Sheets: Provide a list of products (with manufacturer's data sheets) on products to be incorporated within the Work. Arrange data sheets in specification order per system.
 - a. Submit (3) three bound originals of manufacturers' product technical data for each product in sufficient detail to facilitate proper evaluation of product suitability for incorporation in the Work.
 - b. Provide tab dividers for each group of data sheets, arrange each section in alphabetical order.
 3. Shop Drawings:
 - a. Shop drawings are to be prepared in the current version of AutoCAD and submitted 30 days after submittal sheets. Subsequent revisions and Project Record Drawings are also to be generated in the current version of AutoCAD. AutoCAD 2015 or later
 - b. Installation: Special details depicting methods and means specific to each product, assembly and each product manufacturers recommended installation methods and means.
 - c. Schematic: Detailed, redrawn wiring diagrams for each system, including cable types, identification and color codes, and detailed wiring of connections and terminal strips.
 - d. Floor Plans: Drawn to scale of not less than 1/8" = 1'-0". Show AV Systems devices including wall and ceiling mounted speakers, wall and floor panels/plates, junction boxes, and terminal strip locations.
 - e. Control: Detailed wiring diagrams including pin-outs and component lists Include color codes and cable types.
 - f. Equipment: Location of Equipment in racks, consoles, tables, or cabinets, with dimensions. Wire routing and cabling within housings, AC power and terminal strip locations.
 - g. Custom Enclosure and/or Millwork: Full fabrication details indicating size, material, finish, and openings for equipment.
 - h. Speaker Mounting Details: Retain services of registered professional structural engineer, licensed to practice in the state of Oregon to review and develop mounting details. Structural information to include design calculations and copy of engineer's certification stamp. Loudspeaker location, orientation, and support systems shall be shown.
 - i. Labeling: Include representative equipment and cabling labeling scheme.
 - j. Include any other pertinent information generated which is necessary to provide the Work.
 - k. Develop a test report form to be used during the Contractor's Testing Procedures described in Part 3. Submit this form for approval as part of submittal package 30 days after notice to proceed.
- D. Submit three bound original sets of the following Project Record Manual information after substantial completion and prior to final inspection.
1. On the cover of the bound original provide the project name, year and month of substantial completion, name of contractor, address of contractor, phone number for obtaining service in the event of failure and the official end date of the system warranty.

INTEGRATED AUDIO VIDEO SYSTEMS

2. Product Data: Product actually incorporated within the Work, including manufacturers' data sheet and owners manual for each product. Include a complete list of all equipment with serial numbers of all products.
 3. Record Drawings: Final rendition of drawings depicting the actual installed system.
 4. Test Reports, as described in the Test section and approved as part of the submittal documents.
 5. System Operation and Instructions: Prepare a complete and typical procedure for the operation of the equipment as a system, organized by subsystem or activity.
 6. Service and Maintenance Manual: Provide an original copy of the service manual on every piece of equipment for which the manufacturer offers such a manual. Include phone numbers and hours of operation for all manufacturers.
 7. Warranty Manual: Include manufacturers warranty statements, date of substantial completion and ending dates for warranties for each type of product, plus any other pertinent data required for future maintenance.
- E. Project/Site Conditions:
1. Verify All Conditions At Jobsite. Promptly report variations and obstructions to the AV Consultant. All additions or corrections are to be requested prior to fabrication.
 2. Field measurements shall be taken by the AV Contractor prior to preparation of shop drawings to ensure proper fitting of work. Allow for adjustments during installation whenever taking field measurements.

1.5 QUALITY ASSURANCE

- A. AV Contractor must be experienced in installation of systems with similar complexity as those required for this project. The AV Contractor must have at least five years experience with the equipment and systems specified, must install audio/visual systems as at least 80% of their overall business, and must be able to document relevant experience with projects of similar scope installed within the past five years.
- B. Installers Qualifications: Any AV Contractor who wishes to bid must submit qualification information to the Architect and AV Consultant at least (14) fourteen days prior to the bid date. Proposal must include:
1. Names of individuals holding in excess of 33-1/3% of stock in the firm, and individuals, partnerships, or corporations with which the firm is affiliated in co-ventureships or joint ventures.
 2. List of not less than 10 projects of similar size and scope completed within the past five years. AV Contractor shall indicate responsibilities (engineering, shop drawings, fabrication, etc.). Furnish recent contact name, address, and phone number for each project.
 3. List of current projects and approximate contract value and completion dates. Include list of names, phone numbers and addressed of owner, owners representatives, and architect. Include list of personnel who are actively involved in the current projects.
 4. Provide proof of bonding capacity for an amount equal to this project. Include list of other bonded projects coinciding with this project.
 5. Evidence of ability to undertake custom product engineering to meet the specific requirements of the project specifications. Provide sample project engineering drawings for custom products and contact information for facility operators where those products have been installed.

INTEGRATED AUDIO VIDEO SYSTEMS

6. Project Manager and Staff: the AV Contractor must provide the name, title, and resume of the project manager and assigned staff for the Project. The project manager shall not be changed without written consent of the Owner.
7. The AV Contractor must be a franchised dealer and authorized service center for the major products specified (or provide acceptable documentation as to how products will be acquired and serviced).

1.6 DELIVERY HANDLING AND STORAGE

- A. Delivery: Deliver products in original unopened packaging with legible manufacturer's identification.
- B. Storage and Protection: Comply with manufacturers recommendations. Store in a cool, dry place, out of direct sunlight, and protect from damage. Provide protective covering during installation to prevent damage from dust or other foreign materials. For products not currently installed provide secure locked storage both on site and at the AV Contractors own facility.

1.7 WARRANTY

- A. In addition to manufacturers' warranties, the AV Contractor shall warrant all equipment to be free of defects in materials and workmanship for not less than one year after date of Substantial Completion. Defects occurring in labor or materials within the warranty period shall be rectified by replacement or repair within 24 hours (if parts require longer periods to obtain, provide substitute equipment during the intervening period). Provide response to service calls and requests for information within 24 hours.
- B. AV Contractor to provide Owner with exact beginning and ending dates of the warranty period, include the name and phone of the contact person as well as the procedure for obtaining service.
- C. Preventive Maintenance: At six months after system acceptance, and 30 days prior to the end of the warranty, provide a complete checkout of system components. Repair or replace defective equipment, and correct any wiring or functional problems reported by the Owner.

PART 2 - PRODUCTS**2.1 ACCEPTABLE MANUFACTURERS**

- A. Refer to Division 01.
- B. Model numbers and manufacturers included in this specification are listed as a standard of quality. Other qualified manufacturer's products will be considered subject to submission and approval of complete technical data, samples and results of laboratory tests, in accordance with Division 01. Substitutions will only be accepted if, in the opinion of the AV Consultant, the product is an equal to the specified product. No substitutions may be made without written acceptance from the AV Consultant. All substitutions made prior to this acceptance are at the sole risk of the AV Contractor. Substitution requests need to be submitted no less that (14) fourteen days prior to the bid date.
- C. See Attachment "A" for the specific equipment list for each area. The equipment list and drawings are representative of the design and do not necessarily provide all equipment and detail for a fully functioning system. It is the responsibility of the AV Contractor to ensure the system is complete and functions according to the system descriptions and design intent.

INTEGRATED AUDIO VIDEO SYSTEMS

- D. For bids to be considered complete and qualified they must be bid per the documents and specifications. If proposed system includes equipment other than that specified, submit a list of major items and quantities, with a one-line schematic diagram for review and approval. Include a list of previously installed projects with similar equipment included. This list is to be submitted as an alternate to the actual bid document.

2.2 GENERAL

- A. Provide new equipment and materials which conform with applicable UL, SCA, or ANSI provisions.
- B. Regardless of the length or completeness of the product description in this specification, each device shall meet the published manufacturer's specifications. Verify performance as required.
- C. Cable and Wire: The highest quality, lowest signal degradation cable and wire shall be used for the project. Shown below are typical cable and wire types. AV Contractor shall submit wire and cable types for approval prior to wire pull.
1. Microphone: (AM) Belden 9451
 2. Line Level Audio: (AL) Belden 9451
 3. Speaker Cable: (SL, SH, SZ) West Penn C210 (main speakers), West Penn 227 (monitor speakers), West Penn 225 (70.7 V Systems)
 4. Control: (CG, CR) Belden 9455 (9 conductor control cable) Low Voltage AC power sequencing, (CS, CI) Belden 9451 Serial control cable.
- D. Conduit: All cable and wire shall be run through EMT conduit. Separate conduits shall be used for video, line-level and microphone level audio, control, amplified audio to speakers, and network signals.
- E. AC Power Sequencing and Distribution: Each equipment rack shall have power sequencing to supply power to each component in a sequenced manner. A power-on switch shall be provided at each rack. All AV equipment shall be supplied with transformer isolated AC power.
- F. All equipment and components shall be new and complete. No used or reconditioned equipment shall be acceptable.
- G. All mounting hardware shall be included.
- H. All equipment and components shall be factory tested prior to shipping.
- I. All bolts and fasteners must be Grade 5 or better.
- J. All bolted attachments to have lock washers or other approved self-locking hardware.
- K. All microprocessor controls shall utilize a non-volatile memory. System configuration, operating parameters, presets, etc. shall be protected against system power failure for a minimum of 48 hours.
- L. All internal rack wiring shall be factory completed and clearly marked. All field connections shall be by connector, terminal strip or other device previously specified. Any terminal strip connections shall be clearly labeled as to terminal designation.
- M. All wire sizes and insulation to comply with UL standards and local codes.
- N. All wiring to be harnessed and bound. No loose or randomly routed wires shall be permitted.

INTEGRATED AUDIO VIDEO SYSTEMS

- O. No manufacturer logo shall appear on control station face plates or any other device located in public areas.
- P. Any supplementary or auxiliary equipment necessary for the operation of the system shall be supplied with overload and short-circuit protection.
- Q. Do not purchase or fabricate any materials, components or items to be used in the sound, video and communication systems prior to review of shop drawings, unless otherwise directed by AV Consultant.
- R. Use only materials, components and items that conform with industry practice and applicable code standards. Use only components which are new and never previously used. Take care during installation to prevent scratches, dents, chips, etc.
- S. Install all rack-mounted equipment with 10-32 button head machine screws with Phillips head.
- T. Custom rack panels shall be 3/16" thick aluminum, standard EIA sizes, brushed black anodized finish unless otherwise noted. (Brush in direction of aluminum grain only.) Custom connector plates (loudspeaker, microphone, video, etc.) are typically stainless steel. It is the responsibility of the Contractor to verify plate finish with the AV Consultant. Plastic plates will not be accepted.
- U. All engraving shall be 1/8" block unless noted otherwise. Except where noted to the contrary, on dark panels or pushbuttons, letters shall be white; on stainless steel or brushed natural aluminum plates, or light-colored pushbuttons, letters shall be black.
- V. Connections shall be made with approved connectors and/or terminal blocks equal to Cinch 140 series or as indicated. Mount trim potentiometers, custom circuit cards, relays and transformers (except large 70V units) in shielded enclosures, and mark their function and connections with engraved lamacoid labels.
- W. Per IEC-268 standard, all XLR connectors, within equipment or out, shall be wired pin 2 hot (high), pin 3 low, and pin 1 shield (screen).
- X. Unless otherwise stated, all rack-mounted electronic and electrical equipment and components shall conform to EIA 19" standard. Any devices not specifically designed to be rack mountable shall be adapted, by professionally acceptable methods, to meet the EIA standard.
- Y. The rack height of all equipment and components in this specification is in 1.75" (44mm) units denoted xU", i.e., a 5.25" device, which is three rack spaces high is denoted as "3U".
- Z. All components shall be factory tested prior to shipping.
- AA. All switches used in these systems (whether or not mentioned or shown in this specification) shall have sufficient voltage and amperage rating to cover the use for which they are required with a safety factor of at least 2. All switches handling audio circuits shall use gold contacts and shall meet JAN-S-23 or MIS-S-3950A specifications or equivalent. Used LED lighted switch to indicate on, off and preset conditions.
- BB. Audio transformers shall be of appropriate impedance ratio and power handling capacity for the function intended and, unless otherwise noted herein, shall have a frequency response within +/- 1 dB from 20-20,000 Hz.
- CC. All joints and connections shall be made with rosin-core solder or with mechanical connectors approved by the AV Consultant. Where spade lugs or other crimp-type terminals are used, crimp

INTEGRATED AUDIO VIDEO SYSTEMS

properly with ratchet type tool. Between racks, cabinets, consoles or modules, all cable shall terminate in approved terminal connectors, strips, blocks or boards.

- DD. Route unbroken microphone audio line and control wiring from receptacle plate/chassis to rack. Remove spliced cables and replace without additional charge to Owner.
- EE. No splices shall exist in any length of wire run except where noted on drawings.
- FF. Connect all loudspeakers electrically in phase, using the same wire color code for loudspeaker wiring throughout the project.
- GG. All wiring and connections shall be completely visible and labeled in rack. Termination resistors shall be 1/2 watt metal film 1 % tolerance; fully visible and not concealed within equipment or connectors.
- HH. All terminations of shielded cables shall consist of a PVC or neoprene heat shrink sleeve covering the shield drain wire and an overall PVC or neoprene heat shrink sleeve covering the point at which the cable jacket and shield end.
- II. Run vertical wiring inside rack in properly sized raceway with snap-on covers (Panduit type E series). Horizontal wiring in rack to be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack but still allow for service and testing. Provide horizontal support bars for cable bundle sag. Neatly bundle excess AC power cable from rack-mounted equipment with plastic cable ties. Rack wiring to be bundled with plastic cable ties or lacing twine. Electrical tape and adhesive-backed cable tie anchors are not acceptable.
- JJ. Audio Shielding /Grounding:
 - 1. All shielded cables shall have their shields isolated from both the conduit system and any other shielded cables. Shields shall be continuous from source to input points. Shields shall be connected at input points only, with shields lifted at the source, except as noted below.
 - 2. Microphone wiring shall have continuous shields from the microphone receptacle to microphone patch jack and if normalled to a console microphone input, continuous to that point.
 - 3. Tie-line patch points shall have continuous shield connection from one patch jack to another with no permanent connection to the audio ground network.
 - 4. Unbalanced wiring, such as used in certain communication systems, shall have audio shields connected at device inputs and floated at device outputs. Strap shield to "low" side of unbalanced input.
 - 5. No "doubling up" of ground points on multi-pin connectors or terminal blocks shall be allowed.
 - 6. Shielded audio cables that normal through patch panels shall utilize a normalling type jack which has an isolated switching "break" circuit. This shall be used for sleeve normalling.
- KK. AC Power and Grounding:
 - 1. Coordinate final connection of power and ground wiring to racks. Hard wire power wiring directly to power contactors or internal AC receptacles to ensure uninterrupted
 - 2. Install approved isolated-ground receptacles in wireway in each rack. Provide a minimum of two spare outlets in each rack. Label each outlet as to which AC circuit is feeding it and provide the same information in the circuit breaker panel.

INTEGRATED AUDIO VIDEO SYSTEMS

3. Install a copper ground buss bar top to bottom in each rack, insulated from the rack. Ground equipment chassis not having a three-wire power cord to these busses. Connect green ground wire from each AC outlet in rack to this bus bar.
4. AC power for the AV Systems is distributed at 120VAC, 60Hz, on the same electrical phase, building wide.
5. Isolated-Ground (Audio Ground) Distribution:
 - a. The sound system "isolated ground", including ground source, ground conductors, and ground distribution points shall be installed by the Electrical Contractor. The isolation and ground continuity of this network, although the responsibility of the Electrical Contractor, shall be reconfirmed by the AV Contractor prior to installation of equipment.
 - b. Except at the ground source, the audio ground shall be totally isolated from all other electrical grounds. Therefore, if the connection between the audio ground network and the ground source is disconnected, no continuity between the audio ground and the building electrical ground shall exist.
 - c. All equipment racks containing active electronics shall be connected to the audio ground, except as otherwise noted in this specification. Caution must be exercised so that these racks are not permanently, or in any way during operation, capable of being accidentally connected to the building safety ground.
 - d. All conduits and back boxes containing AVC Systems wiring shall be permanently connected to the building electrical safety ground.
 - e. Note: RF video devices, being unbalanced in nature, shall not be connected to the sound system audio ground network. Care shall be taken when intermixing such video and audio equipment.

LL. Electrical Safety:

1. No voltage in excess of 25V RMS AC or 24V ripple free DC shall be exposed to touch in normal use or in any equipment by the withdrawal of modules or of any plug or connector or without the removal of suitably indelibly labeled covers.
2. Unless specifically excepted, all live electrical parts above 50V RMS AC or 60V ripple free DC, including terminals, shall remain completely shrouded by insulation or grounded metal when the main access panels are removed. The separate shrouds or covers shall require a tool to remove them to prevent inadvertent contact with live parts.
3. In addition, where enclosures or items of equipment containing predominantly control, computer, or similar low voltage signals also contain voltages in excess of 50V RMS AC or 60V ripple free DC, clear standard warning notices indicating the maximum voltage present shall be provided on all removable access panels. Similar warning notices shall be provided where voltages exceeding 120V are present in any enclosure or item of equipment and such a voltage would not reasonably be expected to be present.
4. Within enclosures, racks and panels identify with prominent, standard, and indelible signage which circuit breakers or disconnects are to be switched off in order to isolate the equipment totally. Warning notices shall also be provided on all equipment which contains live terminals after operation of its circuit breaker or disconnect. These terminals must be completely shrouded to prevent inadvertent contact.
5. All equipment, control stations, equipment racks, enclosures, and all metal cases, raceways, and conduit shall be efficiently grounded. Special hand held or portable equipment which is not double insulated shall have duplicated grounding connections. All grounding shall be in accordance with the current edition of the National Electrical Code and as identified within this specification.

INTEGRATED AUDIO VIDEO SYSTEMS

MM. Noise From Equipment

1. The residual noise and hum output of the systems shall be such that PNC-15 or below can be measured at the center of main floor, and the character of the remaining noise must be random, with no audible discrete frequency components.
2. Where a control panel or rack is to be used or located in an operational area, such as on the fly chamber, gallery, or control room, there shall be no acoustic noise associated with the panel. No internal cooling fans or similar moving or magnetic equipment shall be permitted unless approved by the AV Consultant in writing.
3. Operation of switches, pushbuttons, relays, solenoids, and similar shall not be audible to members of the audience.

2.3 GYM AND AUDITORIUM SOUND AND VIDEO SYSTEMS

A. System Description:

1. The gym and auditorium shall be provided with a sound system capable of picking up sound in the front area via microphones plugged in at the wall box and reinforcing it into the cafeteria. A fixed mix location shall be provided at the rear of the room.
2. An audio mixer shall be provided for production events. Monitor speakers shall also be provided on a single monitor channel.
3. An AV closet adjacent to the areas will store the AV equipment.
4. A switch for the screen will be located in the AV closet.
5. The mixer, CD player/iPod connection, wireless microphone receivers, monitor equalizer and a drawer for microphones shall be mounted in a portable rolling equipment rack capable of being connected and operated from the mix location or the AV closet.
6. Sound coverage shall be provided to the entire room area by two speakers mounted above the stage. The speakers shall be arrayed in such a manner as to provide seamless coverage of the intended areas. The speakers shall provide uniform sound levels of up to 98 dB (+/- 3 dB). Frequency response at every seat shall be +/- 1 dB from 50 Hz to 17 KHz. %ALCONS shall be 8% or less.
7. A fixed equipment rack shall house the amplifier and speaker processor.
8. A video projector shall project onto a large screen at the front of the room. The projector shall be front projection and the screen shall provide a suitable projection surface.
9. Video inputs for laptop and auxiliary video shall be located in the wall panels at the front and mix location, which will route to the AV closet.

2.4 LOUDSPEAKER ARRAYS – GENERAL REQUIREMENTS

- A. Design and provide all required mounting brackets, hardware and components, safety systems and rigging systems using a minimum safety factor of 7:1.
- B. Provide all integral redundancy components, such as safety cables, as required to meet these criteria.
- C. Coordinate cluster weights and hang locations with Structural Engineer to ensure sufficient structural support.

INTEGRATED AUDIO VIDEO SYSTEMS

2.5 EQUIPMENT RACKS AND ENCLOSURES

- A. EIA 19" standard racks providing up to 44 rack units or as directed on the associated drawings of panel space (overall height: 83"), 24.25" of width, and 22" of depth, minimum. This rack is supplied with rear door and adjustable front and rear mounting rails.
- B. Provide interior switched incandescent work lamp for each rack.
- C. Provide matching blank panels in all spare rack spaces. See "blank panels" section.
- D. Provide matching 1 U ventilation panels above and below all power amplifiers, and additional vent panels as shown in rack elevation drawings.
- E. Provide one (1) rack mount AC power receptacle strip for each rack group, with a minimum of one (1) 120V 20A duplex receptacle (NEMA 5-20R) for each individual rack (e.g., a group of three (3) racks requires a total of three (3) duplex receptacles). Receptacle strip shall mount to the front of one rack and be connected to an unswitched AC power circuit.
- F. Provide heavy copper busbar in each rack for connection of isolated ground circuits. Bond busbars together with 3/0 AWG welding cable in a "star" configuration. Refer to AC power grounding detail on EE drawings for further information.
- G. All racks shall have the same color finish (Textured Black).
- H. All metal cabinets connected to the sound system audio ground shall be effectively isolated from any conduit or other metallic component that is connected to the building electrical safety ground.

2.6 AV RECEPTACLE PANELS AND NEMA WALL BOXES

- A. Custom Fabrication: Single or multiple signal level and circuit receptacle panels shall be provided for connection of auditorium devices at designated locations in the facility. Panels may include any combination of circuits and connectors for these signal levels: microphone level, line level, video level, intercom level, and low volt/impedance loudspeaker level. Connectors shall be identified as to signal level, circuit type, and circuit number by clearly engraved and coordinated legends on each panel. Exceptions as noted. Refer to device plans for locations.
- B. Refer to Systems Panel & Device Schedule (Electrical Drawings) for back box type, size, and depth, and mounting information.
- C. Conduit and AV system back boxes shall be supplied and installed by others.
- D. AV system panel covers shall be provided and installed by the AV Contractor, except as noted.
- E. Wire shall be supplied, pulled, and terminated by the AV Contractor
- F. Connector: Panel or chassis types, as indicated below. Mount on AV system panel as shown on drawings and fasten with stainless steel machine screws, hex nuts, and lock washers (screw head style, color, and thread size to match connector body; slot or Phillips drive to match wall plate screws). Refer to connector specification paragraph below. Exceptions as noted.
 - Microphone level ("AM" series): Female XLR-3.
 - Line level ("AL" series): Male & female XLR-3 pairs.
 - Low volt/impedance loudspeaker ("SL, SH" series): NeutrikNL4 series.

INTEGRATED AUDIO VIDEO SYSTEMS

- G. Engraved Legend: Details as indicated below. Locate legends on AV system panel as shown on drawings. Characters shall be engraved, filled with colored enamel, and entire panel sealed. Exceptions as noted.
- H. Legends shown on drawings are typical. Refer to AV systems block diagrams and/or submit proposed layout to AV Consultant for review.
- I. Signal level title legend size shall be 0.1875" or 0.250" high characters of medium weight (as required).
- J. Termination:
1. XLR-type Connectors: Solder wire directly to connector in the field.
 2. Neutrik NL4 Series Connectors: Attach properly sized crimp-type female disconnect terminals to large gauge loudspeaker wire and mate with male disconnect terminals on the Neutrik connectors. Securely strain relief loudspeaker wires to connector body or wall plate to ensure integrity of the electrical/mechanical disconnect termination.
- K. Wall Receptacle Plates (Sizes As Shown On Drawings And Schedules):
1. All plates shall be flush type for mounting to recess back boxes or surface mount Wiremold-type boxes.
 2. Wall Plate: Standard, x-gang (size "x" to match detail drawings), type 302 stainless steel (heavy gauge), bright brushed or satin finish, flush-type electrical wall plate. Mount to back box with 6-32 stainless steel, slot or Phillips drive, oval head machine screws.
 3. Plates in public areas to have finish by Architect.
 4. AV Panels (Sizes As Shown On Drawings And Schedules): Fabricated of type 5052-H32 aluminum, 0.125" minimum thickness, lightly brushed (vertical direction), with black anodized and clear sealed finish. Panel dimensions to match back box size. Edges of panel shall be ground square and flat. Corners of panel to have small radius. Exceptions as noted below.
 5. Back Box: Provided by others, Hoffman type with a minimum depth of 6". Color: Black. Exceptions as noted below. Coordinate with Electrical Contractor.
- L. Audio Connectors
1. XLR-3 (Microphone, Line; Communication): Neutrik NC3MD-L-I (male) and NC3FD-L-I (female) panel mount connectors; Neutrik NC3MX (male) and NC3FX (female) cable connectors. Silver contacts and nickel shells throughout. Balanced mic/line: pin 1 shield, pin 2 hot, pin 3 low. Unbalanced mic/line: pin 1 shield, pin 2 hot, pin 3 tie to pin 1. Production Intercom: pin 1 shield, pin 2: +30VDC, pin 3 audio/signal.
 2. In no case shall pin 1 be tied to case of connector.
 3. XLR-4 (Production Intercom Headset/Handset): Neutrik NC4MC (male) and NC4FC (female) cable connectors. Silver contacts and nickel shells throughout.
 4. NL4 Type (Loudspeaker): Neutrik Speakon NL4MP panel mount connector; NL4MPR sealed loudspeaker cabinet chassis connector; and NL4FC cable connector.
 5. 1/4" Phone Plugs and Jacks: Plug: Neutrik NP2C 2-pole and NP3C 3-pole cable plugs. Nickel contacts and nickel shells. Jack: Neutrik NJ3FC6C latching 2- or 3-pole cable jack. Silver contacts and nickel shells. 3-pole: Sleeve = ground/shield, ring = low, tip = high (hot). 2-pole: Sleeve = common/ground/shield, tip = high.
 6. 1/8" Mini Plug: 1/8" T/R/S "Walkman-type" stereo mini plug. Metal shell required, Phono (RCA) plugs and jacks. Plug: Neutrik ProFi NF2C/2 RCA plug (available in pairs of black

INTEGRATED AUDIO VIDEO SYSTEMS

and red). Gold plated nickel contacts and brass shell. Jack: Switchcraft 3503 RCA cable jack. Nickel plated brass contacts and shell.

PART 3 - EXECUTION**3.1 GENERAL**

- A. Coordinate work with other trades to avoid causing delays in construction schedule
- B. Mount equipment and enclosures plumb and square. Permanently installed equipment to be firmly and safely held in place, with equipment supports having safety factor of 7 for speaker mounts and 3 for all other equipment
- C. Cover edges of cable pass-through holes in chassis, racks, boxes, etc, with rubber grommets or Brady GRNY nylon grommet material.
- D. Speakers mounted in acoustical tile ceilings must be properly supported with tile bridges or similar structural bracing.
- E. System Wiring: Take precautions to prevent and guard against electromagnetic and electrostatic interference (hum and buzz). Check AC power and grounding prior to AV system installation, and report any issues promptly.
- F. Equipment and Cable Labeling: Provide engraved lamicoid labels on front and rear of active equipment mounted in racks. Include name of device, reference to drawing name, and other areas the device feeds or controls. Label cables in a consistent manner, with permanent, heat-shrunk labels. Show all equipment designations in Permanent Record Drawings.

3.2 INITIAL TESTS AND ADJUSTMENTS

- A. Preliminary: Verify the following before beginning actual tests and adjustments on the system:
 - 1. All electronic devices are properly grounded.
 - 2. All powered devices have AC power from the proper circuit. Verify all dedicated AC power circuits are properly wired, phased, and grounded.
 - 3. Insulation and shrink tubing are present where required.
 - 4. Dust, debris, solder splatter, etc. is removed.
 - 5. All cable is dressed, routed, and labeled; all connections are properly made and consistent with regard to polarity.
- B. Grounding System Tests:
 - 1. Measure the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
 - 2. Temporarily lift the technical ground from the main electrical ground, and measure the DC resistance between them. Resistance should be at least 1 Megohm.
 - 3. Verify the electrical contractor has connected the technical ground to building ground at only one location with 1/0 or larger wire.
 - 4. Measure the DC resistance between the signal ground at any interface plate and the conduit system.
 - 5. Identify and correct any problems if within the Audio system scope of work; notify the General Integrator if problem is in a related area of work.

INTEGRATED AUDIO VIDEO SYSTEMS

- C. Audio System Tests: Perform the following tests and adjustments, supplying all test equipment required. Follow EIA Standards RS160 and RS219 in performing tests. Make all corrections necessary to bring system(s) into compliance with the specifications. Design goals for the system have been calculated in accordance with accepted industry standards. Actual performance may deviate slightly due to component variations, field conditions or limitations, and building interaction. Design parameters are: system frequency response shall be +/- 3dB 50 Hz -16 kHz. Evenness of coverage shall be +/- 3dB maximum at 2 kHz throughout listening area. Nominal sound pressure level shall be 95 dBA SPL at any seat in the auditorium area with a maximum continuous SPL capability of 105 dBA.
1. Measure and record the impedance of each speaker line circuit terminating at the equipment rack, with speakers connected, employing frequencies of 125, 500, 1000 Hz, and 4000 Hz and others as appropriate to the driver (use all for full range systems).
 2. Adjust the gain of each active device to provide optimum signal-to-noise ratio and 18 to 20 dB headroom. Record input and output levels at each step in the signal chain.
 3. Measure and record overall system hum and noise level of each mic or line amplifier with controls set so that -50 dBU microphone input or +4 dBU line level input would drive the system to full amplifier output. Terminate inputs with appropriately sized shielded resistors (150 ohms typ) for this test.
 4. Measure and record electrical distortion of each input through amplifiers, switching, and power amplifier for each system installed; distortion should be less than 0.5% for the overall system in each test. Observe the output waveform on an oscilloscope for freedom from clipping, parasitics, oscillation, or RF components which could indicate unacceptable system operation.
 5. Measure and record system electrical frequency response for each input channel through power amplifier output. Deviation shall not exceed +1 dB within the range 30 to 18,000 Hz.
 6. Check system to assure freedom from oscillation or stray RF pickup. Check all inputs without signal and with 1000 Hz sinewave driving system to full output. Detect unwanted signals on oscilloscope at rack termination and over single loudspeakers connected at the farthest distance from the rack for each loudspeaker line.
 7. Measure and record the output impedance of each active device operating as a source to a passive device or network. Measure and record the input impedance of each active device used to terminate passive devices.
 8. Check polarity of all loudspeakers with an electronic polarity checker and by applying music program or pink noise signal to system while walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with no apparent shift in source from one speaker to the next.
 9. Apply sinewave sweep signal to each loudspeaker system, sweeping from 50 to 5000 Hz at a level 10 dB below full amplifier output, and listen for rattles or objectionable noise.
- D. Report: Upon completion of initial tests and adjustments, submit written report of tests to Owner along with all documents, diagrams, and record drawings required herein. Report shall include date of each test, pertinent conditions such as control settings, etc., test circuit, and test equipment employed. In addition, submit written notification that the installation has been completed in accordance with the requirements of the Contract Documents, and is ready for acceptance testing.

3.3 TEST EQUIPMENT

- A. Provide the following test equipment on site and available to the Owner during acceptance testing. Provide and use only new test tapes for this project.

INTEGRATED AUDIO VIDEO SYSTEMS

1. Tools including screwdrivers, pliers, cutters, wire strippers, nut drivers, crimpers, heat shrink blower, controlled temperature soldering unit, ladders, flashlight, measuring tape, electric drill, etc.
2. Sine Wave Generator. Output: +4 dBu, 5 Hz to 50,000 Hz with less than 0.05% THD into any load. Acceptable: Audio Precision, Hewlett Packard, Sound Technology, or Tektronix.
3. Pink Noise Source. Equal energy per octave bandwidth 20 - 20,000 Hz, +1 dB (long-term average) @ 0 dBu output. Stability: +2 dB per day. Acceptable: Ivie IE-20.
4. Impedance Meter. Capable of testing audio lines at three frequencies, minimum, between 250 Hz and 4000 Hz. Measurement Range: 1 ohm to 100,000 ohms. Acceptable: Sennheiser ZP-3.
5. Multimeter. Measurement range, DC to 20,000 Hz, 100 mV to 300 V, 10 ma to 10A. Acceptable: Fluke 77.
6. Real Time: 1/3 Octave Audio Spectrum Analyzer. Acceptable: Ivie IE-30A or equal.
7. Harmonic Distortion Analyzer: Acceptable: Audio Precision, Sound Technology, or Hewlett Packard.
8. Sound Level meter meeting ANSI SI.4 1971 Type 2. Acceptable: GenRad 1933 or B&K.
9. Dual-trace oscilloscope: 100 MHz bandwidth, 1 mV/cm sensitivity. Acceptable: Tektronix 2445.

B. Turn over Test digital data to Owner for maintenance upon completion of Acceptance Testing.

3.4 ACCEPTANCE

- A. Acceptance testing will include operation of each major system and any other components deemed necessary. AV Contractor will assist in this testing and provide the test equipment specified herein. AV Contractor shall provide at least one technician available for the entire adjustment and testing period (day and night), to assist in tests, adjustments, and final modifications. All tools and material required to make any necessary repairs, corrections, or adjustments shall be furnished by the AV Contractor.
- B. The Owner will physically inspect the system to ensure all equipment is installed in a neat and professional manner and as required by the contract documents. An inventory will be made of all equipment.
- C. The following procedures will be performed on the System:
 1. Adjust, balance, and align all equipment for optimum performance and to meet all manufacturers' published specifications. Settings to be reviewed include gain, delay times, and nominal settings. Establish and mark normal settings for all level controls, and record these settings in the System Reference Manual.
 2. Check all control functions for proper operation, from all controlling devices to all controlled devices.
 3. The audio fidelity test will consist of driving the speaker system with pink noise and measuring the response in each 1/3 octave band from 50 to 16,000 Hz. Equalization as specified shall be used to adjust the response as necessary to fit the requirements of the space.
 4. Any other test on any piece of equipment or system the Owner deems appropriate.
- D. In the event the need for further adjustment or work becomes evident during acceptance testing, the AV Contractor will continue his work until the system is acceptable at no addition to the contract price. If approval is delayed because of defective equipment, or failure of equipment or

INTEGRATED AUDIO VIDEO SYSTEMS

installation to meet the requirements of these specifications, the AV Contractor will pay for additional time and expenses of the AV Consultant at the AV Consultant's standard rate in effect at that time, during any extension of the acceptance testing period.

3.5 INSTRUCTION OF OWNER PERSONNEL

- A. Provide 8 hours of instruction to the Owner's designated personnel on the use and operation of each of the systems. The instructor must be fully knowledgeable of all system functions and all equipment features. The System Reference Manuals shall be complete and on-site at the time of instruction. The AV Contractor shall be present at the first two formal uses of the system.

INTEGRATED AUDIO VIDEO SYSTEMS

ATTACHMENT A: EQUIPMENT LIST

Note: this equipment list specifies major systems components and equipment, and may not detail all equipment required for a complete working system.

System	Sub-System	Manufacturer	Model Num.	QTY
Gym Audio				
		JBL		
	Main Speakers	Professional	AM5212/64	4
	Speaker protection cage	AV Armour	Custom	4
Amplifiers	Main Speaker Amplifiers	Crown Audio	Xti 1002	2
Console	16 Channel Mixer	Mackie	1202VLZ4	1
	Volume / Select Control	Biamp	Volume/Select 8	2
Processing	DSP	Biamp	Audia Flex	1
	Processor Input Card	Biamp	IP-2	4
	Processor Output Card	Biamp	OP-2E	2
Microphones	Wireless Mic/Receiver	Technica Audio	ATW-3141bD	2
	Wireless Microphone lavalier	Technica	ATW-3131b	1
	Handheld Microphone	Shure	SM-58LC	1
	Assistive Listening Transmitter	Listen Tech	LT-800-072	1
	Antenna	Listen Tech	LA-123	1
	Digital Receivers	Listen Tech	LR300-072	10
	Single Ear Phone	Listen Tech	LA-161	10
	Neck Loop for T-Coil Hearing Aid	Listen Tech	LA-166	3
	ADA Signage Kit	Listen Tech	LA-304	1
Racks	Amplifier Rack	Lowell	L267	1
	AV recessed wall rack (paintable)	Lowell	LWTR3	2
	AV wall RC backbox with door	FSR	WB-3G	2
	Power Strip Relay Ctrl	Lowell	RPC-1-20A-CD	4
	Power Sequencer	Lowell	SCS-4R	1
	Custom Panel			5
Custom Plate (Stage Floor)		FSR	FL500P	2
Cafeteria Audio				
		JBL		
Speakers	Main Speakers	Professional	AM5212/64	2
Amplifiers	Main Speaker Amplifiers	Crown Audio	Xti 1002	2
	Volume / Select Control	Biamp	Volume/Select 8	2
Processing (part of gym system)	DSP	Biamp Audio	Audia Flex	0
Microphones	Wireless Mic/Receiver	Technica	ATW-3141bD	2
	Handheld Microphone	Shure	SM-58LC	1
	Custom Panel WP2			1
Rigging				

INTEGRATED AUDIO VIDEO SYSTEMS

Cable

Media Audio

Speakers	JBL	Control 29AV	2
Amplifier/Mixer	Mackie Audio	PPM 608	1
Wireless Receiver	Technica Audio	ATW-2110	1
Wireless Microphone Element	Technica	AT892-cW	1
Handheld Microphone	Shure	SM-58LC	1
Custom Plate (wall)	FSR	WPB	2
Cabling			1

INTEGRATED AUDIO VIDEO SYSTEMS

Labor

Cafeteria Video

Projector		NEC	4000 Lumen
Projector Mount	Ceiling Mount	Chief	CMA-110
Projector Mount	Ceiling Mount Adapter	Chief	VCM-XXX
Projector Mount	Extension Pole	Chief	Custom
Sources	Bluray player	Sony	BDP
Scaler/Switcher		Extron	
PC interface	rack mount	EXTRON	
Screen	front projection, electric	Da-Lite	
Video Control		Extron	
Projector HDMI interface		Extron	
Cabling			

ADD ALTERNATE: Media Video

LCD Panel		Sharp	70"
LCD backbox and mount		Chief	
Projector		NEC	6000 Lumen
Projector CART		Chief	
Sources	Bluray player	Sony	BDP
PC interface HDMI transmit		EXTRON	DTP T UWP 232 D
PC interface HDMI Receiver		EXTRON	DTP HDMI 230 D RX
Video Control		Extron	MLC 226IP
Custom Plate (wall)		FSR	
Cabling			
Misc			

[END OF SECTION]

SECTION 27 0500
COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.

1.02 SECTION INCLUDES

- A. Summary
- B. General Requirements
- C. Environmental Considerations
- D. Site Specific Requirements

1.03 PROJECT SUBMITTAL COMPLIANCE

- A. Project Architect shall be responsible for receiving and compiling all submittal information. As such, all such data pertaining to Section 27 shall conform to the following Division 1 Sections:
 - 1. Section 01 6000 – Substitutions
 - 2. Section 01 3300 – Submittals
 - 3. Section 01 7823 – Operations and Maintenance Data
 - 4. Section 01 7839 – Project Record Drawings

1.04 RELATED SECTIONS

- A. Section 01 7900 – Demonstration and Training
- B. Section 01 9113 – General Commissioning Requirements
- C. Section 27 0000 - Communications
- D. Section 27 0513 – Communications Services
- E. Section 27 0526 – Grounding and Bonding for Communications Systems
- F. Section 27 0528 – Pathways for Communications Systems
- G. Section 27 0528.29 - Hangers and Supports for Communications Systems
- H. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- I. Section 27 0528.36 - Cable Trays for Communications Systems
- J. Section 27 0528.39 - Surface Raceways for Communications Systems
- K. Section 27 0553 – Identification for Communication Systems
- L. Section 27 0800 – Commissioning of Communications
- M. Section 27 1100 – Communications Equipment Room Fittings
- N. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
- O. Section 27 1123 – Communications Cable Management and Ladder Rack
- P. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
- Q. Section 27 1313 – Communications Copper Backbone Cabling
- R. Section 27 1323 – Communications Optical Fiber Backbone Cabling
- S. Section 27 1513 – Communications Copper Horizontal Cabling
- T. Section 27 1543 – Communications Faceplates and Connectors
- U. Section 27 1619 – Communications Patch and Station Cords
- V. Section 27 2133 – Wireless Access Points
- W. Section 27 4100 – Audio-Video Systems
- X. Section 27 4119 – Classroom Audio-Video Systems
- Y. Section 27 5113 – Paging Systems
- Z. Section 27 5313 – Clock Systems

1.05 GENERAL REQUIREMENTS

- A. Eugene School District is a “tobacco free” environment. Tobacco in any form whatsoever is not permitted in this school or on the property owned by the District.
- B. Eugene School District is providing new telecommunications cable and infrastructure to support District-wide deployment of wireless communications and the installation of an IP based video surveillance system. This contract will be responsible for all aspects of telecommunications cabling and supporting infrastructure required for functional systems, specifically:
 - 1. Pathways as per Section 27 0528 and as called out on Drawings.
 - 2. Installation of fiber backbone between the main Equipment Room (MDF) and Telecommunication Rooms (IDF) or Telecommunications Cabinets as identified on Drawings. Fiber shall be 50/125 μ m Laser Optimized (OM3) as per Section 27 1323.
 - 3. Installation of horizontal cabling system and related components as per Sections 27 1513 and 27 1543.
 - 4. Installation of Wireless Access Points as identified on the Drawings and as per Sections 27 1543.
 - 5. Testing of fiber and copper cabling systems in accordance with ANSI/TIA-568 and as outlined in Section 27 0800.
 - 6. Creation of as-built documentation, both electronically and printed, as specified in these documents.
- C. All work outlined in these documents and on the accompanying Drawings must be prior to the substantial completion date called out in Division 00 of this bid package, specifically:
 - 1. All construction in telecommunications spaces, i.e., MDF/IDF and mounting of telecommunications cabinets.
 - 2. All raceway (including requisite surface mounted raceway), conduits, and junction boxes required for telecommunications pathways.
 - 3. Installation and testing of all telecommunications cabling (fiber and copper) to allow District to install active electronics and bring complete systems live.
 - 4. Test results and as-build documentation as per Section 27 0513.

1.06 SUMMARY

- A. The intent of the Division 27 Specifications and the accompanying Drawings is to provide a complete and workable system as shown, specified and required by applicable codes and the Authority Having Jurisdiction (AHJ). Include all work as specified in Division 27 and shown on the accompanying Drawings, including appurtenances, to provide a complete and functional system.
- B. The Division 27 Specifications and accompanying Drawings are complementary and what is called for in one shall be as binding as if called for in both. Items shown on the Drawings are not necessarily included in or called out in the Specifications and vice versa. Specifications shall supersede Drawings in the case of a conflict.
- C. Imperative language is frequently used in the Division 27 Specifications. Except as otherwise noted, such requirements are to be performed by the Contractor or a Sub-contractor directly responsible to the Prime Contractor performing the Division 27 work.
- D. The Drawings accompanying Division 27 (T series) are diagrammatic. They do not show every component of a complete telecommunications premises distribution system which may be required to accommodate unique building construction features or materials installed by other trades. The Drawings are to be followed as closely as practical while making necessary adjustments in the placement of cable to facilitate the overall construction of the building without additional cost to the Owner. The right is reserved to make any reasonable changes in Telecommunications Outlet locations prior to roughing-in.

1.07 ENVIRONMENTAL CONSIDERATION

- A. When at all possible, equipment and materials are to be assembled at Distributors or Contractors location and delivered to construction site without packaging or shipping material. Exceptions are granted for protection of delicate components in transit.
- B. Except as noted for purposes of recycling, all construction related debris; packaging and waste materials will be removed from the job site each day and disposed of by the Contractor.

1.08 SITE SPECIFIC REQUIREMENTS

- A. Site details are shown on the accompanying drawings.

1.09 DEVICE LOCATIONS

- A. Telecommunications Room locations as per the accompanying Drawings.
- B. Telecommunications Outlets will be as per Drawings. Additions or changes will be directed by the Owner and managed via Change Order.

1.10 TELECOMMUNICATIONS CONSULTANT

- A. The Telecommunications Consultant for Division 27 of this project is:
Northwest Information Services
Attn: Darren Herrick
4900 SW Griffith Drive #250
Beaverton, Oregon 97005
503.246.8585, extension 230
ddh@nispdx.com

or
Attn: Diane Forbes
4900 SW Griffith Drive #250
Beaverton, Oregon 97005
503.246.8585, extension 235
drf@nispdx.com

PART 2 (NOT USED)

PART 3 (NOT USED)

END OF SECTION

**SECTION 27 0513
COMMUNICATIONS SERVICES**

PART 1 - GENERAL REQUIREMENT

1.01 SECTION INCLUDES

- A. Basic Communication Requirements
- B. Administrative Requirements
 - 1. Contract Documents, Quality Assurance, and Manufacturer's Warranty
 - 2. Technical Qualifications
 - 3. Certificates and Reference Standards
 - 4. Laws and Regulations, Permits
 - 5. Submittal and Substitution Information
 - 6. Environmental Requirements
 - 7. Progress Drawings and Schedules

1.02 PROJECT SUBMITTAL COMPLIANCE

- A. Project Architect shall be responsible for receiving and compiling all submittal information. As such, all such data pertaining to Section 27 shall conform to the following Division 1 Sections:
 - 1. Section 01 6000 – Substitutions
 - 2. Section 01 3300 – Submittals
 - 3. Section 01 7823 – Operations and Maintenance Data
 - 4. Section 01 7839 – Project Record Drawings

1.03 RELATED SECTIONS

- A. Section 01 7900 – Demonstration and Training
- B. Section 01 9113 – General Commissioning Requirements
- C. Section 27 0000 – Communications
- D. Section 27 0005 – Common Work Results for Communications
- E. Section 27 0526 – Grounding and Bonding for Communications Systems
- F. Section 27 0528 – Pathways for Communications Systems
- G. Section 27 0528.29 - Hangers and Supports for Communications Systems
- H. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- I. Section 27 0528.36 - Cable Trays for Communications Systems
- J. Section 27 0528.39 - Surface Raceways for Communications Systems
- K. Section 27 0553 – Identification for Communication Systems
- L. Section 27 0800 – Commissioning of Communications
- M. Section 27 1100 – Communications Equipment Room Fittings
- N. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
- O. Section 27 1123 – Communications Cable Management and Ladder Rack
- P. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
- Q. Section 27 1313 – Communications Copper Backbone Cabling
- R. Section 27 1323 – Communications Optical Fiber Backbone Cabling
- S. Section 27 1513 – Communications Copper Horizontal Cabling
- T. Section 27 1543 – Communications Faceplates and Connectors

- U. Section 27 1619 – Communications Patch and Station Cords
- V. Section 27 2133 – Wireless Access Points
- W. Section 27 4100 – Audio-Video Systems
- X. Section 27 5113 – Paging Systems
- Y. Section 27 5116 – Public Address and Mass Notification Systems
- Z. Section 27 5123 – Intercommunications and Program Systems
- AA. Section 27 5123.50 – Educational Intercommunications and Program Systems
- BB. Section 27 5313 – Clock Systems

1.04 BASIC COMMUNICATION REQUIREMENTS

- A. All materials and equipment installed under this contract shall be new, unused, free of defects, and of current manufacture.
- B. The Contractor shall field-investigate this facility to ascertain the exact physical and electrical conditions in the main Equipment Room (MDF), and the Telecommunications Room (IDF) locations to become familiar with the physical environment of the building.
- C. The Contractor shall provide, install, and test the entire cable infrastructure as described under this contract.
- D. The Contractor shall call attention to the Owner any error, conflict, or discrepancy in Plans and/or Specifications. Do not proceed with any questionable items of work until a resolution or clarification has been made. Supplemental Plans and Specifications may be supplied as required and shall become part of the Contract Documents.

1.05 CONTRACT DOCUMENTS

- A. The contract documents, such as drawings, schedules and specifications are used to describe the required work.
- B. The work to be performed under the contract documents includes furnishing all labor, materials, equipment and services necessary, whether listed in the specifications or not, to construct and install the complete communications infrastructure as shown on contract drawings and specifications.
- C. The drawings and schedules depict, in general, application-dependent data while the narrative/specifications, in general, define broader requirements, such as overall quality.
- D. The Contractor shall follow all specifications herein. In case of conflict between drawings and specifications, the latter shall prevail unless authorized in writing by the Owner.
- F. Supplementary Details and Plans may be supplied as required. They shall be issued as addendum and shall become a part of the Contract Documents.

1.06 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner.
- B. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated or a substitution is requested, equipment shall be equivalent in every way to that of the equipment specified. All substitutions are subject to the control and approval of the owner or the owner representative.
- C. Strictly adhere to all Telecommunications Industry Association (TIA) and BICSI recommended installation practices and manufacturer’s guidelines when installing communications components.

1.07 MANUFACTURER'S WARRANTY CERTIFICATION

- A. The manufacturer's certification must be supported by Contractor's successful completion of an installation class recognized by an independent organization (such as BICSI or an accredited school). A written test is strongly preferred.

1.08 TECHNICAL QUALIFICATIONS

- A. Contractor must be certified by manufacturer as able to provide a 20 year (minimum) manufacturer's warranty certificate.
- B. A minimum of three references demonstrating Contractor's past installation experience in Certified Category 6A systems in similar facilities with a minimum of 500 nodes shall be submitted. The Contractor must supply a one year warranty upon completion of the job.
- C. At least 50% of the technicians, to include all on-site Journeymen Electricians, must have successfully completed the manufacturer's warranty certification class.
- D. All Journeymen are to possess a current Oregon License.
- E. All Apprentices are to be actively enrolled in an Oregon State approved electrical apprenticeship program.
- F. All Equipment/Telecommunication Room and Telecommunications Outlet equipment shall be installed and tested on-site by a technician(s) who, by virtue of an acceptable training course or documented experience, is qualified to perform these procedures. Acceptable training may include successful completion of the manufacturer's training course, documented on-the-job experience or successful completion of applicable technical courses in a recognized trade school.
- G. Verification of the above requirements must be submitted in writing with bid.

1.09 CERTIFICATES

- A. Contractor must provide evidence of ability to provide a Manufacturer's Certificate of Warranty for the system bid.
- B. Contractor must provide Technician Certificate(s) for the 50% mentioned above.

1.10 REFERENCE STANDARDS

- A. The following standards:
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical Manufacturers Association (NEMA)
 - 3. Telecommunications Industries Association (TIA), specifically:
 - a. TIA TSB-125, Guidelines for Maintaining Optical Fiber Polarity Through Reverse-Pair Positioning
 - b. TIA TSB-140, Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems
 - c. TIA-526-7, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7
 - d. T-526-14-A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14
 - e. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises
 - f. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard Part 1: General Requirements
 - g. ANSI/TIA-568-C.2, Commercial Building Telecommunications Cabling Standard—Part 2: Balanced Twisted Pair Cabling Components
 - h. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard

- i. ANSI/TIA-569-B, Commercial Building Standards for Telecommunications Pathways and Spaces
- j. ANSI/TIA-598-C, Optical Fiber Cable Color Coding
- k. ANSI/TIA-604.2-A, FOCIS 2—Fiber Optic Connector Intermateability Standard
- l. ANSI/TIA-606, Administration Standard for Commercial Telecommunications Infrastructures
- m. ANSI/TIA/607-B, Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- n. ANSI/TIA-758-A, Customer-owned Outside Plant Telecommunications Infrastructure Standard
- o. ANSI/TIA-854, A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling,
- p. ANSI/NECA/BICSI 568-2006, Standard for Installing Telecommunications Systems

1.11 LAWS AND REGULATIONS

- A. The latest versions, including addenda, as enforced by the local authority having jurisdiction of the following codes, associations, acts and agencies:
 - 1. Federal Communications Commission (FCC)
 - 2. National Fire Protection Association (NFPA), specifically:
 - a. NFPA 70, National Electrical Code® (NEC®) plus all Oregon State Electrical Code plus local County and City Amendments
 - b. NFPA 72, National Fire Alarm Code®
 - c. NFPA 76, Recommended Practice for the Fire Protection of Telecommunications Facilities
 - d. NFPA 101, Life Safety Code®
 - e. NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
 - f. NFPA 780, Standard for the Installation of Lightning Protection Systems,
 - g. NFPA 5000™, Building Construction and Safety Code
 - 3. National Electrical Safety Code (NESC)
 - 4. Occupational Safety and Health Administration (OSHA)
 - 5. 2014 Oregon Fire Code (OFC)

1.12 UNDERWRITERS LABORATORIES LISTING

- A. Unless otherwise specified, electrical equipment and material shall be listed and labeled by Underwriters Laboratories (UL®) for the purpose for which it is used. This requirement may be waived only if a UL® listing is not available for this type of product. Telecommunications cables are acceptable if UL® recognized.

1.13 ADDITIONAL REFERENCE MATERIALS

- A. ANSI/NECA/BICSI-568-2006, Standard, Installing Commercial Building Telecommunications Cabling
- B. BICSI Outside Plant Design Reference Manual (COOSP)
- C. BICSI Electronic Safety and Security Reference Manual (ESSDRM)
- D. BICSI Information Transport Systems Installation Methods Manual (ITSIM)
- E. BICSI Network Design Reference Manual (NDRM)

- F. BICSI Telecommunications Distribution Methods Manual (TDMM)
- G. BICSI Wireless Design Reference Manual (WDRM)
- H. Institute of Electrical and Electronic Engineers (IEEE)
- I. National Electrical Manufacturers Association (NEMA)
- J. American Standards Association (ASA)

1.14 PERMITS, LICENSES AND TAXES

- A. Contractor shall obtain and pay for permits, inspections, licenses and taxes applicable to this work. Copies of all permits and inspections are to be prominently displayed at each site. Copies of all inspection reports are to be presented to Owner upon closeout of project.

1.15 SUBMITTALS

A. GENERAL

- 1. Owner must approve all submittals before the start of fabrication (or shipment, for stock items) of any equipment requiring submittals.

B. DRAWINGS

- 1. The Contractor shall submit shop drawings for any modification or new product installation not previously identified in bid documents.
- 2. The drawing must be submitted not less than five (5) days (weekends and national holidays excluded) before the scheduled work begins.
- 3. The Contractor shall proceed with the installation only after approval from the Owner.

C. MATERIALS LIST

- 1. The Contractor shall submit a list of all materials for the proposed work.

D. FIRESTOPPING

- 1. The Contractor shall comply with all requirements of Section 07 8400 – Fire Stopping

E. SOUND DEADENING MATERIALS

- 1. The Contractor shall submit a list of acoustic separation products and procedures. The submittal shall include the manufacturer's technical data for each product including product description, specifications (including labeling or listing by an agency acceptable to the Owner), and storage requirements.

F. MATERIAL SAFETY DATA SHEETS

- 1. Supply Material Safety Data Sheets (MSDS) to Owner for all material accompanied by such.

G. TEST PLANS

- 1. The Contractor shall submit a plan for the testing the installed network.
- 2. The test plan shall include test equipment to be used, procedure and report structure.

H. CERTIFICATES

- 1. Low Voltage Electrical Permit
- 2. The Contractor shall post a copy of the permit and email or fax a copy to the Owner.
- 3. The Contractor shall provide copy of approved permit to the Owner certifying that the work has been inspected and that the work conforms to the requirements of the Authority Having Jurisdiction.

I. PRODUCT WARRANTY

1. A manufacturer's warranty is required for this work in addition; Contractor shall provide no-cost warranty on the installed work for a period of one year.

1.15 REQUESTS FOR SUBSTITUTION

- A. Substitution of items shown in the contract documents must be requested in writing.
- B. Approval shall be by written addendum or change order. Substitutions made without prior written approval will be reversed and all costs related to reversal will be the responsibility of the Contractor.
- C. Contractor shall be responsible for any design changes and costs related to substitution approval.
- D. The functions and features specified are vital to the operation of these facilities; therefore the acceptance of alternate manufacturers does not release Contractor from strict compliance with the requirements of the specification.

1.16 ENVIRONMENTAL REQUIREMENTS

- A. Power and lighting, and parking spaces for standard installer's trucks shall be provided by the General Contractor.
- B. Job site trailer, if required, shall be coordinated with the General Contractor prior to placement. Secured storage is the responsibility of the Contractor.

1.17 PROGRESS DRAWINGS AND SCHEDULES

- A. All drawings shall be revised as necessary during the course of the work.
- B. The Contractor shall maintain on-site, one neatly and legibly marked (redlined) set of full-size Drawings accurately depicting as-built locations, changes, and repairs made during the work.
 1. Marking of the Drawings shall be kept current.
 2. Drawings shall be delivered to the Owner prior to final progress payments.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number herein is for the purpose of establishing the product set, which the Contractor is to supply and install.
- B. Quantities are to be determined by Contractor unless specified.
- C. Products shall be UL[®] listed for the purpose they are to be used.

2.02 PRE-APPROVED PRODUCT SETS

- A. The following product sets are pre-approved for this project. Except as noted, all others will require a substitution request to be completed and approved as per these documents. The District will not consider product sets that have not been pre-approved or accepted as per the substitution request process.
 1. Structured Cable Systems:
 - a. CommScope - all category 5e, 6 and category 6A components, i.e., jacks, patch panels, patch cords and fiber optic components.
 - b. Panduit - all category 5e, 6 and category 6A components, i.e., jacks, patch panels, patch cords and fiber optic components. Partner cable, i.e., General is acceptable for the Panduit solution.
 2. Racks, cabinets, frames and associated fastening devices
 - a. Chatsworth Products Incorporated (CPI) no substitutions.

2.03 FIRESTOPPING

- A. Comply with the requirements of Section 07 8400
- B. Products may be in the form of caulk, putty, strip, sheet, or devices that shall be specifically designed to fill holes, spaces, and voids at communications penetrations.
- B. Firestopping materials shall also provide adhesion to substrates and maintain fire and smoke seal under normal expected movements of substrates, conduits and cables.

2.04 ACOUSTIC SEPARATION

- A. Acceptable products for 2" through 4" penetrations are as follows
 - 1. STI EasyPath™
 - 2. Resilient latex caulk and re-enterable putty manufactured by 3M™, Specified Technologies or Hilti.
 - 3. Or approved substitution
- B. Acceptable products for less than 2" penetrations are as follows
 - 1. Resilient latex caulk and re-enterable putty manufactured by 3M™, Specified Technologies or Hilti.
 - 2. Or approved substitution

PART 3 - EXECUTION

3.01 GENERAL

- A. Manufacturer's installation instructions and requirements shall be strictly adhered to in the telecommunications equipment installation, fabrication and testing process.
- B. Where conflicts arise between the requirements of this Specification and the manufacturer's installation instructions, the Owner shall be consulted for resolution.
- C. All twisted pair wiring systems shall be installed according to manufacturers' installation guidelines, and according to related ANSI/TIA-568-C standards.
- D. All installed cables shall be kept free from nicking, abrading, or cutting during storage and during the installation process.
- E. Cable shall be installed into conduits after conduit installation is complete and appropriate bushings or couplers have been installed. Manufacturers' recommendations for maximum pulling tensions and minimum bend radii for all cables must not be exceeded.
- F. Care shall be exercised in wiring to avoid damage to wiring and equipment.
- G. Connections shall be made with approved mechanical connectors.
- H. All wiring and connectors shall be installed in strict adherence to standard communications installation practices and to federal, state or local applicable codes.
- I. Equipment shall be firmly held in place. Fastenings, supports, and hangers shall be adequate to support their loads.
- J. Open areas requiring suspension for cables will employ properly rated support mechanisms and devices to accommodate future addition of cable.
- K. Cable ties will be used in concealed areas only as mandated by code or ANSI/TIA-568-C. Cable ties shall bear the same rating as the cable when installed in plenum areas.
- L. Cable running in exposed areas will be bundled using Velcro® or similar hook and loop material. Such material will be used exclusively in the ER and TRs. Cable ties are permitted for temporary cable dressing only and shall be removed prior to substantial completion.
- M. The installation must conform to OSHA standards and comply with state and local safety codes.

- N. Applicable fire codes will be strictly adhered to in regards to plenum ratings for cable and associated cable ties. Fire stopping will be the responsibility of this contract in areas penetrated as a part of this project.
- O. Installation shall be neat, well organized, and professional.
- P. Installation shall be conducted as to maintain consistency between color-coding, labeling and documentation.
- Q. Splicing of any unshielded twisted pair or fiber optic is not acceptable, unless directed to by specifications, addendum, drawings or other written communication with owner or authorized representative.
- R. Any discrepancies, conflicts or issues must be brought to the attention of the Owner before installation or as soon as possible thereafter.
- S. The Contractor shall clean up the work area at the end of each day. At the end of the project all material removed or left over, and/or not being used shall be removed from the project site unless other arrangements have been made. A final clean up shall be made before final payment is made.
- T. The Contractor shall coordinate with the General Contractor for final cleaning of the Equipment and all Telecommunications Rooms. Final cleaning shall include necessary steps to remove all debris from the rooms and provide completely dust-free surfaces on all installed components.
- U. All wall and floor penetrations shall be fire stopped at or before substantial completion.

3.02 PREPARATION

- A. Before installation of cabling and/or equipment in telecommunications spaces, the Contractor shall field-investigate the facility and ascertain if the physical and electrical conditions within the facility shall permit commencement of the Contractor's work.
- B. Any discrepancies, questions, or concerns noted at that time should be brought to the immediate attention of the Owner.

3.03 DOCUMENTATION

- A. GENERAL
 - 1. All hard copy documentation must be neat and legible
- B. TEST REPORTS
 - 1. The Contractor shall compile test results into the forms that contain all applicable test data. Hard copy output indicating successful testing of every location is not required.
 - 2. A solid state USB memory device containing all test data and the appropriate application to display such in a Windows-based environment shall be provided.

3.04 AS BUILTS

- A. Contractor will be provided the T series AutoCAD[®] drawings electronically. These drawings shall be the base drawings for the as built documentation with the following being provided by the Contractor as a separate AutoCAD[®] layer:
 - 1. Outlet location,
 - 2. Cable ID.

3.05 TELECOMMUNICATION OUTLETS

- A. All locations shall be annotated with information that duplicates the labeling on the jack. In the case of a field terminated plug, such as WAPs or IP based, single cable applications the location shall be so noted.

END OF SECTION

SECTION 27 0526
GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.01 SUMMARY

- A. This section includes the grounding and bonding requirements for the metallic components located in the Telecommunications Rooms.

1.02 SCOPE

- A. Provide all labor, materials, tools, and equipment required for the complete installation of a telecommunications grounding system.

1.03 QUALITY ASSURANCE

- A. See Section 27 0513
- B. All grounding and bonding cables shall be installed in a neat and workmanlike manner.
- C. Grounding shall meet applicable ANSI/TIA-607-B, NEC Articles 250 and 800 requirements and practices except where other authorities or codes may impose a more stringent requirement or practice. All racks and cable trays shall be bonded to a ground bar with #6 AWG cable. All termination equipment shall be grounded according to the specifications of the manufacturer.
- D. Impedance shall not exceed 5 Ω between any two metallic points within a Telecommunications Room.

PART 2 - PRODUCTS

2.01 TELECOMMUNICATIONS MAIN GROUND BUS BAR – MAIN EQUIPMENT ROOM

- A. Telecommunications Main Grounding Busbar (TMGB) shall be constructed of .25" thick solid copper bar.
- B. The busbar shall be 4" high and 20" long and shall have 30 attachment points (two rows of 15 each) for two-hole grounding lugs.
- C. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI/TIA/607-B and shall accept lugs with 5/8" with 1" hole centers.
- D. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" (100 mm) standoff from the wall.
- E. The busbar shall be UL[®] Listed as grounding and bonding equipment.

2.02 GROUND BUS BAR – TELECOMMUNICATIONS ROOM

- A. Telecommunications Grounding Busbar (TGB) shall be constructed of .25" thick solid copper bar.
- B. The busbar shall be 2" high and 12" long and shall have 9 attachment points (one row) for two-hole grounding lugs.
- C. The hole pattern for attaching grounding lugs shall meet the requirements of ANSI/TIA/607-B and shall accept lugs with 5/8" and 1" hole centers.
- D. The busbar shall include wall-mount stand-off brackets, assembly screws and insulators creating a 4" standoff from the wall.
- E. The busbar shall be UL[®] Listed as grounding and bonding equipment.

2.03 CABLE RUNWAY BONDING STRAPS

- A. Continuous #6 AWG with two hole compression lugs, Chatsworth 40164-001 or approved alternate.
- B. #6 AWG from bench stock is acceptable with machine compression or exothermically applied lugs.

2.04 BONDING ACCESSORIES

- A. Two Mounting Hole Ground Terminal Block
 - 1. Ground terminal block shall be made of electroplated tin aluminum extrusion.
 - 2. Ground terminal block shall accept conductors from #14 AWG through 2/0.
 - 3. The conductors shall be held in place by two stainless steel set screws.
 - 4. Ground terminal block shall have two .25" holes spaced on 5/8" centers to allow secure two-bolt attachment to the rack or cabinet.
 - 5. Ground terminal block shall be UL[®] Listed as a wire connector.
- B. Compression Lugs
 - 1. Compression lugs shall be manufactured from electroplated tinned copper.
 - 2. Compression lugs shall have two holes spaced on 5/8" or 1" centers, as stated below, to allow secure two bolt connections to busbars.
 - 3. Compression lugs shall be sized to fit a specific size conductor, sizes #6 to 4/0, as stated below.
 - 4. Compression lugs shall be UL[®] Listed as wire connectors.
- C. **Antioxidant Joint Compound:** Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.
- D. C-Type, Compression Taps
 - 1. Compression taps shall be manufactured from copper alloy.
 - 2. Compression taps shall be C-shaped connectors that wrap around two conductors forming an irreversible splice; requires a hydraulic crimping tool
 - 3. Compression taps shall be sized to fit specific size conductors, sizes #2 AWG to 4/0, as stated below.
 - 4. Compression taps shall be UL[®] Listed.

PART 3 - EXECUTION**3.01 GENERAL**

- A. A copper bonding and grounding system shall be installed which places a properly sized (as per Table 250-122 of National Electrical Code) copper cable in the immediate vicinity of the telecommunications backboard. Contractor shall be responsible for placement of the above referenced ground busbars and terminal(s) as well as their connection to the building system grounding cable using an exothermic-welded type connector or appropriate compression applied connector to satisfy the Authority Having Jurisdiction.
- B. Bonding and grounding shall meet applicable ANSI/TIA-607-B, NEC[®] Articles 250 and 800 requirements and practices except where other authorities or codes may impose a more stringent requirement or practice. All racks and cable trays shall be bonded to a ground busbar with #6 AWG cable. All termination equipment shall be bonded to a known source of building system ground according to the specifications of the manufacturer.

3.02 TELECOMMUNICATIONS BONDING AND GROUNDING SYSTEM USING STRUCTURAL METAL (The following two paragraphs are as per directives in ANSI/TIA/607-B-2)

- A. When structural metal is bonded to the building's grounding electrode system it may be used in place of a TBB or a GE. Before utilizing structural metal in place of a TBB or a GE, building plans (including as-builts as applicable) and specifications shall be reviewed to ensure the structural metal is electrically continuous or can be made so. Additionally, the two-point continuity test described in ANSI/TIA-607-B should be performed from floor-to-floor on the structural metal, thereby ensuring electrical continuity through the entire structure. Concrete reinforcing steel shall not be used as a TBB or a GE.

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

- B. **Connections to the TMGB/TGB:** The bonding conductor from the structural metal to the TMGB or TGB shall be sized according to table 1 of ANSI/TIA-607-B. Bonds to structural metal shall be made by listed exothermic welding, listed compression or listed mechanical connectors and shall be accessible. Bonds to the TMGB or TGB shall be made as specified in ANSI/TIA-607-B. Components to be connected to the TMGB or TGB shall be as specified in ANSI/TIA-607-B.

3.03 PREPARATION

- A. Preparation of surfaces: Clean contacting surfaces of ground connections to bright metal before connecting
- B. When making bolted connection to aluminum or galvanized structures, apply a corrosion-inhibitor such as Penetrox A to contact surfaces between connector, and surface of structure.

3.04 INSTALLATION

- A. **Outdoor Grounding and Bonding Connections:** All outdoor grounding and bonding (earthing) connections shall be accomplished using exothermic welding.
- B. Wall-Mount Busbars
1. Attach busbars to the wall with appropriate hardware according to the manufacturer's installation instructions.
 2. Conductor connections to the TMGB or TGB shall be made with two-hole bolt-on compression lugs sized to fit the busbar and the conductors.
 3. Each lug shall be attached with stainless steel hardware after preparing the bond according to manufacturer recommendations and treating the bonding surface on the busbar with antioxidant to help prevent corrosion at the bond.
 4. The wall-mount busbar shall be bonded to ground as part of the overall Telecommunications Bonding and Grounding System.
- C. Rack-Mount Busbars and Ground Bars
1. When a rack or cabinet supports active equipment or any type of shielded cable or cable termination device requiring a ground connection, add a rack-mount horizontal or vertical busbar or ground bar to the rack or cabinet. The rack-mount busbar or ground bar provides multiple bonding points on the rack for rack and rack-mount equipment.
 2. Attach rack-mount busbars and ground bars to racks or cabinets according to the manufacturer's installation instructions.
 3. Bond the rack-mount busbar or ground bar to the room's TMGB or TGB with appropriately sized hardware and conductor.
- D. Ground Terminal Block
1. Every rack and cabinet shall be bonded to the TMGB or TGB.
 2. Minimum bonding connection to racks and cabinets shall be made with a rack-mount two-hole ground terminal block sized to fit the conductor and rack and installed according to manufacturer recommendations.
 3. Remove paint between rack/cabinet and terminal block, clean surface and use antioxidant between the rack and the terminal block to help prevent corrosion at the bond.
- E. Cable Runway Bonding Straps
1. Bond equipment to a vertical rack-mount busbar using bonding jumper according to the manufacturer's recommendations.
 2. Clean the surface and use antioxidant between the compression lugs on the jumper and the rack-mount busbar to help prevent corrosion at the bond.

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

3.05 BONDING

- A. All metallic components that make up the equipment racks and ladder rack shall be bonded together in a manner that provides continuous continuity between the components. Attention must be given to the removal of paint or powder coating to present bare metal where bonding straps are fastened to the metallic component.

END OF SECTION

SECTION 27 0528
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.01 GENERAL

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.02 DESCRIPTION OF WORK

- A. This contract shall be responsible for all hangers and support mechanisms required to properly support all telecommunications cables to satisfy the local Authority Having Jurisdiction.
- B. This contract shall be responsible for all pathways as called out on Drawings, specifically:
 - 1. Various conduits and "J-Boxes" as detailed on "T" series Drawings to accommodate Telecommunications Outlets (TO) and Wireless Access Points (WAP) locations. Any necessary penetrations shall accommodate a minimum of a Trade Size 1 EMT conduit.
 - 2. Surface mounted raceway, as per "T" series Drawings
- C. The Contractor shall coordinate with the General Contractor and all other trades prior to final placement of telecommunications pathways. Placement shall be such that pathway will be accessible for future additions requiring placement of telecommunications cable.
- D. The Contractor shall provide all labor, equipment and supplies to furnish and install the communications pathway, hangers and supports.
- E. Installation shall include the actual physical installation of the hardware and/or support structure, firestopping, testing and documentation.

1.03 RELATED SECTIONS

- A. Section 26 0533 - Raceways and Boxes for Electrical Systems
- B. Section 27 0528.29 - Hangers and Supports for Communications Systems
- C. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- D. Section 27 0528.36 - Cable Trays for Communications Systems
- E. Section 27 0528.39 - Surface Raceways for Communications Systems

1.04 REFERENCES

- A. ANSI/NFPA 70/250 - National Electric Code – Ground and Bonding
- B. ANSI/NFPA 70/318 – National Electric Code – Cable Trays
- C. ANSI/NFPA 70/645 – National Electric Code – Information Technology Equipment
- D. ANSI/NFPA 70/770 – National Electric Code – Optical Fiber Cables and Raceways
- E. ASTM A 510 - Specifications for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- F. ASTM B 633 - Specifications for Electrodepositing Coatings of Zinc on Iron and Steel, Sections SC2 and SC3
- G. ASTM A653 - Specifications for Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process
- H. ASTM A123 - Specifications for Zinc (Hot Galvanized) Coatings on Iron and Steel
- I. ANSI/TIA/568-C Series - Commercial Building Telecommunications Cabling Standard.
- J. ANSI/TIA/ 569-B Commercial Building Standard for Telecommunications Pathways and Spaces
- K. NEMA VE 2-2006 Cable Tray Installation Guidelines
- L. NEMA VE-1/CSA C22.2 No 126 1-02 Metal Cable Tray Systems

- M. UL® E209183
- N. ANSI C80.1 Rigid Steel Conduit - Zinc Coated
- O. ANSI C80.4 Fittings for Rigid Metal Conduit
- P. BICSI Electronic Safety and Security Reference Manual (ESSDRM)
- Q. BICSI Information Transport Systems Installation Methods Manual (ITSIM)
- R. BICSI Network Design Reference Manual (NDRM)
- S. BICSI Telecommunications Distribution Methods Manual (TDMM)
- T. BICSI Wireless Design Reference Manual (WDRM)

1.05 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Assure that the "as installed" system is correctly and completely documented including engineering drawings, manuals, and operational procedures in such a manner as to support maintenance and future expansion of the system.

1.06 SUBMITTALS

- A. The following information shall be provided:
 - 1. Manufacturer's literature and catalog cuts indicating:
 - 2. Physical dimensions, including dimensions (if appropriate)
 - 3. Materials of construction

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials and equipment installed under this contract shall be new, unused, free of defects, and of current manufacture. Equipment and material shall carry Underwriters Laboratory certification if required by local, state or national codes. Products are to be from the acceptable manufacturer listed below or an approved alternate. In no case will field fabrication or "shop built" cable support products be acceptable.

2.02 SURFACE MOUNTED RACEWAY

- A. Surface Mounted Raceway (SMR) shall be provided as per Section 27 0528.39 with all fittings including but not limited to mounting clips and straps, couplings, flat, bend limiting internal and external elbows, cover clips, bushings, device boxes and other incidental and miscellaneous hardware required for a complete SMR system.

2.03 ADJUSTABLE CABLE SUPPORT SYSTEM

- A. Cable support system shall be a factory produced assembly and sized to accommodate 100 percent expansion, i.e., rated to hold double the number of initially installed cables.
- B. Acceptable product is: CADDY® CABLECAT Adjustable Cable Support

2.04 ROD MOUNTED CABLE SUPPORT SYSTEMS

- A. Acceptable product is: CADDY® CAT-CM Cable Support System

2.05 FIRESTOPPING SYSTEMS TELECOM RACEWAYS

- A. Comply with the requirements of Section 07 8400
- B. Acceptable products for 2" through 4" penetrations are as follows
 - 1. STI EasyPath™
 - 2. Resilient elastomeric caulk and re-enterable putty manufactured by 3M™, Specified Technologies or Hilti.
- C. Acceptable products for less than 2" penetrations are as follows
 - 1. Resilient elastomeric caulk and re-enterable putty manufactured by 3M, Specified Technologies or Hilti.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install per manufacturer's instruction per weight loading.
- B. All conduits shall be installed stacked and attached to walls unless conditions exist which prohibit this type of installation. When this condition exists, mount conduits side-by-side supported with 3/8" rod attached to building structure utilizing UniStrut® channel to form a trapeze. Double nut the top and bottom at the UniStrut®. Utilize conduit clamp to secure conduits to UniStrut®.
- C. Install in accordance with directions given in Section 27 0528.39
- D. Installation and configuration shall conform to the requirements of the current revision levels of ANSI/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- E. Do not exceed load ratings specified by manufacturer.
- F. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- G. SMR shall be securely supported using mechanical fasteners at intervals not exceeding 10 feet or in accordance with manufacturer's installation instructions.
- H. The path of the SMR shall minimize impact on molding, tack boards and other architectural elements. Vertical runs of raceway from the ceiling to outlets shall be installed on walls near corners wherever possible. Raceway may be installed horizontally at the same height as the outlets or near to the ceiling. Entrance end fittings will be supplied at the ends of raceway runs to transition to conduit sleeves through walls, ceilings or floors. SMR shall be installed parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.
- I. Metal components shall be bonded and grounded in accordance with applicable code and ANSI/TIA-607-B.
- J. J-hooks are to be supported by dedicated wires or rods installed by this contract. In no case will ceiling grid wires be used to support J-hooks. J-hooks will be attached to ceiling grid wires (where applicable) to satisfy seismic bracing requirements and to prevent swinging.
- K. Adjustable cable support systems are to be securely attached to building structure and loaded as per manufacturer's instruction.
- L. Fire Rated wall and floor penetrations shall be fire-stopped in accordance with the manufacturer's instructions using the product set referenced in 2.05 above.

END OF SECTION

SECTION 27 0528.29
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.01 SUMMARY

- A. Section includes discrete J-Hooks, slings and related accessories for supporting low voltage cable bundles above accessible.

1.02 REFERENCES

- A. American National Standards Institute (ANSI) / Telecommunications Industry Association (TIA)
 - 1. ANSI/TIA-568-C.1 Commercial Building Telecommunications Cabling Standard
 - 2. TIA -569-C Standard for Telecommunications Pathways and Spaces for Commercial Building
 - 3. ANSI/NFPA 70 National Electrical Code
- B. Underwriters Laboratories, Inc. (UL[®])
 - 1. UL[®] 2043 Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
 - 2. UL[®] 2239 Conduit, Tubing and Cable Support Hardware

1.03 SUBMITTALS

- A. Provide submittal information in accordance with Section 27 0500 - Common Work Results for Communications and supplementary requirements described in this specification.
- B. Product Data: Submit product data on all cable support devices and accessories. Indicate materials, finishes, load ratings, dimensions, listings, approvals and attachment methods.
- C. Closeout Submittals
 - 1. As-built Drawings: Provide as-built drawings of main pathways in AutoCAD[®] format as per Section 27 0513.

1.04 QUALITY ASSURANCE

- A. Low voltage system cable supports and accessories shall be listed to Underwriters Laboratories, Inc. Standard 2239.
- B. Low voltage system cable supports and accessories shall have the manufacturers name and part number stamped on the part for identification.
- C. Pre-Installation Meetings: Contractor shall set up a pre-installation meeting to discuss low voltage cable support layout work and installation guidelines. Attendees shall include Owner contractor, and appropriate subcontractors. Purpose of meeting shall be to coordinate work between the parties to have a consistent layout for all low voltage system cables, minimize interferences and to make cable system accessibility for future Owner modifications and maintenance high priority issue for all installers.

1.05 COORDINATION

- A. Coordinate layout and installation of low voltage cable bundle supports with other construction elements to ensure adequate headroom, working clearance and access. Revise locations and elevations for those indicated as required to suit field conditions and as approved by Owner.
- B. Particular attention is called to clearances as related to HVAC ducting and sheet metal work in and adjacent to Telecommunications Rooms.

PART 2 - PRODUCTS

2.01 NON-CONTINUOUS CABLE SUPPORT SYSTEMS (J-HOOKS)

- A. Shall be constructed of galvanized steel, stainless steel, or hot dipped zinc
 - B. Fastener is to be installed using dedicated wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments. Product is to be UL[®] Listed for the application.
1. Non-Continuous Cable Supports
 - a. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; UL[®] Listed.
 - b. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
 - c. Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
 - d. Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
 - e. Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.
 - f. Non-continuous cable supports shall be ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CM™ Double J-Hook CAT100CM; CAT-CM™ U-hook series CAT200CMLN, CAT300CMLN; and CAT-CM™ retainer CATRT200CM, CATRT300CM or approved equal
 - g. Non-continuous cable supports shall be ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CM™ Double J-Hook CAT100CM; CAT-CM™ U-hook series CAT200CMLN, CAT300CMLN; and CAT-CM™ retainer CATRT200CM, CATRT300CM or approved equal.
 2. Adjustable non-continuous cable support sling
 - a. Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5e and higher cable, or optical fiber cable; UL[®] Listed.
 - b. Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
 - c. Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
 - d. If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.
 - e. Acceptable products: ERICO CADDY[®] CableCat™ CAT425; or approved equal.
 3. Multi-tiered non-continuous cable support assemblies

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

- a. Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; UL[®] Listed.
 - b. If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.
 - c. The multi-tiered support bracket shall consist of ERICO CADDY[®] CATHBA and CableCat[™] J-Hooks with screws; or approved equal.
4. Non-continuous cable support assemblies from tee bar
 - a. Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; UL[®] Listed.
 - b. Acceptable products: ERICO CADDY[®] CAT12TS, CAT21528, CAT32528; or approved equal.
 5. Non-continuous cable support assemblies from drop wire/ceiling
 - a. Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; UL[®] Listed.
 - b. Acceptable products: ERICO CADDY[®] CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.
 6. Non-continuous cable support assemblies from beam, flange
 - a. Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; UL[®] Listed.
 - b. Acceptable products: ERICO CableCat[™] J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY[®] beam clamps and CADDY[®] flange clips; or approved equal.
 7. Non-continuous cable support assemblies from C & Z Purlin
 - a. Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, UL[®] Listed.
 - b. Acceptable products: ERICO CableCat[™] J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY[®] Purlin hangers; or approved equal.
 8. Non-continuous cable support assemblies from wall, concrete, or joist
 - a. Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, UL[®] Listed.
 - b. Acceptable products: ERICO CableCat[™] J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY[®] angle bracket; or approved equal.
 9. Non-continuous cable support assemblies from threaded rod

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

- a. Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, UL[®] Listed.
 - b. The multi-tiered support bracket shall have a static load limit of 300 lbs.
 - c. U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.
 - d. Acceptable products: ERICO CableCat™ J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY[®] CATHBA series; CAT-CM™ Double J-hook CAT100CM, CAT-CM™ Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.
10. Cantilever-Mounted cable supports
- a. U-hook shall be able to be assembled to a wide variety of wall mount brackets.
 - b. Spacing of individual U-hooks as needed, max of 4' to 5' apart.
 - c. U-hooks may have the optional attachment of a cable roller for ease in pulling cables.
 - d. Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN; CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket; or approved equal.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Coordinate installation with General Contractor and other trades
- B. All low voltage systems cables shall be supported along entire Pathway.
- C. Space supports a maximum of 48 inches apart and at each change of direction of the cables. In areas covered by dropped ceiling, tiles shall be left open to allow inspection by Owner.
- D. Hang cable supports from ³/₈" all thread rods, dedicated #8 galvanized ceiling drop wire or wall brackets connected directly to structure. Do not support from the ceiling grid or ceiling wire system.
- E. Where main pathways are indicated on the Drawings, contractor shall follow the indicated pathways as closely as possible according to field conditions. Pathways for smaller cable counts shall be designed and documented on the as-built drawings by the contractor.
- F. Install support wires, brackets or rods to route cables parallel and perpendicular to building lines.
- G. Provide multiple hooks or slings at each hanger location as required by cable count and cable segregation requirements.
- H. Fill supports with cabling to 50% or less of the manufacturer's recommended fill. Provide multiple supports where required cable count exceeds 50% fill.
- I. Install low voltage cable support system above accessible ceilings only.
- J. Elevation of Cable Supports: Contractor shall coordinate the allocation of ceiling space and the mounting elevations to allow maintenance and accessibility for future modifications. Telecommunications cable supports shall be as close to the ceiling as possible while allowing ceiling tiles to be removed. Supports shall be located to avoid interference with maintenance access to other equipment.
- K. Cable installation and supports shall comply with applicable provisions of ANSI/TIA-569-C and NFPA 70.

END OF SECTION

SECTION 27 0528.33
CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes boxes and conduits related to the installation of telecommunications cable supporting voice, data, and video (A/V and Video Surveillance) systems.

1.02 RELATED DOCUMENTS

- A. Related Sections
 - 1. Section 26 0533 - Raceways and Boxes for Electrical Systems
 - 2. Section 27 0528.29 - Hangers and Supports for Communications Systems
 - 3. Section 27 0528.36 - Cable Trays for Communications Systems
 - 4. Section 27 0528.39 - Surface Raceways for Communications Systems
 - 5. Section 27 1300 - Communications Backbone Cabling
 - 6. Section 27 1500 - Communications Horizontal Cabling
- B. Other References
 - 1. ANSI/TIA-569-C - Commercial Building Standard for Telecommunications Pathways and Spaces
 - 2. ANSI/TIA-607-B – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

1.03 DESCRIPTION

- A. Provide raceway systems for the installation of the telecommunications cables.
- B. This Section shall include all raceways, outlet boxes; plaster rings and all appurtenances required for the conduits and raceways.
- C. Size conduits and raceways as indicated. Where no size is indicated, conduit will be a minimum of Trade Size 1.

PART 2 - PRODUCTS

2.01 RACEWAYS

- A. Except as noted below and on Drawings, components shall be as per Section 26 0533, Raceways and Boxes.
- B. Minimum conduit size for telecommunications outlets shall be Trade Size 1 EMT

2.02 TELECOMMUNICATIONS OUTLET BOXES

- A. Comply with Section 26 0533, Raceways and Boxes
- B. Telecommunications Outlet locations consist of one (1) 4-11/16" square by 2-1/8" deep flush mounted box. Each outlet box shall have an EMT conduit stubbed above the drop ceiling or extended into the hallway cable tray. Conduits size is as follows:
 - 1. For Outlets with 3 or less cables, use a Trade Size 1 EMT conduit
 - 2. For Outlets with 3-6 cables, use a Trade Size 1.25 EMT conduit
 - 3. For all other sizes, calculate fill ratio at 40% for proper sized conduit
- C. Surface-mounted construction TO typically consists of surface-mounted raceway including base, cover, end fitting, entrance end fitting, and (2) Trade Size 1 EMT conduits stubbed out top of entrance end fitting to above ceiling or out to nearest hallway distribution system. Size of the raceway is site dependent based on number of conductors to be installed.

2.03 OUTLET DEVICE RING

- A. Provide $\frac{5}{8}$ " deep single gang device (mud) ring.

CONDUITS AND BACKBOXES FOR COMMUNICATION SYSTEMS

2.04 DEVICE PLATES

- A. Provide as per 27 1543 – Communications Faceplates and Connectors

2.05 PULL STRING

- A. Shall be nylon having not less than 200-pound tensile strength.

PART 3 - EXECUTION

3.01 RACEWAYS

- A. Comply with Section 26 0533, Raceways and Boxes
- B. No length of run shall exceed 100 feet and shall not contain more than two 90-degree bends or the equivalent without a code size pull box. Provide pull boxes where necessary to comply with these requirements. Locate pull boxes in straight runs only, not as a replacement for an elbow.
- C. Conduits with an internal diameter of two inches or less shall have a bend radius at least 6 times the internal conduit diameter. Conduits greater than two inches shall have a bend radius at least 10 times the internal conduit diameter.
- D. Provide an insulated bushing on all conduits terminated in a cabinet and/ or pull boxes.
- E. Terminate conduits stubbed out above accessible ceiling space so that the conduit is parallel with the ceiling and provide an insulating bushing.

3.02 PULL BOXES

- A. Pull boxes shall be sized per the following table:

<u>PULL BOX SIZING (inches)</u>				
<u>Conduit Trade Size</u>	<u>Width</u>	<u>Length</u>	<u>Depth</u>	<u>Width increase for additional conduit</u>
1	4	16	3	2
1- ¹ / ₄	6	20	3	3
1- ¹ / ₂	8	27	4	4
2	8	36	4	5
2- ¹ / ₂	10	42	5	6
3	12	48	5	6
3- ¹ / ₂	12	54	6	6
4	15	60	8	8

3.03 PULL STRINGS

- A. Nylon type pull strings shall be included in all raceways over 10 feet long. Leave not less than 12 inches of slack at each end of the pull wire.

END OF SECTION

SECTION 27 0528.36
CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to completely execute a complete wire basket cable tray system as described in this specification and as shown on the Drawings.
- B. Wire basket cable tray systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.
- C. Material listed in this section is for use non-telecommunications room spaces. See section 27 1123 for cable tray in telecommunications room spaces.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM) International:
 - 1. ASTM A1011 / A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - 2. ASTM A123 / A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A510 - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
 - 4. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
 - 5. ASTM A580 – Standard Specification for Stainless Steel Wire
 - 6. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - 7. ASTM A641 / A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 8. ASTM A653 / A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 9. ASTM D769 - Standard Specification for Black Synthetic Iron Oxide
- B. National Electrical Manufacturers Association:
 - 1. NEMA FG 1 - Fiberglass Cable Tray Systems.
 - 2. NEMA VE 1 - Metal Cable Tray Systems.
 - 3. NEMA VE 2 - Cable Tray Installation Guidelines.
- C. NFPA 70: National Electrical Code (2008)
- D. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises
- E. ANSI/TIA-569-C – Commercial Building Standard for Telecommunications Pathways and Spaces

1.03 DRAWINGS

- A. The Drawings, which constitute a part of these specifications, indicate the general route of the wire basket cable tray systems. Data presented on Drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

- B. Specifications and Drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

1.04 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the owner or owner's representative.
- B. Supply all equipment and accessories new and free from defects.
- C. Supply all equipment and accessories in compliance with the applicable standards listed in Part 1.02 of this section and with all applicable national, state and local codes.
- D. All items of a given type shall be the products of the same manufacturer.
- E. Zinc plated wire basket cable tray shall be classified by Underwriters Laboratories (UL).
- F. Wire basket cable tray shall be of uniform quality and appearance.
- G. Comply with the National Electrical Code (*NEC*[®]), as applicable, relating to construction and installation of cable tray and cable channel systems (Article 392, *NEC*[®]).
- H. Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.05 SUBMITTALS

- A. Submittal Drawings: Submit drawings of wire basket cable tray and accessories including connector assemblies, clamp assemblies, brackets, splice plates, splice bars, grounding clamps and hold-down plates showing accurately scaled components. Indicate wire basket cable tray dimensions, support points, and finishes.
- B. Product Data: Submit manufacturer's data on wire basket cable tray system including, but not limited to, types, materials, finishes and inside depths.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under references. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.06 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.07 PRE-INSTALLATION MEETINGS

- A. Convene a minimum of two week(s) prior to commencing work of this section. Meeting shall include General Contractor and all sub-contractors involved with the installation of duct work, plumbing or other such fixtures that will be placed in shared space above the dropped ceiling.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Ship and store wire basket cable tray system equipment in its original packages and in a clean, dry space to prevent damaging from weather, construction traffic or foreign matter. All handling performed in accordance with manufacturer's recommendations. Provide protective coverings during construction.
- B. Deliver wire basket cable tray systems and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment.
- C. Replace at no expense to Owner, equipment or material damaged during storage or installation as directed by the Architect.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Coordinate selected product with Section 26 0536.
- B. Subject to compliance with these specifications, wire basket cable tray systems to be installed shall be as manufactured by the following:
 - 1. Cooper B-Line - 509 West Monroe Street, Highland, IL, 62249. Phone: (618) 654-2184 or email blineus@cooperindustries.com
 - 2. Snake Tray® - 291 Skip Lane, Bay Shore NY, 11706. Phone: (800) 308-6799
 - 3. Approved equivalent

2.02 WIRE BASKET CABLE TRAY SECTIONS AND COMPONENTS

- A. Provide wire basket cable tray of types and sizes indicated with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the additional construction highlighted in Section 2.02.
- B. All straight section longitudinal wires shall be constructed with a continuous top wire safety edge. Safety edge must be kinked and T-welded on all tray sizes.
- C. Wire basket cable tray shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All mesh sections must have at least one bottom longitudinal wire along entire length of straight section.
- D. Wire basket cable tray sizes shall conform to the following nominal criteria:
 - 1. Straight sections shall be furnished in standard 118.3 inch lengths.
 - 2. Wire diameter shall be 0.196" (5mm) minimum on all mesh sections (minimum size of 4.5mm on stainless steel).
 - 3. Wire basket cable tray shall have a 4 inch usable loading depth by 12 or 18 inches wide as called out on Drawings.
- E. In order for a system to be approved as an equipment ground conductor (EGC), all splicing assemblies shall be UL® Classified or CSA approved as an EGC. When using powder coated wire mesh cable tray as an EGC, the paint must be completely removed at all contact points of splice/ground bolt attachments.
- F. Material and Finishes: Material and finish specifications for are as follows.
 - 1. Non-exposed cable tray shall be bright zinc plated, as manufactured.
 - 2. In exposed areas the cable tray shall be white powder coat. Straight sections shall be powder coated with an average paint thickness of 1.2mils (30microns) to 3.0mils (75microns).
- G. All fittings shall be field formed from straight sections in accordance with manufacturer's instructions. Where exposed, white touch-up matching powder coat shall be applied to conceal bright edges.
- H. Wire basket cable tray supports shall be center support hangers, trapeze hangers or wall brackets from the manufacture of the tray.
- I. Trapeze hangers or center support hangers shall be supported by ¼" inch or ⅜" inch diameter rods.
- J. Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install wire basket cable tray in accordance with NEMA VE 2 to ensure that the cable tray equipment complies with the requirements of the *NEC*[®], applicable portions of NFPA 70B, and the National Electrical Contractors Association's (NECA) 'Guide to Quality Electrical Installations' pertaining to general electrical installations practices.
- B. All trays should be supported using a minimum of ¼" All Threaded Rod (ATR).
- C. Special accessories shall be furnished as required to protect, support and install a wire basket cable tray system.
- D. Coordinate wire basket cable tray with other electrical work as necessary to properly interface installation of wire basket cable tray with other work.
- E. Support trays and fasten to structure. Install supports at each connection point, at end of each run, and at other points to maintain spacing between supports of 5 feet maximum.
- F. Install firestopping in accordance with local and NFPA regulations to sustain ratings when passing wire basket cable tray through fire-rated elements.
- G. Ground and bond metal cable tray in accordance with NFPA 70, National Electrical Code Article 392: Cable Trays. Additionally;
 - 1. Bond cable tray system to a known source of building ground.
 - 2. Provide continuity between wire basket cable tray components. Powder coating must be thoroughly removed at grounding device connection point.
 - 3. Make connections to tray using mechanical, compression or exothermic connectors.
 - 4. If required, ground cable trays by mounting up to two #6 AWG bare copper wires to each wire basket cable tray section, bonded with a grounding clamp
- H. Provide sufficient space encompassing wire basket cable tray to permit access for installing and maintaining cables.

3.02 TESTING

- A. Test wire basket cable tray support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. See NFPA 70B, Chapter 20, for testing and test methods.
- B. Manufacturer shall provide test reports witnessed by an independent testing laboratory of the "worst case" loading conditions outlined in this specification and performed in accordance with the latest revision of NEMA VE-1.

END OF SECTION

SECTION 27 0528.39
SURFACE RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.01 SECTION INCLUDES

- A. Surface mounted raceway (SMR).

1.02 RELATED SECTIONS

- A. Section 26 0533 - Raceways and Boxes for Electrical Systems
- B. Section 27 0528 – Pathways for Communications Systems
- C. Section 27 0528.29 - Hangers and Supports for Communications Systems
- D. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- E. Section 27 0528.36 - Cable Trays for Communications Systems

1.03 SUBMITTALS

- A. Submit under provisions of Section 27 0513
- B. Samples: If other than specified product is bid, Contractor must submit a 24-inch length of proposed product. Show finished detail with boxes, faceplate, connectors, angles and transitions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firms regularly engaged in manufacturer of raceway systems, boxes and fittings of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide fittings and boxes produced by a manufacturer listed in this section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver raceways and distribution systems in factory labeled packages.
- B. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- C. Protect from damage due to weather, excessive temperature, and construction operations.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Provide surface mount raceway distribution components as manufactured by Panduit (TG70 Series), or approved alternate.
- B. SMR shall be manufactured by Panduit (TG70 or equal). All fittings and transitions pieces are to be of the same manufacturer; however, low voltage receptacles may be from a different manufacturer so long as the product is designed to be an integral part of the completed system

2.02 SURFACE MOUNTED RACEWAYS AND FITTINGS

- A. General:
 - 1. System: Surface raceway systems shall consist of bases, covers, appropriate fittings, mounting brackets, workstation boxes / enclosures and device mounting brackets and fasteners necessary for a complete installation.
 - 2. Surface mounted raceways shall be a rectangular design with removable covers or solid construction, constructed of shatter-proof thermoplastic (or similar) raceway, utilizing elbows, couplings, and connectors of the same material.

3. Mounting Brackets: Surface mounted raceway shall be secured to wall using properly rated anchors or mounting brackets. Brackets shall provide un-obscured inspection of fastening bolts at point of wall penetration. In no case whatsoever will surface mounted raceways be attached with drywall screws.
 4. Fittings: Fittings shall include flat, internal and external elbows, tees, couplings for joining raceway sections, wire clips, blank end fittings, and device mounting brackets and plates as applicable. Provide full capacity corner elbows and fittings to maintain a controlled 2-inch cable bend radius, meeting the specification for Fiber Optic and UTP cabling and exceeding the ANSI-TIA-569-C requirements for communications pathways.
- B. Termination Boxes: Boxes should be at least 4-inch high by 2-inch wide by 3 -inch deep, constructed from same material as the SMR and pre-punched holes or knockouts. Boxes shall be surface mounted on the wall approximately 18 to 48 inches above final floor line depending on room furniture type and layout. Boxes shall have a minimum of two separate wall-fastening points and fastened to the wall using screws or bolts

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine conditions under which raceways, boxes, distribution systems, accessories, and fittings are to be installed and substrate that will support raceways. Notify the Owner's Representative in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Strictly comply with manufacturer's installation instructions and recommendations and approved installation practices. Care should be taken to prevent "over tightening" of fastening devices.
- B. The SMR shall be surface mounted on the wall using properly rated anchors or brackets. The top edge of the SMR shall be horizontally level below the suspended ceiling line or the true ceiling line, whichever is lower, shall be installed to permit visually inspection to verify the physical integrity of the raceway for its entire run, shall not block doorways or access to emergency exits, shall not inhibit the operation of windows, and shall not run across windows.
1. Support: SMR shall be supported by properly rated anchors or mounting brackets at intervals not to exceed 5 feet or in accordance with manufacturer's installation sheets.
 2. Accessories: Provide accessories as required for a complete installation.

3.03 FINAL FINISH

- A. All surfaces are to be left completely smooth and finished. No cut edges are to be exposed. In the event a metallic product is used, all rough edges are to be dressed and covered with appropriate fittings that prevent any access whatsoever with sharp edges.
- B. The Contractor shall coordinate with General Contractor to schedule paint of metallic product to match wall. Non-metallic product shall not be painted.

3.04 CLEANING AND PROTECTION

- A. Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
- B. Protect raceways and boxes until acceptance.

END OF SECTION

SECTION 27 0553
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL REQUIREMENT

1.01 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete labeling of the telecommunications infrastructure.

1.02 SCOPE

- A. This section includes all telecommunications cables and the associated infrastructure in the telecommunications rooms and telecommunications cabinets.

1.03 QUALITY ASSURANCE

- A. Contractor shall verify labeling requirements meet current district standards with Owner prior to cable installation.
- B. All cable identification tags and labels shall be installed in a neat and workmanlike manner.
- C. Contractor shall submit to Owner a sample faceplate for a data outlet in music room C102.

PART 2 - PRODUCTS

2.01 LABEL TAGS – CABLE AND FACEPLATES

- A. The labels shall be machine generated.
- B. The label background shall be white with either black or blue ink.
- C. Lettering on sleeves shall be 1/8-inch high

2.02 ENGRAVED SIGNAGE

- A. Engraved signage shall be laminate (color as specified) with engraved white letters.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General
 - 1. All horizontal (station) cables and outlets in which they terminate shall be identified by the Contractor at both ends of the wiring run. The standard nomenclature for the labeling is Classroom Number.Position.Port Number, hereafter known as CN.P.NN.
 - 2. All fiber tie cables shall be labeled at each end. The standard nomenclature for labeling is "From <Room-1> to <Room-2>", where "Room-1" is the originating location and "Room-2" is the destination.
 - 3. "Room numbers used for equipment labeling are to reference Architectural Signage Plans A601 and A602 only"
- B. Telecommunication Room and Telecom Enclosures shall be identified with building room numbers
- C. Horizontal (Station) Cables
 - 1. All cables will be labeled the same at both ends. The tag shall be secured to the sheath no more than 4 inches from the end of the cable. Each end of the UTP horizontal cables shall be labeled with the nomenclature "CN.P.NN". Where CN indicates the Classroom Number, P indicates the relative position within the room, and NN indicates the port number.
 - 2. Relative position identification shall commence to the immediate left of the entrance door with the position identifier starting at "A" and increasing through the alphabet in a clockwise direction.

3. Port numbers shall be "1" – "x", where x is the total number of ports on a plate.
4. Examples;
 - i. 101.A.1-3 - would be the first telecommunications outlet in room 101 and have three ports
 - ii. 101.B.1-4 - would be the second telecommunications outlet in room 101 and have four ports
 - iii. 101.C.1-2 - would be the third telecommunications outlet in room 101 and have two ports
- D. Copper Tie Cables
 1. Cables shall be labeled "From" – "To", specifically:
From MDF to IDF-x, where "x" = IDF Number
- E. Fiber Tie Cables
 1. Cables shall be labeled "From" – "To", specifically:
From MDF to IDF-x, where "x" = IDF Number
- F. Telecommunication Outlets (TO)
 1. Each TO shall be labeled at the top of the modular jack enclosure with the "CN.P.NN" nomenclature.
- G. Telecommunications Racks and Frames
 1. Labeling in the Main Equipment Room and Telecommunications Rooms shall be as per the Drawings. Labels shall be 1" blue laminate with ½ inch white letters. Labels shall be placed left-to-right identifying "FRAME-1" through "FRAME-x", where "x" = number of racks/cabinets present.
- H. Patch Panels
 1. Patch panels shall be labeled identical to the cables and telecommunications outlets.
- I. Door Signage
 1. The exterior door of the Main Equipment Room (MDF) and Telecommunications Rooms (IDFs) shall have signage as per the drawings.

END OF SECTION

SECTION 27 0800
COMMISSIONING OF COMMUNICATIONS

PART 1 - GENERAL REQUIREMENT

1.01 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.02 COMMISSIONING

- A. Comply with all requirements of Section 01 1900

1.03 TESTING, IDENTIFICATION AND ADMINISTRATION

- A. All cables and termination points will be tested and labeled per specifications.
- B. Testing is required for this project for all copper telecommunications cables. Fiber optic testing will be as detailed below.
- C. All test results shall be forwarded to the Owner's Representative for certification. Any results observed to be outside stated performance parameters shall be used by the Contractor for immediate correction.

1.04 POST INSTALLATION SERVICES

- A. The Contractor shall provide on-site service as part of the warranty in the event of the failure of any installed components.
- B. The contractor will provide support and warranty for installed cabling.
 - 1. The Contractor will be the first contact point and will interface between manufacture and Owner for warranty issues.
 - 2. The Contractor will provide the owner with contact information of the manufacture for warranty coverage prior to cable acceptance.

1.05 QUALITY ASSURANCE

- A. See Section 27 0513

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. The Contractor shall provide all tools and instruments used to test the installed telecommunications signal cabling.
- B. Test instruments used by the Contractor shall be suitable for the purpose at hand, and shall be of industry-recognized manufacture. Note that copper testing parameters are written for Fluke DTX-1800 or newer tester.
- C. Tools leased by the Contractor are acceptable, provided the operator of the test instrument(s) has a sufficient degree of operational awareness to use the rented instrument(s) correctly and obtain test data that is both, accurate and relevant.

2.02 WARRANTY

- A. All telecommunications cable installed as part of a manufacturer's certified system shall carry the manufacturer's warranty for a minimum of 20 years.
- B. The manufacturer shall provide certification attesting to on-site service as part of the warranty in the event of the failure of any installed balanced twisted pair cables, fiber-optic cables, telecommunications room terminations, telecommunications outlet terminations, or cross-connect cables.
- C. Such service shall be free of charge to the Owner and shall commence from the date of project acceptance and terminate not earlier than the twenty year anniversary of that date as a minimum.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS - COPPER

- A. The basic link shall be tested.
- B. All test results observed shall be used by the Contractor to determine any polarity and noise anomalies for immediate correction.
- C. Test results shall be used jointly by the Contractor and the Owner's Representative to determine the viability of each cable for transmission in accordance with the specifications of the cable manufacturer, and the requirements imposed by the transmission system. This shall form part of the acceptance procedure for the cable plant.
- D. All results obtained by use of pair-scanner testing shall be collated by TO number and presented to the Owner's Representative at the conclusion of the testing. Test compilation shall be initialed and dated by the Contractor's technician performing the test.
- E. Hard copy output indicating successful testing of every location is not required; rather a diskette containing test data and the appropriate application to display such in a Windows base environment is preferred.

3.02 GENERAL TESTING PARAMETERS - COPPER

- A. Copper cabling shall be tested and certified after installation as follows and as required for cable manufacturer's warranty. Twisted-pair copper cable channels shall be tested for continuity as specified below, presence of ac/dc voltage, and performance. All cabling shall be tested for conformance to horizontal cable specifications as outlined herein, and shall be tested according to test set manufacturer's instructions utilizing latest firmware and software. Testing shall include all of electrical parameters as specified in Paragraph D below. All cables and termination hardware shall be 100 percent tested under installed conditions. All conductors of each installed cable shall be verified useable by Contractor prior to system acceptance. All cables shall be tested according to contract documents, manufacturer's warranty provisions, and best industry practices. If any of these are in conflict, Contractor shall comply with most stringent requirements. All defects in cabling system installation shall be repaired or replaced in order to ensure 100 percent useable conductors in all cables installed, at no additional cost to Owner.
- B. Categories of balanced twisted pair cable:
 - 1. Unless otherwise designated, all station cable shall be category 6A.
 - 2. If so noted on drawings, selected cables shall be category 5e and 6.
- C. Balanced twisted pair testing shall provide certification and summary for all locations.
- D. All "category" cable paths shall be tested at each jack for the following parameters and meet the requirements imposed by the ANSI/TIA-568-C.2 and the manufacture's written specification.

Category 5e and 6	Category 6A
Wire Map	Wire Map
Cable Length	Cable Length
Pair-to-pair NEXT	Insertion Loss
Power Sum NEXT	Next Loss
Attenuation	PS Next Loss
Pair-to-Pair ELFEXT	ACR-F Loss
Power Sum ELFEXT	PS ACR-F Loss
Return Loss	Return Loss
Propagation Delay	Propagation Delay
Delay Skew	Delay Skew

3.03 ADDITIONAL CATEGORY 6A TESTING PARAMETERS

- A. In addition to testing the “In-link” performance parameters detailed in A.1 above, Alien Crosstalk testing or “Between-link” testing shall be carried out in accordance with Section 4.7 of ANSI/TIA-1152. Alien crosstalk testing includes the PS ANEXT and PS AACR-F (Power sum alien attenuation-to-crosstalk ratio from the far end) performance parameters. The standards refer to the link-under-test for Alien Crosstalk as the *disturbed* link.
- B. PS ANEXT and PS AACR-F shall meet or exceed the limits defined in Section 6 of the TIA Category 6A Standard.

1. Selection of disturbed (victim) links:

Installation size (No. of total links)	Sample size (No. of links to test)
3 – 33	100%
34 – 3,200	33
3,201 – 35,000	126
35,001 – 150,000	201
150,001 – 500,000	315

- 2. Choose short, medium and long links equally.
- 3. Selection of disturber links. Select all of the links that are in the same cable bundle and the most consistently positioned relative to the disturbed link as disturbing links.
- C. If the margin of PS NEXT and PS ACR-F exceeds 5 dB for the first three short, medium and long links (nine in total), further alien crosstalk testing can be discontinued.
- D. The installed twisted-pair horizontal links shall be tested from the telecommunications room to the telecommunication wall outlet in the work area for compliance with the “*Permanent Link*” performance specification as defined in the TIA Cat 6A Standard.
- E. One hundred percent of the installed cabling links must pass the requirements of the standards mentioned in above and as further detailed in Section 3.04 below. Any failing link must be diagnosed and corrected. The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements. The final and passing result of the tests for all links shall be provided in the test results documentation in accordance with Section 3.05 below.
- F. Trained technicians who have successfully attended an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. Appropriate training programs include but are not limited to installation certification programs provided by BICSI or the ACP (Association of Cabling Professionals).
- G. The test equipment (tester) shall comply with the accuracy requirements for level IIIe field testers as defined in ANSI/TIA-1152. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy *plus* adapter contribution) are specified in Table 4 of ANSI/TIA-1152 (Table 4 in this TIA document also specifies the accuracy requirements for the Channel configuration).
- H. The eight-pin modular (RJ45) test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.
- I. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.

- J. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
- K. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
- L. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks. To which extent '*' results shall determine approval or disapproval of the element under test shall be defined in the relevant detail specification, or agreed on as a part of a contractual specification.

3.04 PERFORMANCE TEST PARAMETERS FOR BALANCED TWISTED PAIR

A. **Wire Map**

Report "Pass" if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B. **Length**

The field tester shall be capable of measuring length of all pairs of a basic link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation (NVP)¹. The physical length of the link shall be calculated using the pair with the shortest electrical delay. This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

C. **Insertion Loss (Attenuation)**

Insertion Loss is a measure of signal loss in the permanent link or channel. The term "Attenuation" has been used to designate "Insertion Loss." Insertion Loss shall be tested from 1 MHz through 250MHz for category 6 and 1 through 500 MHz for category 6A in maximum step size of 1 MHz. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter. Minimum test results documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.

D. **NEXT Loss**

Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through 250MHz for category 6 and 1 through 500 MHz for category 6A. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair.

¹ Nominal Velocity of Propagation (NVP) expresses the speed of the electrical signals along the cabling link in relation to the speed of light in vacuum (3×10^8 m/second). Insulation characteristics and twist rate of the wire pair influence NVP in minor ways. Typically, an 'average' value for NVP is published for all four wire-pairs in a data cable.

The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the standard as shown in Table 1. . Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin² **and** the wire pair combination that exhibits the worst value of NEXT (worst case). NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

Frequency Range (MHz)	Maximum Step Size (MHz)
1 - 31.25	0.15
31.26 – 100	0.25
100 – 250	0.50
250 - 500	1.00

Table 1 -- Maximum frequency step size as defined in ANSI/TIA-1152

E. PS NEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link under-test (a total of eight results). PS NEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when all other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 through 250MHz for category 6 and 1 through 500 MHz for category 6A and the step size may not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS NEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

F. ACR-F, pair-to-pair

Attenuation Crosstalk Ratio Far-end is calculated from the pair-to-pair FEXT Loss. It shall be measured for each wire-pair combination from both ends of the link under-test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ACR-F Loss that must be evaluated and reported in the test results. ACR-F measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ACR-F is to be measured from 1 through 250MHz for category 6 and 1 through 500 MHz for category 6A and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the standard as in Table 1. Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR-F. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

G. PS ACR-F Loss

Power Sum Attenuation Crosstalk Ratio Far-end is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields eight wire-pair combinations. Each wire-pair is evaluated from 1 through 500 MHz in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results):

² 'Margin' designates the difference between the measured value and the corresponding test limit value. For passing links, 'worst case margin' identifies the **smallest** margin over the entire frequency range; the point at which the measured performance is "closest" to the test limit.

1. Identify the wire pair that exhibits the worst pair combinations must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

H. Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through 250 MHz for category 6 and 1 through 500 MHz for category 6A in frequency increments that do not exceed the maximum step size defined in the standard as shown in Table 1. Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

I. Propagation Delay

Propagation delay is the time required for the signal to travel from one of the link to the other. This measurement is to be performed for each of the four wire pairs. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

J. Delay Skew [as defined in the TIA Cat 6A Standard; Section 6.2.19]

This parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero. Minimum test results documentation (summary results): Identify the wire pair with the worst-case propagation delay (the longest propagation delay). The report shall include the delay skew value measured as well as the test limit value.

K. PS ANEXT

Pair-to-pair Alien NEXT (ANEXT) contributions is measured by applying the stimulus signal at the near end to one wire pair of a disturbing link and measuring the coupled signal at the near end of a wire pair in a disturbed link. This process is repeated for every wire pair in a disturbing link. The PS ANEXT for each wire pair in a disturbed link is obtained by the power sum addition of all the pair-to-pair ANEXT results to that wire pair from all wire pairs in disturbing links. All the links that are bundles with the disturbed link need to be included as disturbing links. In addition, links that are terminated in adjacent positions in a patch panel or interconnect panel should also be included as disturbing links in this test.

Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS ANEXT. These wire pairs must be identified for the tests performed from each end. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

L. PS AACR-F

The pair-to-pair Alien Far End crosstalk (AFEXT) contributions is measured by applying the signal at the near end to one wire pair of a disturbing channel or permanent link and measuring the coupled signal at the far end of a wire pair in a disturbed channel or permanent link. This process is repeated for every wire pair in a disturbing link and for all links in close proximity. A normalization, which is dependent on the relative length of disturbing and disturbed link, is applied to each pair-to-pair alien FEXT measurement. Then the PS Alien Attenuation-to-Crosstalk Ratio from the Far end (PS AACR-F) for each wire pair in a disturbed channel or permanent link is obtained by the power sum addition of all the normalized pair-to-pair far end alien crosstalk results to that wire pair from all wire pairs in disturbing links in close proximity.

Minimum test results documentation (summary results): Identify the wire pair that exhibits the worst-case margin and the wire pair that exhibits the worst value for PS AACR-F. If the link or channel connects two patch panels (data center), these wire pairs must be identified for the tests performed from both ends. Each reported case should include the frequency at which it occurs as well as the test limit value at this frequency.

3.05 TEST RESULT DOCUMENTATION

- A. The test results/measurements shall be transferred into a Windows™-based database utility that allows for the maintenance, inspection and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., "as saved in the tester" at the end of each test and that these results cannot be modified at a later time.
- B. The database for the completed job shall be stored and delivered on magnetic media including the software tools required to view, inspect, and print any selection of test reports.
- C. Test results shall be provided that lists all the links that have been tested with the following summary information
 1. The identification of the link in accordance with the naming convention defined in the overall system documentation
 2. The overall Pass/Fail evaluation of the link-under-test including the NEXT Headroom (overall worst case) number
 3. The date and time the test results were saved in the memory of the tester.
- D. General Information to be provided in the electronic data base with the test results information for each link:
 1. The identification of the customer site as specified by the end-user
 2. The identification of the link in accordance with the naming convention defined in the overall system documentation
 3. The overall Pass/Fail evaluation of the link-under-test
 4. The name of the standard selected to execute the stored test results
 5. The cable type and the value of NVP used for length calculations
 6. The date and time the test results were saved in the memory of the tester
 7. The brand name, model and serial number of the tester
 8. The identification of the tester interface
 9. The revision of the tester software and the revision of the test standards database in the tester
 10. The test results information must contain information on each of the required test parameters that are listed in Section 3.04 and as further detailed below under paragraph E & F.
- E. In-link (In-Channel) detailed test results. The detailed test results data to be provided in the electronic database for must contain the following information:

For each of the frequency-dependent test parameters, the value measured at every frequency during the test is stored. The PC-resident database program must be able to process the stored results to display and print a color graph of the measured parameters. The PC-resident software must also provide a summary numeric format in which some critical information is provided numerically as defined by the summary results (minimum numeric test results documentation) as outlined above for each of the test parameters.

 1. Length: Identify the wire-pair with the shortest electrical length, the value of the length rounded to the nearest 0.1 m and the test limit value

2. Propagation delay: Identify the pair with the shortest propagation delay, the value measured in nanoseconds (ns) and the test limit value
 3. Delay Skew: Identify the pair with the largest value for delay skew, the value calculated in nanoseconds (ns) and the test limit value
 4. Insertion Loss (Attenuation): Minimum test results documentation as explained in Section B for the worst pair
 5. Return Loss: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link
 6. NEXT, ACR-F: Minimum test results documentation as explained in Section B for the worst pair combination as measured from each end of the link
 7. PS NEXT and PS ACR-F: Minimum test results documentation as explained in Section B for the worst pair as measured from each end of the link
- F. Between-Link (Between-Channel) Test Results Data
- A test report shall be provided for each disturbed link included in the Alien Crosstalk sample test. This test report must contain
1. PS ANEXT results at each frequency (See Table 1 above) for each wire pair in a victim link as well as the PS ANEXT results for the average of these four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS ANEXT shall be measured and tested from the end of the link or channel where all cables are terminated at a distribution panel. In case the cabling runs from panel to panel (data center) where the worst case PS ANEXT margin is less than 2 dB, the PS ANEXT test results for each disturbed link shall be collected and saved from both ends (both panels) of the disturbed link.
 2. PS AACR-F results at each frequency tested (See Table 1) for each wire pair in a disturbed link as well as the PS AACR-F results for the average of the four wire pairs. The worst case margin and the worst values shall be provided for each wire pair and the average of the four wire pairs. PS AACR-F only needs to be measured and tested from one end of the link or channel. Connect the main DTX-1800 unit (measurement of PS AACR-F disturbance) to the disturbed link or channel at the end where all cabling links are terminated at a distribution panel. Select End 1 in the AxTalk Analyzer Software.

3.06 GENERAL TESTING REQUIREMENTS – FIBER OPTIC BACKBONE CABLES

- A. All multi-mode fiber cable paths shall be tested utilizing a power meter to determine the following:
 1. Loss at both 850 and 1310 nanometers
 2. Cable length
- B. Test shall include fiber termination cassettes modules.
- C. Contractor shall provide results from power meter testing of fiber optic cable to attest to proper polarity and end-to-end performance of the installed fiber.
- D. Contractor shall provide for the Owner's Representative as part of the as-built documentation the factory test results indicating the actual length and the measured end-to-end loss.

END OF SECTION

SECTION 27 1100
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL REQUIREMENT

1.01 SECTION INCLUDES

- A. Construction Requirements
- B. Site Specific Requirements

1.02 RELATED SECTIONS

- A. Section 27 0000 – Communications
- B. Section 27 0005 – Common Work Results for Communications
- C. Section 27 0513 – Communications Services
- D. Section 27 0526 – Grounding and Bonding for Communications Systems
- E. Section 27 0528 – Pathways for Communications Systems
- F. Section 27 0528.29 - Hangers and Supports for Communications Systems
- G. Section 27 0528.33 - Conduits and Backboxes for Communications Systems
- H. Section 27 0528.39 - Surface Raceways for Communications Systems
- I. Section 27 0553 – Identification for Communication Systems
- J. Section 27 0800 – Commissioning of Communications
- K. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures
- L. Section 27 1123 – Communications Cable Management and Ladder Rack
- M. Section 27 1126 – Communications Rack Mounted Power Protection and Power Strips
- N. Section 27 1313 – Communications Copper Backbone Cabling
- O. Section 27 1323 – Communications Optical Fiber Backbone Cabling
- P. Section 27 1513 – Communications Copper Horizontal Cabling

1.03 CONSTRUCTION REQUIREMENTS

- A. This contract is responsible for the build out of the telecommunications spaces to include telecommunications rack(s), Uninterruptable Power Systems (UPS), ladder racking and all required rack and cabinet power distribution emanating from the UPS.

1.04 SITE SPECIFIC REQUIREMENTS

- A. As a part of this project, the Main Equipment Room (ER) and Telecommunications Rooms (TR) will be constructed as shown on the Drawings. This contract will be responsible for procurement and installation of all components from the plywood backboards out, i.e., installation of required racks, ladder tray, bonding and grounding and other ancillary equipment as shown on the Drawings or deemed necessary for the operation of a complete system.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The use of a manufacturer's name and model or catalog number herein is for the purpose of establishing the product set, which the Contractor is to supply and install.
- B. Quantities are to be determined by Contractor unless specified.

2.02 PRE-APPROVED PRODUCT SETS

- A. The following product sets only are approved for this project.
 - 1. Racks, cabinets, enclosures, frames and associated fastening devices
 - a. Chatsworth Products Incorporated (CPI)

PART 3 - EXECUTION

3.01 GENERAL

- A. Manufacturer's installation instructions and requirements shall be strictly adhered to in the telecommunications equipment installation, fabrication and testing process.
- B. Where conflicts arise between the requirements of this Specification and the manufacturer's installation instructions, the Owner's Representative shall be consulted for resolution.
- C. Equipment shall be firmly held in place. Fastenings, supports, and hangers shall be adequate to support their loads. Fasteners are to be a minimum of Grade 5 and constructed of stainless steel or zinc plated steel. In no case will drywall screws be accepted as permanent fasteners.
- D. The installation must conform to OSHA standards and comply with state and local safety codes.
- E. Installation shall be neat, well organized, and professional.
- F. The Contractor shall clean up the work area at the end of each day. At the end of the project all material removed or left over, and/or not being used shall be removed from the project site unless other arrangements have been made. A final clean up shall be made before final payment is made.
- G. All wall and penetrations shall be fire stopped at or before substantial completion.

3.02 PREPARATION

- A. Before commencing work, the Contractor shall field-investigate each facility and ascertain if the physical and electrical conditions within the facility shall permit commencement of the Contractor's work.
- B. Plywood backboards must be painted prior to installation of cabinets or any racking that will bolt to the plywood.
- C. Any discrepancies, questions, or concerns noted at that time should be brought to the immediate attention of the Owner's Representative.

3.03 COMPONENT INSTALLATION

- A. All equipment is to be bonded as per Section 27 0526
- B. Install all telecommunications cabinet and racking materials in accordance with Sections 27 1116 and 27 1123.

END OF SECTION

**SECTION 27 1116
COMMUNICATIONS CABINETS, RACKS, FRAMES AND ENCLOSURES**

PART 1 - GENERAL REQUIREMENT

1.01 WORK INCLUDED

- A. Provide all labor, materials, and equipment for the complete installation of work called for in the Contract Documents.

1.02 SCOPE OF WORK

- A. This section includes the minimum requirements for the equipment and cable installations in telecommunications equipment rooms (MDF/IDF).
- B. Included in this section are the minimum composition requirements and installation methods for the following:
 - 1. Racks and Frames
 - 2. Telecommunications enclosures

1.03 QUALITY ASSURANCE

- A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Owner or Owner Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.
- B. Strictly adhere to all Building Industry Consulting Service International (BICSI) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.
- C. Material and work specified herein shall comply with the applicable requirements of the current adopted revision of the following:
 - 1. ANSI/TIA-568-C Series Commercial Building Telecommunications Cabling Standard,
 - 2. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces,
 - 3. ANSI/TIA-607-B Joint Standard for Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - 4. NFPA 70 – National Electric Code (*NEC*[®])
 - 5. BICSI – Telecommunications Distribution Methods Manual

1.04 SUBMITTALS

- A. Provide Manufacturers cut sheets, specifications and installation instructions for all products .

PART 2 - PRODUCTS

2.01 GENERAL

- A. The Owner desires a single manufacturer for rack and cabinet Products and part numbers specified are from Chatsworth Products Incorporated (CPI). CPI is the only approved product set. All others require substitution request(s) to be submitted. Specific rack criteria:
 - 1. Racks shall be manufactured from aluminum.
 - 2. Each rack will have two L-shaped top angles, two L-shaped base angles and two C-shaped equipment-mounting channels. The rack will assemble with nut and bolt hardware. The base angles will be pre-punched for attachment to the floor.

3. Equipment mounting channels will be punched on the front and rear flange with the EIA-310 Universal Mounting hole pattern.
4. Racks will be threaded with 12-24 roll-formed threads and will include 40 each (minimum) combination pan head, pilot point mounting screws.
5. The rack will include assembly and equipment-mounting hardware.
6. The rack will be rated for 1,000 lb. of equipment
7. The rack will be UL[®] Listed
8. When assembled with top and bottom angles, equipment-mounting channels will be spaced to allow attachment of 19" EIA rack-mount equipment.

2.02 TELECOMMUNICATIONS RACK

- A. Freestanding telecommunications racks shall be installed in the Telecommunications Rooms as per the Drawings.
- B. Rack is to provide 45 rack-mount spaces in a "7 foot rack" for equipment. Each mounting space will be marked and numbered on the mounting channel.
- C. Racks shall be Chatsworth 7' x 19". Part 55053-703
- D. Chatsworth 3" channel rack-to-runway mounting plate with bracket. Part 12730-712
- E. Chatsworth cable runway radius drop, Part 12100-712

2.03 TELECOMMUNICATIONS RACK – FOUR POST

- A. A four-post server racks shall be installed in the Main Telecommunications Equipment Room as per the Drawings.
- B. Racks shall be Chatsworth 7' x 19" x 40" (D), Part 15214-703
- C. Chatsworth Runway Mounting Bracket, Part 15205-701
- D. Chatsworth Equipment Support Rails, Part 15235-706

2.05 LABELING

- A. Telecommunications Racks and Frames
 1. Labeling in the Main Equipment Room and Telecommunications Rooms shall be as per the Drawings. Labels shall be 1" blue laminate with ½ inch white letters. Racks shall be labeled from left to right.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS -

- A. Racks shall be firmly affixed to the floor using anchors and Grade 5 bolts.
- B. Top of rack shall be firmly affixed to ladder tray by means of a mounting plate as detailed in Section 27 1123.
- C. Rack shall be bonded to adjacent assemblies as detailed in Section 27 0526.
- D. All metallic components shall be bonded as per 27 0526.

END OF SECTION

SECTION 27 1119**COMMUNICATIONS TERMINAL BLOCKS AND PATCH PANELS****PART 1 - GENERAL****1.01 GENERAL**

- A. Drawings and general provision of the Contract, including General and other Conditions and other Division 1 – General Requirements sections, apply to the work specified in this section

1.02 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment, including all support structure whether called out for or not, required for the complete installation of work called for in the Contract Documents
- B. Install utility supply and special circuit's cables, riser blocks, patch panels, and all support structure in the Equipment and Telecommunication Rooms as outlined on drawings and specifications.

1.03 SECTION INCLUDES

- A. This Section addresses the termination of copper backbone and station cables which are to be placed between the Main Equipment Room (ER) and the Telecommunications Rooms (TRs) located throughout the building. Included is all equipment and materials required to allow the Telecommunications Rooms to support all associated serving zones and connect it to the main Equipment Room backbone.

1.04 QUALITY ASSURANCE

- A. All equipment shall be installed in a neat and workmanlike manner.
- B. All materials shall be installed per manufacturer's specifications.

PART 2 - PRODUCTS**2.01 GENERAL**

- A. All products must be new and UL Listed for their use.

2.02 PUNCHDOWN BLOCKS

- A. 100 pair 110 type punch down blocks with legs.
- B. 5 pair connecting clips

2.03 PATCH PANELS

- A. 8-pin modular Category 5e 24 or 48 port for access control applications.
- B. 8-pin modular Category 6 (Copper Risers) 24 or 48 port for voice and utility applications.
- C. 8-pin modular Category 6A (Station Cables) 24 or 48 port for data cabling.

PART 3 - EXECUTION**3.01 GENERAL**

- A. All 110 blocks shall be installed as per the detail provided on the Drawings.
- B. All patch panels supporting the copper backbone cabling shall be installed in 7' x 19" equipment racks in the MDF and IDFs unless otherwise noted.

3.02 INSTALLATION

- A. 110 blocks shall be labeled as per criteria provided on Drawings and Section 27 0553
- B. A one RMU horizontal wire management panel shall be installed at the top of each rack used for copper backbone cables. Additional horizontal wire management shall be installed at a rate of one RMU per each 24 port panel installed.

3.03 PATCH PANELS

- A. Patch Panels shall be installed in equipment racks.
- B. Patch panels shall be installed per manufacturer's instruction and as indicated in drawings and specifications.

END OF SECTION

**SECTION 27 1123
COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK**

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents
- B. Install ladder racks, cable trays, and all support structure in the Equipment and Telecommunication Rooms as outlined on drawings and specifications.
- C. Equipment installed shall include:
 - 1. ladder trays,
 - 2. vertical cable management,
 - 3. brackets and support pieces, and
 - 4. All related materials required to provide cable management and transition pathways within the Equipment and Telecommunications Rooms of this project.
- D. Material listed in this section is for use within the telecommunications rooms. See section 27 0528.36 for cable tray in non-telecommunications room spaces.

1.02 RELATED SECTIONS

- A. Section 27 1100 – Communications Equipment Room Fittings
- B. Section 27 1116 – Communications Cabinets, Racks, Frames and Enclosures

1.03 QUALITY ASSURANCE

- A. All equipment shall be installed in a neat and workmanlike manner.
- B. All materials shall be installed per standard installation practices and manufacturer's specifications.

1.04 SEISMIC CONSIDERATIONS

- A. All equipment must meet or exceed the requirements of Seismic Zone 3 and satisfy the AHJ for suitable components.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Chatsworth Products Incorporated (CPI) is the approved for the products listed in this Section.
- B. Attachment hardware not supplied in kits from manufacturer shall be Grade 5 or greater.

2.02 CHANNEL RACK-TO-RUNWAY

- A. Use a Channel Rack-to-Runway Mounting Plate Kit to securely attach channel rack tray to equipment rack. A kit from Chatsworth includes all necessary bolts, washers, and nuts to make the attachments. CPI Part 12730-7xx

2.03 HORIZONTAL WIRE MANAGEMENT

- A. Horizontal cabling managers shall be used to organize and contain patch cord runs from patch port to vertical cable wire management. Manufacturer to be same as structured cabling system.
- B. Double (3.5') RMU units only are acceptable and are to be supplied at the rate of 1 RMU per each 24 ports of patch panel.

2.04 VERTICAL CABLE MANAGEMENT

- A. Vertical cable managers shall be installed as per Drawings.
- B. The cable manager shall be sized to match cabling requirements. The initial quantity of cables within the cable manager shall not exceed a whole number value equal to 40% of the interior area of the cable manager.
- C. Epoxy-polyester hybrid powder coat finish, black in color.
- D. Vertical cable management panels shall have front and rear channels, with covers.
- E. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.
- F. Double-sided 3.65-inch wide by 84-inches tall. Chatsworth Products Inc., 12096-703.
- G. Double-sided 6-inch wide by 84-inches tall. Chatsworth Products Inc., 11729-703.

2.05 EQUIPMENT SHELF

- A. Provide equipment shelf, CPI 40074-700 at the rate of one per 4 post rack. Deliver in unopened carton to Owner.

2.06 LADDER RACK, SUPPORTS, AND ACCESSORIES

- A. The ladder rack shall be 12" or 18" wide universal cable runway as shown on the drawings. CPI 10250-712 or CPI 10250-718 Ladder Rack (Universal Cable Runway)
 - 1. Ladder rack shall be manufactured from 3/8-inch wide by 1-1/2-inches high tubular steel with .065-inch wall thickness.
 - 2. Ladder rack (side stringers) will be 9-foot-11½-inches long. Cross members will be welded in between stringers on 12-inches intervals/centers beginning 5-3/4-inches from one end so that there are 10 cross members per ladder rack. There will be 10-1/2-inches of open space in between each cross member.
 - 3. Ladder rack will be UL® Classified for suitability as an equipment grounding conductor only (the installer must remove paint or use ground straps at splices and intersections)
 - 4. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below.
- B. Horizontal 90° Turns (Cable Runway E-Bend)
 - 1. Horizontal 90° turns shall be manufactured from 3/8 wide by 1 1/2-inches high tubular steel with .065-inches wall thickness.
 - 2. Stringers (sides) will be formed in a 90° arc. Cross members will be welded in between stringers on approximate 23° increments so that there are 5 cross members per turn. The welded assembly will have a 15-inches inside radius and will create a smooth horizontal 90° turn.
 - 3. Horizontal 90° turns will be available in the width(s) specified below.
 - 4. Black finish
- C. Vertical-To-Horizontal 90° Turns (Cable Runway Outside Radius Bend)
 - 1. Vertical-to-horizontal 90° turns shall be manufactured from 3/8-inch wide by 1-1/2-inches high tubular steel with .065-inch wall thickness.
 - 2. Stringers (sides) will be formed in a 90° arc with a 12-1/2-inches outside radius. Cross members will be welded in between stringers on approximate 23° increments so that there are 3 cross members per turn. The welded assembly will create a smooth 90° vertical-to-horizontal turn.
 - 3. Vertical-to-horizontal 90° turns will be available in width(s) specified below.
 - 4. Black finish
- D. Horizontal-To-Vertical 90° Turns (Cable Runway Inside Radius Bend)
 - 1. Horizontal-to-vertical 90° turns shall be manufactured from 3/8-inch wide by 1-1/2-inches high tubular steel with .065-inch wall thickness.

COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

2. Stringers (sides) will be formed in a 90° arc with a 12-1/2-inches outside radius. Cross members will be welded in between stringers on approximate 23° increments so that there are 3 cross members per turn. The welded assembly will create a smooth 90° horizontal-to-vertical turn.
 3. Horizontal-to-vertical 90° turns will be available in the width(s) specified below.
- E. Corner Brackets (Cable Runway Corner Bracket)
1. Corner brackets shall be manufactured from 3/8-inch wide by 1-1/2-inches high tubular steel with .065-inch wall thickness.
 2. The inside stringers of the corner bracket will be formed at 90° with a small chamfer at the vertex. The outside stringer of the corner bracket will be formed in a 90° arc that is either 15-inches or 24-inches in radius. A single cross member will connect the chamfered portion of the inside stringer to the outside stringer. The welded assembly will create a smooth 90° turn within the L-shaped corner created by two intersecting ladder racks.
 3. Corner brackets will be available in the size(s) specified below. Installation hardware will be included with the corner bracket. Corner bracket installation hardware does not include the junction splice kit required to form the L-shaped intersection between two ladder racks.
- F. Ladder Rack Splices
1. Splice kits will provide a method of mechanically connecting ladder rack sections and turns together end-to-end or side-to-end to form a continuous pathway for cables.
 2. Grounding kits will provide a method of bonding ladder rack sections and turns together that is independent of the pathway splices. The grounding kit should be constructed of UL® Listed components. The preferred solution is a #6 AWG green insulated stranded copper conductor connected on both ends to ladder rack using two-hole compression lugs and stainless steel hardware.
 3. Splices (splice plates) will be manufactured from steel. Splice, grounding and insulator bar kits will include installation hardware.
 4. Finish (of splice plates and hardware) shall be zinc plate in the color(s) specified below. Colors are applied as a chemical film over the zinc plate.
 5. Manufacturer: Chatsworth Products, Inc. (CPI), Cable Runway Splices:
 - a. Part Number 11301-701, Butt-Splice Kit, Black. Compression splice for end-to-end connections.
 - b. Part Number 11302-701, Junction-Splice Kit, Black. Compression splice for T- or L-connections.
- G. Ladder Rack Supports
1. Supports will be sized to match the width of the ladder rack that is supported. Some supports will work with multiple or all widths of ladder rack.
 2. Each support will include a means of mechanically securing ladder rack to the support.
 3. Supports will be manufactured from steel or aluminum.
 4. Finish shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below or zinc plate with a gold chem. finish specified gold. Included hardware shall be zinc plated with a gold chem. finish.
 5. Manufacturer: Chatsworth Products, Inc. (CPI), Cable Runway Supports:
 - a. Part Number 11421-712, Wall Angle Support Kit, For 12-inches Wide Cable Runway (Ladder Rack), Steel, Black.

COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

- b. Part Number 10595-712, Rack-To-Runway Mounting Plate, for 9-inches to 12-inches Wide Cable Runway (Ladder Rack), for Standard and Universal Racks with 3-inches Deep Equipment Mounting Channels, Steel, Black. NOTE: Rack-To-Runway Mounting Plate attaches cable runway to the top of 2-post freestanding racks in parallel or perpendicular orientation. Includes J-bolt installation hardware for 1-1/2-inches High cable runway and rack top angles. CPI recommends use with Cable Runway Elevation Kit.

H. Ladder Rack Accessories

1. Cable straps used for attaching cable bundles to the ladder rack cross members must be reusable with a hook and loop-style closure, at least 3/4-inch wide, and sized for cable bundles that are 2-inches, 3-inches or 4-inches in diameter.
2. Cable retaining posts used to keep cable from falling off of the side of the ladder rack shall be manufactured from 1-inch by 1/2-inch tubular steel with .065-inch wall thickness. Cable retaining posts will be 8-inches high and will attach to the side stringer of the ladder rack with included hardware. The top of the cable retaining posts will be fitted with a rubberized end cap to protect cables.
3. End caps used to cover the ends of ladder rack will be manufactured from a black fire-retardant rubberized material. End caps will be sized for 3/8-inch wide by 1-1/2 -inches high side stringers and will be sold in pairs.
4. End closing kits used to cover the end of ladder rack will be manufactured from 3/8-inch wide by 1-1/2- inches high tubular steel with .065-inch wall thickness. Kits will consist of a bar cut to match the width of the ladder rack and the hardware required to attach the bar to the end of a length of ladder rack.
5. Radius drops used to create a radius to form cables over as the cables exit or enter the ladder rack will be manufactured from aluminum extrusion. The extrusion will be formed in a 90° arc with a minimum bend radius of 3-inches. Radius drops will attach to either the side stringer or the cross member of the ladder rack using a clevis pin. Radius drops will include 1 1/2-inch high cable spools that attach to the top of the radius drop to guide cables.
6. Movable cross members used to support cross member radius drops in between welded cross members on ladder rack will be manufactured from 3/8-inch by 1-1/2-inches aluminum bar. Movable cross members will attach to ladder rack at the side stringers with included hardware so that the location of the movable cross member can be adjusted. Moveable cross member will support a cross member radius drop.
7. Cable spools used to separate ladder rack into multiple cable pathways will be made from a black flame retardant ABS. Cable spools will attach to the cross members with a clip that allows the width of the ladder rack to be divided into any proportion. The spools will be 3.94-inches tall, with a 1.94-inches diameter top cap, and a body that tapers from .88-inch diameter at the top to .62-inch diameter at the bottom.
8. Auxiliary support brackets used to support cables that should be physically separated from the cables in the ladder rack will be made from 1/8-inch by 1-inch steel bar. The bracket will be L-shaped and will attach to the side stringer of the ladder rack. The bracket will hang below the ladder rack a minimum of 4-inches. The bracket support surface will be 4-inches long. The bracket will be zinc plated with a gold chem. finish.
9. Touch-up paint used on ladder rack and ladder rack system components will be color-matched to the finish on the ladder rack or component. A spray on and brush on option will be available.

COMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

10. Unless otherwise noted, finish on all metal components shall be epoxy-polyester hybrid powder coat (paint) in the color(s) specified below. Hardware will be zinc plated with a gold chem. finish.
11. Manufacturer: Chatsworth Products, Inc. (CPI), Cable Runway Accessories:
 - a. Part Number 10596-706, Cable Retaining Post, 6-inches High, Black.
 - b. Part Number 10642-001, Cable Runway Protective End Caps, 1 Pair, Black.
- I. Grounding straps shall be CPI 40164-001 (available in lots of 25 each as CPI 40164-025)

2.07 CHANNEL RACK-TO-RUNWAY

- A. Use a Channel Rack-to-Runway Mounting Plate Kit to securely attach 12" wide cable tray to equipment rack. A kit from Chatsworth includes all necessary bolts, washers, and nuts to make the attachments. CPI Part 12730-712
- G. Grounding straps shall be CPI 40164-001 (available in lots of 25 each as CPI 40164-025)

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Equipment Racks
 1. Equipment racks shall be equipped with a mounting plate suitable for securing a 12-inch width cable tray from the rack to the backboard.
 2. A two RMU horizontal wire management panel shall be installed at the top of the rack. Additional horizontal wire management shall be installed as described above.
 3. Bolts used to attach the rack to the floor shall be stainless steel or zinc coated steel. Fasteners shall be Grade 5 or higher
- B. Cable Tray
 1. The cable tray shall be installed as per Drawings to support cable runs from equipment rack to wall connections.
 2. Appropriate vertical wall brackets, support brackets, and splice kits are to be used when securing the runway.
- C. All racks and associated components shall be grounded in accordance with ANSI/TIA-607-B, National Electric Code[®], and the Authority Having Jurisdiction.
- D. This contract is responsible for satisfying all requirements pertaining to seismic compliance. All inspections or engineering associated with seismic compliance shall be included in this contract at no additional cost to the Owner.

END OF SECTION

SECTION 27 1126**COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS****PART 1 - GENERAL REQUIREMENT****1.01 DESCRIPTION OF WORK**

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.
- B. Install Uninterruptable Power System (UPS) as per documents and Drawings.
- C. Provide and install power distribution as per documents and Drawings.
- D. Install network management card(s) and verify connectivity to Owner's network.

1.02 QUALITY ASSURANCE

- A. All equipment shall be installed in a neat and workmanlike manner.
- B. All materials shall be installed per standard installation practices and manufacturer's specifications.

PART 2 - PRODUCTS**2.01 GENERAL**

- A. Quantities are to be as called out on Drawings.
- B. All products must be new and UL Listed for their use.
- C. Liebert and Emerson are synonymous in this in this Section.

2.02 UNINTERRUPTABLE POWER SYSTEMS

- A. 2200VA UPS – Approved are:
 - 1. APC Smart-UPS RT 2200VA - Rack Mounted 120V, APC Part Number SURTA2200RML2U.
 - 2. Liebert GXT3 1500VA/1350kW – Rack Mounted 120V, Liebert Part Number GXT3-2000RT120.
- B. 3000VA UPS - Approved are:
 - 1. APC Smart-UPS RT 3000VA - Rack Tower 120V, APC Part Number SURTA3000RML3U
 - 2. Liebert GXT3 3000VA/2700kW – Rack Tower 120V, Liebert Part Number GXT3-3000RT120.
- C. 5000VA UPS – Approved are:
 - 1. APC Smart-UPS RT 5000VA RM 208V to 208/120V, APC Part Number SUA5000R5TXFMR.
 - 2. Liebert GXT3 5000VA/4000kW – Rack Tower 208V to 120/208V, Liebert Part Number GXT3-5000RT208. Power Distribution Box PD2-101 must be included if this UPS is selected.

2.03. ENVIRONMENTAL MONITORING AND NETWORK INTERFACE MODULE

- A. All UPS units will be equipped with a network management card with environmental monitoring. Approved are:
 - 1. APC Part Number AP9631.
 - 2. Liebert IntelliSlot Webcard Part Number IS-WEBCARD

2.04 POWER DISTRIBUTION UNITS

- A. One per rack in all Telecommunications Rooms. - Approved are:
 - 1. Rack PDU, Basic, Zero U, 15A, (14) 5-15, APC Part Number AP9567
 - 2. Rack PDU, Knurr DI Strip, 15A, (12) 5-15, Part Number 035351021

COMMUNICATIONS RACK MOUNTED POWER PROTECTION AND POWER STRIPS

PART 3 - EXECUTION**3.01 GENERAL**

- A. Follow manufacturer's instruction in terms of moving and mounting. These units will, in all likelihood, require two people to safely mount into the prescribed racks/cabinets.
- B. Bond all TVSS components as per manufacturer's instruction.
- C. Units are to be powered on and batteries fully charges prior to any load testing whatsoever including the energizing of Owner supplied active electronics.

3.02 INSTALLATION

- A. 2000/2200VA
 - 1. UPS to be installed in lowest position of rack in IDF.3.
 - 2. UPS is to be installed in the north rack in IDF.2.
 - 3. UPS to be installed in the lowest position of the wall mounted cabinets.
 - a. The input for the UPS 120 Volt, 20 amps and requires a NEMA 5-20 receptacle.
 - 4. Rack PDU – install one on each side on rear rails with supplied brackets in the rack allocated to Owner Supplied / Active Electronics. Energize from UPS.
 - 5. Network Management Card – install in each UPS. Connect to designated port on District supplied Ethernet switch. Verify link light on card.
- B. 3000VA
 - 1. UPS is to be placed in the bottom most position of the south 2-post rack in the IDF.2.
 - 2. UPS is to be placed above the 5000VA UPS in the four-post rack in the MDF.1.
 - 3.
 - a. The input for the UPS 120 Volt, 30 amps and requires a NEMA L5-30 receptacle. This Contract is responsible for and must coordinate with Electrician for placement of this receptacle.
 - 4. Rack PDU – install one on each side on rear rails with supplied brackets in the rack allocated to Owner Supplied / Active Electronics. Energize from UPS
 - 5. Route network interface cable and output power cables in overhead ladder tray.
 - 6. Network Management Card – install in each UPS. Connect to designated port on District supplied Ethernet switch. Verify link light on card.
- C. 5000VA
 - 1. UPS is to be placed in the bottom most position of the four-post rack in the Main Equipment Room (MDF.1).
 - a. The input power for these units is 208/240 Volt. The APC comes with an 8 foot power cord and requires a NEMA L6-30R receptacle. The Liebert unit is designed to be hard wired. This contract is responsible for selection of the proper method of power to match the unit selected. This contact must coordinate with electrician for placement of receptacle or in the case of hard wire, coordinate the 208/240 Volt connection.
 - 2. Rack PDU – spaced across the rear of the racks with supplied brackets in the rack(s) allocated to Owner Supplied / Active Electronics. Energize from UPS.
 - 3. Route network interface cable and output power cables in overhead ladder tray.
 - 4. Network Management Card – install in UPS. Connect to designated port on District supplied Ethernet switch. Verify link light on card.

END OF SECTION

**SECTION 27 1313
COPPER BACKBONE CABLING**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.02 SCOPE

- A. This section includes the copper backbone cable and the termination requirements.
- B. Multi-pair copper cables shall be installed between the Main Equipment Room (MDF.1) and each Telecommunications Room (IDF.2 & IDF.3). Cables shall be terminated on 110 blocks and extended to category 6 rack mounted 24-port patch panels.

1.03 QUALITY ASSURANCE

- A. See Section 27 0513
- B. All cable shall be installed in a neat and workmanlike manner.

PART 2 - PRODUCTS

2.01 UTILITY SUPPLY CABLE

- A. The utility supply cable shall be six, category 6, 4-pair unshielded twisted pair cables.
- B. The cable shall be 24 AWG with a jacket rated for installation in under-slab ducts.

2.02 PATCH PANEL

- A. Utility Supply, 24 port panel, rated for Category 6.

2.03 110 BLOCKS

- A. 100 pair with legs utilizing C-4 clips

PART 3 - EXECUTION

3.01 GENERAL

- A. Cable ties must be finger tight. The cable tie must not distort the outer jacket.
- B. The bend radius shall be no less than 10 times the outside cable jacket.
- C. Only Velcro®-type wraps shall be used to bundle cables on the back of the equipment racks and in the cable trays located in the Telecommunication and Equipment Rooms.

3.02 PREPARATION

- A. Conduits
 - 1. All conduits and sleeves shall be inspected for bushings prior to cable installation. Missing bushings shall be brought to the attention of the Owner.

3.03 INSTALLATION

- A. Copper Riser Cable
 - 1. Cables shall be installed between punch down blocks in the Main Equipment Room (MDF) and Telecommunications Rooms (IDFs).
 - 2. The punch down side of the cable shall be terminated 110 blocks with C-4 clips. 110 blocks are to be placed on the telecommunications backboard in the main equipment room as per the drawings.
 - 3. 24 port utility supply patch panels shall be placed as per the Drawings in each of the Telecommunications Rooms.
 - a. Provide (1) in the MDF and (1) in each of the IDFs.
 - 4. Place six cables from the 110 block in each room to the patch panel. Terminate one pair per port.
- B. Label 110 blocks and patch panels "UTILITY FEED TO IDF-x", where X = IDF Number, specifically "IDF-1", "IDF-2" or "IDF-3".

END OF SECTION

**SECTION 27 1323
COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING**

PART 1 - GENERAL REQUIREMENT

1.01 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.02 SCOPE

- A. This section includes the fiber backbone cable and the termination requirements.

1.03 QUALITY ASSURANCE

- A. See Section 27 0513
- B. All cable shall be installed in a neat and workmanlike manner.

PART 2 - PRODUCTS

2.01 FIBER OPTIC CABLE

- A. Multimode fiber shall be 50/125µm Laser Optimized multimode (OM3). Strand count shall be as per Drawings. Rating shall be suitable for applications with a minimum rating of OFNR. Factory terminated, pre-connectorized assemblies are preferred.
- B. Singlemode fiber shall be 9/125µm (OS2). Strand count shall be as per drawings. Rating shall be suitable for applications with a minimum rating of OFNR.
- C. Fiber assemblies shall roll within the wall as per ANSI/TIA-568-C.3, Type-C. The final fiber sequence will be as follows:

End	Fiber sequence for multimode fiber(delivered at the LC connector)											
MDF	1	2	3	4	5	6	7	8	9	10	11	12
IDF	2	1	4	3	6	5	8	7	10	9	12	11

2.03 READER BOARD FIBER

- A. This contract will place a four-strand multimode fiber between the MDF and the Reader Board. Fiber will be placed using a two-cell Maxcell innerduct. A Trade Size 2 conduit will be installed by others as a pathway for the fiber and innerduct.

2.04 FIBER OPTIC TERMINATION

- A. Fiber termination equipment will be:
 1. 2U frame. Approved is Panduit part number FRME2U. Place one in each IDF and in the MDF.
 2. Fiber shall terminate on LC fiber adapter panels. Approved is Panduit part number FAP6WAQDLCZ. Quantities as required
 3. Blank panels shall be used to cover all unused openings in the frames. Approved is Panduit part number FAPB.
 4. Reader board fiber will be terminated as follows:
 - a) Terminate fiber using duplex LC connector modules. Approved is Panduit part number CMDJAQLCZBL.
 - b) Place fiber modules in surface mount box. Approved is Panduit UICBX4IW-A.

PART 3 - EXECUTION

3.01 GENERAL

- A. Cable ties must be finger tight. The cable tie must not distort the outer jacket.
- B. The bend radius shall be no less than 10 times the outside cable jacket.
- C. Only Velcro®-type tie wraps shall be used to bundle cables on the back of the equipment racks and in the cable trays located in the Telecommunication and Equipment Rooms.

3.02 PREPARATION

- A. Conduits - all conduits shall be inspected for bushings prior to cable installation.

3.03 INSTALLATION

- A. Install per manufacturer's instructions.
- B. Install the fiber optic cable by hand or by using a mechanical pulling machine. If a mechanical pulling machine is used, equip the machine with a monitored or recording tension meter. Ensure that at no time the manufacturer's recommended maximum pulling tension is exceeded. Ensure that the central strength member and aramid yarn are attached directly to the pulling eye during cable pulling. Use pulling attachments, such as "basket grip" or "Chinese finger" type, to ensure that the optical and mechanical characteristics are not degraded during the fiber optic cable installation.
- C. Ensure that excess cable is coiled in a figure eight and fed manually when pulling through pull boxes and splice boxes by hand. If pulleys and sheaves will be used to mechanically pull through pull boxes and splice boxes, provide a drawing of the proposed layout showing that the cable will never be pulled through a radius less than the manufacturer's minimum bend radius. Use large diameter wheels, pulling sheaves, and cable guides to maintain the appropriate bend radius. Provide tension monitoring at all times during the pulling operation. Ensure that cable pulling lubricant used during installation is recommended by the optical fiber cable manufacturer.
- D. Label fiber patch panels in the MDF as: "Feed to IDF-x", where x = IDF number
- E. Label fiber patch panels in the IDF as "Feed from MDF"
- F. Coordinate placement of fiber within the Reader Board with General Contractor.
- G. Place Reader Board surface mount box on backboard in MDF. Provide a 20' slack coil of fiber. Label fiber and mounting box as "READER BOARD".

END OF SECTION

**SECTION 27 1513
COMMUNICATIONS COPPER HORIZONTAL CABLING**

PART 1 - GENERAL REQUIREMENT

1.01 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.
- B. Install horizontal cable as outlined on drawings and specifications. Also included is sleeves for any ceiling or wall penetrations not provided by the General or Electrical Contractor; fire stopping as directed by the most stringent of these specifications or code; and all support structure needed to install the above components.
- C. Verify actual counts on prints and drop detail.

1.02 SCOPE OF WORK

- A. It is the intent of this section for the Contractor to provide a complete workable cabling system ready for the Owner's use in accordance with the latest current version of ANSI/TIA-568 standards to support high speed data applications up to 10Gbs including IEEE 802.3x system standards.

1.03 QUALITY ASSURANCE

- A. All cable shall be installed in a neat and workmanlike manner.
- B. Strictly adhere to all category 6A installation practices when installing horizontal cabling.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Refer to Section 27 0513 for General Requirements.
- B. The horizontal UTP cabling system shall be a Category 6A warranted link system, including the patch cords, patch panels, cables, and telecommunications outlets.

2.02 COPPER CABLE

- A. The horizontal copper cable supporting all locations except as noted on Drawings, shall be 4-Pair balanced twisted pair rated for category 6A. Color to be dark blue.
- B. Cable supporting locations identified as Wireless Access points (WAP) and so noted as a circled "W" on the Drawings, shall be 4-Pair balanced twisted pair rated for category 6A. Color to be yellow.
- C. Cable supporting locations identified as Cameras and so noted on the drawings, shall be 4-Pair balance twisted pair rated for category 6A. Color to be purple.
- D. Cable called out as category 5e shall be shall be 4-Pair balanced twisted pair. Jacket shall be white in color.
- E. Backbone cable shall be 4-Pair balanced twisted pair rated for category 6. Jacket shall be rated for wet locations and black in color.

PART 3 - EXECUTION

3.01 GENERAL

- A. Cable ties must be finger tight. The cable tie must not distort the outer jacket.
- B. The bend radius shall be no less than 4 times the outside cable jacket diameter for the horizontal UTP cable and 10 times the outside cable jacket diameter for both the fiber and multi-pair copper riser cable.
- C. Only Velcro® (hook and loop) type cable wraps shall be used to bundle cables on the back of the equipment racks and in the cable trays located in the Telecommunication and Rooms.

3.02 PREPARATION

A. Conduits

1. All conduits and sleeves shall be inspected for bushings prior to cable installation.
2. Missing bushings shall be brought to the attention of the owner or authorized representative.

3.03 INSTALLATION

A. Copper Horizontal Cables

1. Installation shall be in a manner to meet the specifications as outlined by the cable manufacturer for the product set being installed.
2. Copper horizontal cables shall be pulled from the TR to the workstation.
3. Service loops of
 - a. 10 feet minimum shall be left coiled high as high as possible in the MDF or IDF.
 - b. 10 feet of slack shall be neatly coiled and secured with Velcro[®] at the telecommunications outlet (typically in the ceiling) used for Wireless Access points
 - c. Placement of service loops subject to verification by Owner.
4. Location and label shall be annotated on the as built drawings.
5. Locations coiled for wireless shall have 1/2" black on white labels placed below the outlet on the ceiling grid.

END OF SECTION

COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 - GENERAL REQUIREMENT

1.01 GENERAL

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.02 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.03 QUALITY ASSURANCE

- A. See Section 27 0513
- B. All faceplates shall be installed in a neat and workmanlike manner.

PART 2 - PRODUCTS

2.01 OUTLET FACEPLATE

- A. Standard Telecommunications Outlet shall be a four port faceplate with three 8 pin modular jacks and one blank insert. Color shall be gray.
- B. Exceptions (as shown on Drawings) will require differing count/port faceplate and 8 pin modular jacks.

2.02 TERMINATION – WAP

- A. Termination for cables supporting WAPs is to be made using a white category jack. Each WAP location shall be two cables placed in a white, two port biscuit box.
- B. Termination shall provide a 20 foot slack loop to be coiled and secured with Velcro®. Biscuit box shall be affixed to structure.

2.03 OUTLET JACK

- A. The termination jack for the standard connections shall be an 8-pin (4 pair) modular jack T568A rated for category 6A. Jacks shall be different colors and installed as follows:
 - a. Upper left – black
 - b. Upper right – gray
 - c. Lower left – gray
 - d. Lower left - blank

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install faceplates as per manufacturer's instructions. Care must be taken to provide a plumb and level appearance.
- B. WAP locations shall be labeled on the dropped ceiling or wall in a manner that is clearly visible ($\frac{1}{2}$ " black on white label) and allows Owner to quickly determine which ceiling panel covers the WAP.

END OF SECTION

**SECTION 27 1619
COMMUNICATIONS PATCH CORDS AND STATION CORDS**

PART 1 - GENERAL REQUIREMENT

1.01 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.02 QUALITY ASSURANCE

- A. See Section 27 0513

PART 2 - PRODUCTS

2.01 FIBER PATCH CORDS - MULTIMODE

- A. The Contractor shall supply the fiber-optic patch cords in the quantities listed. Each patch cord shall be a duplex LC connector to duplex LC connector. The patch cords shall be made from Laser Optimized (OM4) 50/125µm multimode fiber and shall be aqua in color.

Length	1M	2M	3M
Quantity	4	5	4

2.02 COPPER PATCH CORDS

- A. The Contractor shall supply the patch cords in the quantities listed. Each patch cord is a stranded 8-pin modular plug to an 8-pin modular plug cable. The sheath and boot shall be gray in color and rated category 6

Length	3'	5'	7'	10'	14'	25'
Quantity	40	100	90	50	10	10

2.04 WAP PATCH CORDS

- A. The Contractor shall supply the patch cords in the quantities listed. Each patch cord is a stranded 8-pin modular plug to an 8-pin modular plug cable. The sheath and boot shall be yellow in color and rated category 6A

Length	1'	3'	5'	7'
Quantity	35	15	15	12

2.05 VOIP PATCH CORDS

- A. The Contractor shall supply the patch cords in the quantities listed. Each patch cord is a stranded 8-pin modular plug to an 8-pin modular plug cable. The sheath and boot shall be black in color and rated category 6A

Length	3'	5'	7'	10'	14'	25'
Quantity	20	20	30	10	10	5

PART 3 - EXECUTION

3.01 GENERAL

- A. Deliver all patch cords in sealed cartons to Owner. Coordinate with Owner for delivery schedule and locations.

END OF SECTION

**SECTION 27 2133
WIRELESS ACCESS POINTS**

PART 1 - GENERAL REQUIREMENT

1.01 WORK INCLUDED

- A. Provide all labor, specified material, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.02 QUALITY ASSURANCE

- A. See Section 27 0513

PART 2 - PRODUCTS

2.01 WIRELESS ACCESS POINTS

- A. Owner shall supply and contractor shall install Wireless Access Points (WAP).
- B. Mounting brackets shall be Owner supplied as a component of the WAP

PART 3 - EXECUTION

3.01 GENERAL

- A. WAPs are to be installed after the cable system has been tested and certified.
- B. Contractor shall install WAPS in the locations as shown on the Drawings. WAPS are to be mounted horizontal wherein at all possible.
- C. WAPS will be labeled by Owner prior to installation and Owner will provide a matrix indicating which WAP is to be placed in a corresponding location so identified in the building.
- D. Contractor shall mount WAP and connect it to the category 6A plug.
- E. Contractor shall validate WAP number and include on as-built drawings.
- F. WAP locations shall be labeled on the ceiling grid where outlet is installed above drop in ceiling tile.

END OF SECTION

CLASSROOM AUDIO SYSTEMS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This project will include design and installation of classroom A/V Systems. Components may be those currently installed, furnished by this contract or Owner Furnished, Contractor Installed as specified or as shown on Drawings.

1.02 RELATED SECTIONS

- A. Section 27 0000 – Communications
- B. Section 27 0500 – Common Work Results for Communications
- C. Section 27 0513 – Communications Services
- D. Section 27 0526 – Grounding and Bonding for Communications Systems
- E. Section 27 0528 – Pathways for Communications Systems
- F. Section 27 0528.29 – Hangers and Support for Communications Systems
- G. Section 27 0528.33 – Conduits and Backboxes for Communications Systems
- H. Section 27 0528.39 – Surface Raceways for Communications Systems
- I. Section 27 0800 – Commissioning of Communications

1.03 CLASSROOM AUDIO PRODUCT CONTACT

- A. Classroom audio (sound reinforcement) components shall be;
 - a. LightSPEED Technologies.
 - b. AMX ResQ

1.04 CLASSROOM AUDIO CABLING

- A. Cables shall terminate in the classroom audio faceplate, as shown on drawings.

1.05 CABLE RACEWAYS

- A. All raceway routing and mounting height information shall be coordinated with the Electrical and Architectural Drawings.

1.06 VIDEO PROJECTOR SYSTEMS

- A. Classroom Projectors – Owner Furnished, Contractor Installed.
- B. Classroom Projector Mounts – furnished as a part of a kit with projector
- C. Classroom AV Cabling, Contractor Furnished Contractor Installed.

1.07 SYSTEM CONTROL

- D. The operation shall be automated through the Owner provided classroom computer and projector remote control and shall not, typically, require adjustments or user intervention.
- E. Audio Visual Playback – System shall be capable of playing DVD/PC based media, from Owner provided source equipment.

PART 2 - PRODUCTS

2.01 PROJECTOR MOUNTS AND INSTALLATION

- A. Contractor is to install Owner Furnished Smart 60IW short throw projector, in locations as called out on Drawings. This is a kit and includes the mounting bracket. Part number is SB-SLR60WI.
- B. Contractor is to install Owner Furnished LCD displays and Owner Furnished wall mount kits, in locations as called out on Drawings.

2.02 PROJECTOR VIDEO CABLING

- A. Install video cable as shown on the Drawings. Field verify final placement.
- B. Contractor is to provide and install one Quiktron Rapid run cable # 42138-050 at each projector or LCD TV.
- C. Contractor is to provide and install one Quiktron Rapid run cable # 42404-050 at each projector or LCD TV.
- D. Provide one Quiktron Wallplate # 42423-001 at each presenter and projector or LCD TV locations indicated on the drawings.
- E. Provide one Quiktron Wallplate # 42335-001 at each presenter and projector or LCD TV locations indicated on the drawings.

2.03 SOUND REINFORCEMENT UNITS

- A. Every classroom will receive a sound reinforcement system. Units will be LightSPEED CAT 955IR, or AMX ResQ or approved equivalent. All systems will include paging override option.
 - 1. Systems are to be placed as per drawings. Provide ceiling mounted IR sensors at the rate of one per 1000 sq/ft or smaller classroom and at the rate of two per 1001 sq/ft or larger classroom.
 - i. Contractor shall work with manufacture to determine optimal placement of IR sensors to avoid interference from other IR microphone sources outside the classroom
 - 2. Ceiling mount speakers are to be placed as per drawings. Bogen CSD2X2, Lightspeed DRQ or approved.
 - 3. Wall mount speakers are to be placed as per drawings. Bogen MB8SQ, Lightspeed WMQ or approved.
 - 4. Include power supply, and cables for sensor and speakers.
 - 5. Provide, two volume control lanyard microphones, with batteries and charger.
 - 6. Provide stereo RCA connections between the projector and the sound reinforcement system.

2.04 USB CONNECTIONS

- A. Provide USB 2.0 connectivity between the presenter location and the projector.

2.05 PATCH CORDS

- A. Provide the following patch cords:

- 1. USB Patch Cords

Length	3'
Quantity	27

- 2. RCA Stereo Audio Patch Cords (Red/White connector)

Length	7'
Quantity	27

- 3. HDMI Patch Cords

Length	3'	7'
Quantity	30	30

PART 3 - EXECUTION

3.06 GENERAL

- A. A complete system shall be installed in strict accordance with manufacturer's recommendations.
- B. All wiring shall be installed in raceways within walls where at all possible. Surface mounted raceway is not permitted.
- C. All wiring shall be plenum rated, where routed through plenum ceiling areas.

3.07 CERTIFIED INSTALLATION CONTRACTOR REQUIREMENT

- A. All new LightSPEED an AMX components must be installed by a certified contractor to preserve factory warranty.

3.08 CABLE PLACEMENT AND PATHWAYS

- A. All cables must be completely enclosed (or above the dropped ceiling where applicable) except for the patch cables that transition between the Quiktron faceplate and the projector.
- B. Cables may be run in the area above the dropped ceiling. In such areas, cables are to be supported by Caddy[®] fasteners / hangers at intervals not exceeding 48 inches. Extra slack shall not be "stored" exposed at the projector.

3.09 INSPECTION AND TEST UPON COMPLETION

- A. Check-out and final connections to the Audio and video systems shall be made by a factory trained technician certified by the manufacturer of the products installed. In addition, factory trained technicians shall demonstrate operation of the complete system and each major component to the Owner.
- B. System field wiring diagrams shall be provided to this subcontractor by the system manufacturer prior to installation.
- C. Training – this contract shall provide training for not less than three District staff members. Training will include all aspects of the system as well as complete documentation covering all components requiring operator control or intervention.

3.10 SYSTEM DOCUMENTATION AND AS-BUILTS

- A. Contractor shall provide a complete set of system documentation bound into a three-ring manual with a table of contents and tabs for each piece of equipment. As-built documentation shall be generated in AutoCAD[®] version 2010 or later and provided in hard copy as well as electronically on CD.

3.11 WARRANTY

- A. All materials and installation shall be guaranteed for a minimum of one year from installation. Warranty work will be performed "on-site" at no cost to the Owner.
- B. Upon completion of the installation, four (4) copies of complete operational instructions shall be furnished, complete with record drawings. Instructions shall include part numbers and names, addresses, and telephone numbers of parts source. Final payment shall not be made until operational manuals have been received.
- C. Upon completion of the installation of the equipment, the Contractor shall provide to the Owner or the Owner's Representative a signed statement from the equipment supplier that the system has been wired, tested, and functions properly according to the specifications.
- D. Nothing herein contained shall be construed to relieve the Contractor from furnishing a complete and acceptable electrical wiring system in all its categories. The Owner or the Owner's Representative will condemn and reject any materials or labor which are or may become detrimental to the accomplishment of the intentions of these specifications.

END OF SECTION 27 4100

SECTION 27 4119**INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT****PART 1 – GENERAL****1.01 WORK INCLUDED**

- A. The work described by this section includes the furnishing of all components, materials, equipment, installation and technical labor and the performance of all operations necessary for the complete installation of a Unified Campus System in operating condition as indicated on the drawings and/or specified herein.
1. Included in the Scope of this Section:
 - a) Licenses, permits as may be applicable
 - b) Provision of submittal information
 - c) Installation in accordance with contract documents, manufacturers' recommendations and applicable codes
 - d) Configuration of control and signal processing software
 - e) Testing and adjustments, including documentation thereof
 - f) Provision of manuals
 - g) Maintenance and warranty services
 2. Applicable References:
 - a) National Electric Code (NEC)
 - b) Underwriters Laboratories (UL)
 - c) Telecommunications Distribution Methods Manual (TDMM)
- B. In general, the conduit and/or cable tray, junction boxes, electrical power circuits and outlets and terminal cabinets, as required for a complete operating system, shall be furnished and installed by the Electrical Contractor. The entire responsibility for the system, its installation, operation and function shall be that of THIS Contractor.

1.02 DESCRIPTION

- A. Project Summary for consistent bidding purposes:
1. System Type: Unified Campus
 2. System Mode: Intercom
 3. Admin Paging: 1 Gooseneck Mic
 4. Classroom / Zone Count: 25 / 6
 5. Classroom Input Count and Type: (1) HDMI and (1) IP Video
 6. Common Audio Zone Count: as per Drawings, e.g. Hallways, Outside, Offices, Cafeteria, etc.
 7. Emergency Notification: Video and Audio
 8. Digital Signage Displays: as per Drawings
 9. Additional Admin User Interfaces
 - (1) Wall Mount TP – Provide 2
 - (2) iPad using TPControl app
 10. Background Music Sources
 - (1) AM/FM/Network Radio/iPod Dock
 11. Telephone Interface
 - (1) Enhanced
 12. Energy Management Options (Contact Closures)
 - (a) HVAC
 - (b) Lighting

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

13. Building Management System Interface (Contact Closures)
 - (a) Access Control
 - (b) Security
- B. This system shall consist of:
 1. 1 administration control center location
 2. 1 common area control centers
 3. 27 classroom control panels
 4. 27 classroom casework mounted Enzo
 5. 27 classroom AV switches
 6. 27 classroom OFCI projector or LCD TV.
 7. Headend audio distribution system
 8. Headend video distribution system
- C. System Integration Matrix
 1. AMX system shall receive notification from Access Control upon lockdown.
 2. AMX system shall send notification to paging system upon lockdown for playing pre-recorded system messages.
 3. AMX system shall send notification to Access Control upon lockdown initiation via AMX software.
 4. AMX System shall display source information for PV display and water reclamation systems.
- D. System components are described below. The audio rack shall contain the master control system in which the Integrated Audio-Video System software is to be installed. This rack location shall be dedicated to managing campus clocks, bells, PA/Intercom, remote microphones, telephone interfaces, background music sources, common zone audio and audio extractor for video sources.
 1. System Includes:
 - a) Software
 - b) Admin Touch Panels
 - c) Bell System
 - d) Digital Clock Control
 - e) Audio Paging
 - f) Background Music
 - g) 2-Way Intercom Option
 - h) Remote Audio
 - i) Teacher's Web Interface
 - j) Video Broadcast (DVD, Satellite, Cable, Digital Signage, video intercom)
 - k) Digital Signage
 - l) Emergency Alerts
 - m) Security Camera Interface
 - n) Microphones
 - o) Equipment cabinet
 - p) Analog Telephone Paging Interface
 - q) Bell & Alert Tones
 - r) Admin Monitor Speaker
 - s) Loudspeakers
 - t) Conductors and cables.

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

- u) All material and/or equipment necessary for proper operation of the system, not specified or described herein, shall be deemed part of these specifications.
- E. Quality Assurance
- 1. Installation shall be in compliance with the National Electric Code and all other applicable codes.
 - 2. All equipment described herein or otherwise required to perform the specified system functions shall be a regular product line, produced by the system manufacturer.
 - 3. All materials furnished under this contract shall be new, of highest quality and shall be of a regularly manufactured line, currently in production at the time of installation.
- F. Contractor Qualifications
- 1. The Unified Campus equipment package shall be furnished and installed by a contractor who meets all the requirements listed herein. It shall not be acceptable for the Unified Campus contractor to utilize a sub-contractor for any portion of the work, unless the Subcontractor has been approved in writing by the Engineer based upon adherence to the qualifications listed herein.
 - 2. The Contractor shall maintain a fully equipped, factory certified service organization capable of providing full maintenance and service of the installed system within 24 hours. This facility shall be available for inspection by the Engineer.
 - 3. The Contractor shall employ factory-trained service personnel for the installation, service and maintenance of the system.
 - 4. A statement of contractor's qualifications to verify compliance with other provisions within the specifications, unless the contractor has been pre-approved.
 - 5. The names of at least two technicians who have or will complete factory Installation Training prior to start of project must be included with the submittals.
- G. Shop Drawings
- 1. A complete and comprehensive list of materials with quantity, manufacturer, model and part number and reference to the Part 2 specification paragraph number for each item.
 - 2. Manufacturers Data Sheets of all products and cabling, specific to the project. Data sheets shall show the exact parts, with model numbers and options as required and clearly identified.
 - a) Drawings shall include designations, dimensions, operating controls, electrical requirements, input/outlet configurations, operating controls, etc.
 - b) Major components including all sub-assembly components (daughter cards, option cards, etc.) required to perform the specified functions.
 - c) Any items of equipment which have features and/or functions that deviate from the specifications contained herein shall have these deviations clearly called out by a separate attachment with the shop drawings specifically listing and detailing the deviation along with a justification. Deviations must be approved specifically in writing.
- H. Job specific diagrams
- 1. This indicates a block schematic diagram that shows all major items of equipment required for the contract project and the actual interconnection that will be installed.

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

2. Riser diagram showing conduit requirements with pull boxes, outlet boxes, part numbers of cable used, and a number of circuits in each conduit.
3. Electrical power requirements for the head-end and ancillary equipment. Include diagrams for any remote control of electrical power, in sufficient detail to coordinate with electrical work. Electrical diagrams shall also indicate all required plug and power outlet configurations including where direct connection is required/preferred.
4. Schematic and point-to-point wiring diagrams showing all devices and wiring.
5. Identify terminals to facilitate installation, operation, and maintenance.
6. Single-line diagram showing interconnection of components.
7. Cabling diagram showing cable routing.
8. Details of interconnection with other systems
9. Supplier shall provide rack elevations showing the configuration of all rack mounted equipment including detailed interconnection diagrams between equipment
10. 30x42 floor plans at a scale of not less than 1/8"=1'-0" showing the location of all items of equipment. Drawings shall also indicate each location where electrical power is required, and the specific configuration of that power connection (voltage, plug type, mounting height, etc.)
11. Proposed construction details for all custom fabricated items, including wall plates, interface panels, mounting hardware and systems, and rigging hardware. These details shall show labeling, dimensions and indicate finishes and color selection.
12. Power calculations for sizing Owner Furnished Contractor Installed UPS system.
13. Submittals that do not contain all the required information will be REJECTED unless prior approval for partial submittals has been approved.

PART 2 – PRODUCT**2.01 PRODUCT EQUIVALENCY**

- A. Pre-approved product AMX Schoolview, Unified Campus
 1. Where products are listed with multiple manufacturers, these manufacturers will be approved as equals if all specified features are provided. Any equipment not specifically approved in writing prior to the bid date will not be considered regardless of qualifications. Failure to provide the "precise functional equivalent" shall result in the removal of the alternate equipment at the Contractor's expense.
 2. Different manufacturers may require various options, accessories, converters, patch cables, etc. to perform the specified features and functions. Therefore, all material and/or equipment necessary for proper operation of the system shall be deemed part of these specifications.
 3. Provide all required licenses for Unified Campus and related components.
- B. Functional Description of System
 1. Bell System Functions:
 - a) Software shall control and broadcast all bell tones over IP. Bell tones shall be stored as standard MP3 files and as such may be any type of audio tone, including but not limited to, bell tones, music files in part or full, recorded voice announcements, coded audio messages, or audible alerts. All MP3 files shall be directly selectable by the touch panel and web interface.
 - b) MP3 files shall be stored on an easily changeable USB flash drive.
 - c) The system shall support practically unlimited combinations of rooms and common areas to be saved as named zones with multiple

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

automated schedules. Software shall provide the ability to create and maintain the bell schedules graphically on a rolling 12-month calendar.

- d) Events shall be triggered by schedule or manual button on the touch panel.
- e) A voice-prompted menu shall provide system administration functions via telephone. This option is referred to as "Enhanced Telephone Interface".

2. AMX system Digital Clocks

- a) The system shall provide an internal clock if network time, (NTP) information is not available.

C. Audio Paging

- 1. Software shall control encoding and broadcast of live voice announcements via IP to any and all classrooms and common areas. The system shall provide practically unlimited combinations of rooms and common areas to be saved as named zones. Assignment of zones shall be chosen via a graphical floor plan image of the school. Audio paging is available from, but not limited to, the following:
 - 2. Software shall control encoding and broadcast of live voice announcements via IP to any and all classrooms and common areas. The system shall provide practically unlimited combinations of rooms and common areas to be saved as named zones. Assignment of zones shall be chosen via a graphical floor plan image of the school. Audio paging is available from, but not limited to, the following:
 - 3. Wall mounted microphone 1 per Admin Touch Panel
 - 4. Desktop telephone
 - 5. Two-Way IP Intercom
 - a) Software shall be capable of supporting 2-way communication via the network between classrooms & predetermined locations such as a principal's office, administration, or library.
 - b) Events shall mute local audio sources in selected classrooms for the duration of the event and subsequently return local audio sources to the previously selected level.

D. Background Music

- 1. Software shall support the encoding and broadcast of Owner Furnished Equipment for MP3 or other portable audio sources to any combination of classrooms and common areas via direct IP audio streaming.
- 2. The Unified Campus System shall support any RS-232 or IR controllable music source with published protocols including AM/FM Tuner, CD Player and / or Internet Radio.
- 3. Events shall mute local audio sources in selected classrooms for the duration of the event and subsequently return local audio sources to the previously selected level.

F. Classroom Speaker Controls

- 1. Software shall provide direct network management of classroom speaker zones as a group. Individual Classroom volume control for Unified Campus is adjustable by the Unified Campus Contractor via audio decoder settings or optional external amplifier.

G. Remote Audio

- 1. Virtually any properly configured network data drop shall function as an input point to the system. The system shall allow the remote audio source to be defined as either a standard or priority audio event. As a standard audio event, the event shall not interrupt normal PA or bell events. As a priority event, the

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

event shall interrupt all other audio events. Remote audio inputs shall support the following input types:

2. Stand-Alone Sound Systems: The software shall support 2-Way audio from a stand-alone sound system such as a Gym, Lecture room, Cafeteria or Students lounge.
 - a) The system shall allow for the audio from the location to be routed to any and all zones within the Unified Campus System.
 - b) The system shall support local start / end of the broadcast event from the Stand-Alone Sound System. Administration location support shall not be required.
 - c) The system shall also allow for the stand-alone sound system to receive any PA, bell, or background music event from the Unified Campus System.

H. Classroom Control (27 Classrooms)

1. The Unified Campus System shall provide control of the following devices / features:
 - a) local classroom display
 - b) AV switcher/audio amplifier
 - c) video decoder
2. Controls shall be available via Teacher Client by default plus the 8-button control keypad method listed below. The Teacher Client shall be accessible as an application or via an Internet web browser such as Internet Explorer, Safari, Chrome and Firefox.
3. Classroom control methods include:
 - a) 8-button Keypad
 - b) Teacher Client Application
4. All classroom controls must communicate with the Unified Campus System.
5. Classroom display must support RS232 control with a published protocol for the following functions:
 - a) Discrete Power On
 - b) Discrete Power Off
 - c) Discrete Input Select (VGA, Component, HDMI1, HDMI2)
6. Specific classroom functionality shall include, but not be limited to, the following:
 - a) Display Select
 - b) Room volume / mute
 - c) Local source select
 - d) Headend source (Campus Video) select with controls
 - e) Favorite Channel
 - f) Intercom call button

I. Video Broadcasting

1. The software package shall direct any and all classroom and common area flat panel systems to decode IP multicast video streams generated by third party MPEG-2 or h.264 video encoders (Visionary Solutions or APPROVED substitutions). The system shall provide a minimum of 20 combinations of rooms and common areas to be configurable zones and assigned to Owner supplied standard video sources such as, but not limited to, the following:
 - a) DVD players
 - b) Cable converter boxes
 - c) Satellite receivers

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

2. The user shall be able to control each source from the admin touch panel, teacher's web client or graphical touch interface. Preview of the video shall be available directly on the Admin touch panel or through use of VideoLan's VLC video player on any connected PC or MAC. A video preview window shall be embedded within the teacher web client. Basic IR controls shall consist of but not be limited to navigation and transport controls.
- J. Manage Displays
1. The software package shall provide network control and management of all digital signage displays in classrooms and common areas. This shall include definition of auto-off times, current power status, monitoring for anti-theft alarms. Multiple auto-off time configurations must be available and programmable for multiple zones. The system shall support practically unlimited combinations of rooms and common areas to be saved as named zones. Named zones, groups of rooms or individual rooms shall also be controllable via a direct control interface. Control functions shall include, but not be limited to, the following:
 - a) Power
 - b) Input Select
 - c) Favorite Channels
 - d) Default Channel
 - e) Campus Video
 - f) Campus Audio
- K. Digital Signage
1. The software package shall include a three (3) AMX Inspired Signage Xpress player to stream owner-created content to each display via multicast video encoder. The system shall support practically unlimited combinations of rooms and common areas to be saved as named zones. The system shall control all displays for auto-on and auto-off times. Named zones, groups of rooms or individual rooms shall also be controllable via a direct control interface, which shall include, but not be limited to, the following:
 - a) Power
 - b) Input Select
 - c) Channel Selection +/-
 2. The system shall allow for management of crawl information of the digital signage player. The user shall be able to simply enter text using the Admin Touch Panel, either directly or via web interface.
- L. Emergency Alert
1. The software package shall allow for the broadcast of audio emergency alert or drill messages to all audio zones via IP.
 2. The software package shall direct any and all classroom and common area flat panel systems to decode IP multicast video streams generated by third party MPEG-2 or h.264 video encoders , Visionary Solutions or approved substitution. To be used for the broadcast of video emergency alert or drill messages.
 3. The alerts/drills shall include at least Lockdown, Emergency, Fire and All Clear.
 4. The system shall override current use of the projector by the teacher.
 5. The system shall allow for custom messages for each alert/drill screen to be entered at the Admin Touch Panel or web interface.
 6. Emergency alerts shall trigger visual, audible and textual alerts through the connected hardware.
 7. On command, the system shall provide an all-clear message for one (1) minute to end the alert / drill. After the all-clear message has ended, all displays shall return to their previous state (power and input).

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

8. Any systems that do not return displays to their pre-alert state shall not be accepted.
- M. System Management
1. The software package shall provide a system management page which will consist of the following areas:
 - a) System power management
 - b) Default volume management
 - c) MP3 Bell/Tone/Audio/Recorded voice management
 - d) User access management
 - e) System time management
 - f) Direct phone paging zone management
 - g) Paging chime management
 - h) Classroom Status Page
 - i) Schedule management
 - j) Alert management
 2. System Power
 - (1) The software package shall allow certain items in the hardware racks to be powered down for the purposes of conserving electricity.
 3. Default Volume
 - (1) The software package shall allow these individual sources to be adjusted to a specific volume:
 - (a) Push-to-talk microphones
 - (b) Bells
 - (c) Music
 - (d) Phone Interfaces
 - (e) Program Audio
 - (f) Remote Audio
 4. Manage MP3 Files
 - a) The software package shall allow for display of all MP3 files on the Admin touch panel graphical interface. All MP3 files shall reside on a USB flash drive in the IMS rack and adjusting the duration of each MP3 file.
 5. User Access
 - a) The software package shall allow for management of users and access rights to the system. Users can be added to the system with a unique password. Each user can be given access to any or all of the follow areas:
 - (1) Audio Events
 - (2) Audio Paging
 - (3) Video Paging
 - (4) Manage Displays
 - (5) Background Music
 - (6) System Management
 - (7) Digital Signage
 - (8) Emergency Alerts
 6. Alerts
 - a) The software package shall provide for system alerts, which shall be audible, visual and textual. These alerts can be triggered by contact closures such as doorbell switches or motions sensors. In addition, alerts can be triggered by virtual switches tied to the interruption of network communication between the system and the classroom devices. Physical or virtual web call/panic buttons

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

shall be available to every classroom system. Audible alerts shall be available to all PA/Intercom zones and have an assignable MP3 audio file.

b) Visual alerts shall be available on the graphical interface via the touch panel or teacher interface. Text alerts shall be sent to any personnel assigned to receive e-mail alerts specific to the occurrence. The system shall support display of selected security camera streams on the graphical interface based on specific triggered occurrences.

7. Projector Alerts

a) The software package shall allow for defining of a start and end time which will establish a period of time for which a trigger can be customized.

b) The customization shall include the assigning of an MP3 tone and a zone for which the MP3 shall be played.

c) There shall be 3 defined times which are Daytime, Nighttime and Holiday.

d) Daytime and Nighttime hours shall be opposite of each other

e) Holiday times shall be determined by enabling the "Switch Alerts to Holiday Mode" setting in the System Power section of the System Management page.

f) System Response: When a display managed by the Unified Campus System is disconnected from the network or the power cord is removed. The following shall occur:

(1) Different response activities are supported for each of the Daytime/Nighttime/Holiday periods.

(2) An e-mail shall be sent to selected school personnel (or distribution list)

(3) A visual alert shall be displayed on the touch panel pinpointing the exact location of the occurrence

(4) An MP3 tone shall be played through the PA system to a designated zone setup by the user

8. Panic Button/Office Call

a) See also Voice Reinforcement & **Panic Button**

9. E-mail Notification

a) The software package shall allow entry of e-mail addresses of individuals to receive e-mail alerts for, but not limited to, the following:

(1) Panic button alerts

(2) Display alerts

(3) Door alerts

(4) The Unified Campus System shall allow for the storage of multiple e-mails addresses of key campus or district personnel.

Addresses can be assigned to various triggered alerts for the purposes of notifying campus or district personnel. Alerts can be triggered by physical contact closures (push button), switches, or virtual web button presses.

10. Enhanced Telephone Interface

a) The software package shall allow ability to access the system from any telephone or cell phone. The enhanced telephone interface will allow for control or access to the following:

(1) Manual bells

(2) Zoned paging system

(3) Manage Projectors

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

- b) Emergency alerts
 - (1) Telephone interface shall allow for triggering of any of the 6 manual bells that have been configured for zones and have been assigned an MP3 file. The telephone interface shall also allow for paging any of the configured paging zones and allow the phone microphone to act as the paging microphone to address any and all zones on campus. The telephone interface shall allow the user to power all projectors on or off. The telephone interface shall allow the user to trigger any emergency alerts/drills and trigger the all-clear message.
- 11. Classroom Software (Interface)
 - a) Provide a Unified Campus System classroom control interface to allow the teacher to control the local classroom Audio/Video system. Various degrees of control shall be available depending on the type of interface provided.
 - (1) 8-Button Control Keypad: The application shall utilize an 8-button control keypad to provide basic room system control such as, projector power, source selection, streaming video channel selection, room volume control, audio mute and intercom system call button.
 - (2) All Unified Campus classrooms, regardless of selected UI, shall have access to a Teacher Client and on-screen Toolbar.
 - (a) Shall support PC users
 - (b) Shall support Mac users
- 12. Classroom Software (Functions)
 - a) Provide the Unified Campus System password protected classroom software application to allow the classroom teacher to control the following:
 - (1) Room controls
 - (2) Local Source selection
 - (3) Video Source(s) selection and control
 - (4) Intercom control
 - (5) Tools
- 13. Classroom Projector
 - a) The Unified AV System graphical classroom interface shall provide basic projector controls, display streaming channel selection, room volume control and volume mute.
- 14. Local Sources
 - a) The Unified Campus System graphical classroom interface shall provide the capability to switch the projector and audio to local classroom sources such as a classroom computer, DVD player, document camera, campus video channel, or campus background audio.
- 15. Favorite Channels
 - a) When a dedicated video stream is assigned (fixed) to each desired Cable / Satellite channel, the Unified Campus System graphical classroom interface shall have the capability to have predetermined channels represented by the broadcast channel logo or icon. The user shall have the capability to preview the video embedded within the web client. Once the user has selected an appropriate video stream, the system shall have a "Send to Projector" function allowing the teacher to send the current video stream directly to the projector with a single button press.
 - b) Favorite Channels are not supported when each cable / satellite tuner allows the viewer to select their desired channel.
- 16. Intercom

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

a) The Unified Campus System graphical classroom interface shall provide for 2-way communications between the classroom and the front desk or Gym or Multipurpose room. Other functions shall include press-to-talk, place call, do not disturb, hang up call, and hands free.

- (1) Provide two 10.3" Admin Interfaces
 - (a) 2 Admin Touch Panel(s)
 - (b) 27 tablet/PC/MAC via TPControl license

17. Tools

a) The graphical classroom interface shall provide a stopwatch application and countdown timer. The user shall have the capability to place a stopwatch or countdown timer pop-up on the teacher's computer desktop for the purpose of timing students or events.

b) The software package described above shall be required to fulfill a complete Unified Campus System specification. All software modules and capabilities described here are included within the software package.

18. Voice Reinforcement

- a) The Unified Campus System supports voice reinforcement .
- b) See also section 27 4100 Classroom Audio Systems.

N. General Equipment And Material Requirements

1. Compatibility of Components: Coordinate component features to form an integrated system. Match components and interconnections for optimum performance of specified functions.
2. Equipment: Comply with UL 813. Equipment shall be modular, using solid-state components, and fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.
3. Equipment Mounting: 4-Post equipment racks are provided by others.
4. Weather-Resistant Equipment: Listed and labeled by a qualified testing agency for duty outdoors or in damp locations.

O. Administration Location

1. Provide a password protected interactive touch panel in the administration area of the school campus. The touch panel shall provide access to and control of the Unified Campus System software. System shall provide one wall mounted microphone and one push-to-talk microphone. There shall be a ceiling mounted speaker with an associated volume control. The software shall allow for network access and control of the administrative touch panel from anywhere on the school's LAN or district WAN.
2. Required hardware :
 - a) Admin touch panel: AMX FG5968-13 MXD-1000L (Wall Mount), provide two.
 - b) AMX rough-in box Model # FG039-17, provide two as shown on drawings..
3. Required hardware for optional features:
 - a) Gooseneck wall mount microphone (Shure 503BG with G12, or equivalent)
 - b) Push-to-talk microphone (Shure 522 or equivalent)
 - c) 8-ohm volume attenuator (DAT8ST or equivalent)
 - d) Wall mount single gang speaker.

P. Paging and Intercom Speakers

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

1. Drop in tile locations - 2' x 2' lay-in tile 8-ohm speaker (CSD2X2/U, or equivalent).
2. Gypsum ceiling locations – 8" speaker with backbox and white grill (Bogen RE-84 with S86T725PG8 with recessed volume control, or equivalent).
3. Gymnasium speakers – Flange Mounted, (Bogen FMH15T or equivalent).
4. Custom ceilings such as wood slat – Flush mount black grill 8" speaker with integral enclosure (Bogen HFCS1LPB, or equivalent).
5. Wall mount – White 12x12 angled enclosure with integral 8" speaker with volume control (Bogen MB8TSLVR, or equivalent).
6. Ceiling mount when open to structure - White 12x12 flat enclosure with integral 8" speaker with volume control (Bogen MB8TSQVR, or equivalent).

Q. Audio & Video Rack Location

1. 4-post rack installed by Division 271116 for all equipment listed below to reside in the MDF location. Provide all shelves, rack mount kits, rack power supplies, backup power supplies, doors, rack top, lacing bars, etc. as needed to have a neatly dressed rack. The required hardware shall consist of, but not be limited to, the following:
2. Required audio hardware:
 - a) Provided by section 271116 in the MDF.
 - b) AMX NX-3300 (Qty. 1 – Primary Master)
 - c) AMX NX-1200 (Qty. 5)
 - d) AMX PSN6.5 power supply (Qty. as needed)
 - e) AMX AC-RK rack mount kit (Qty. as needed)
 - f) Barix Annunicom 50SV (Qty. 4 – audio encoders with license)
 - g) Barix Exstreamer 100 (Qty. 1 – bell player)
 - h) Barix Exstreamer 100 (Qty. 1 – voice menu player for **Enhanced Phone**)
 - i) USB flash drive (Qty. 2 – bell & voice menu MP3 file storage)
 - j) Barix equipment rack mount (Qty. 1 per every 4 Barix devices in headend rack)
 - k) Amino H140 or AMX MA1350-85 network video decoder (Qty. 1)
 - l) Audio summing devices (Qty. as needed): Whirlwind PodDI
 - m) Applied Technical Systems CC186R rack mount clock (Qty. 1) plus power supply as needed to support clocks throughout campus
 - n) 70-volt amplifier, Bogen 250 watt or equivalent
 - o) Network switch (Qty. as needed, Owner Furnished Contractor Installed)
3. Required video hardware for all systems:
 - a) Digital Signage
 - (1) Required: 3
 - (a) AMX FG1231-01 player
 - (b) AMX FG1231-20 Standard License
 - (c) AMX FG525 or FG1231-71 mounting bracket
 - b) MPEG-2 or h.264 video encoders
 - (1) 1 per video source (composite, S-Video, YPbPr, HDMI)
 - (2) Approved: Visionary Solutions AVN-200
 - c) Video sources – must be IR-controlled using codes from AMX IR Library or submit remote control for capture)
 - (1) DVR (Qty. 1)

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

- d) 19" rack mounted preview monitor (LCD) with composite video input and integrated speakers
 - e) Audio summing / Attenuation devices (Qty. 6)
 - (1) Approved: Whirlwind PodDI
- R. Remote Audio Locations:
- 1. Provide integration of stand-alone sound systems specifically the following:
 - a) Gym sound systems
 - b) Cafeteria sound systems
 - c) Required: Barix Annunicom 100SV (Qty. 1 per stand-alone system)
 - 2. Control volume levels and source selection for the gym and multipurpose sound systems.
 - a) See drawings for Control Panel locations.
 - b) Configure the controls to provide audio source and output signals to each individual room or as a larger combined space. Refer to sound system drawings and specifications.
 - c) Configure the controls to provide video source and output signals to each individual room or as a larger combined space.
- S. Common Areas Clocks refer to 275313 for Sapling
- T. Classroom Hardware Configurations
- 1. Unified Campus classrooms are fully featured classrooms with integration of local A/V sources, head end based and remote audio sources (bells, PA, background music, call buttons, gym & cafeteria audio systems, etc.) and head end based and remote video sources if equipped, (DVD players, TV tuners, broadcast cart, emergency alerts, etc.)
 - 2. SchoolView Unified Campus options shall include the following hardware:
 - a) SchoolView Equipment Tray for each AV location surface mount
 - b) Audio Decoder (Barix Annunicom 50SV)
 - c) Microphone for Intercom
 - d) 8-button keypad control
 - e) Call Button (on 8-button keypad)
 - f) GL-300 Amplifier
 - g) AMX UPX-CN+A-US
 - h) NMX-MX-1000 Enzo
 - i) FG1702-01
 - j) NX-1200
 - k) 4 ea -Ceiling sound reinforcement speakers
 - l) 1 ea -Ceiling paging speaker
 - m) 1 ea -IR Sensor
 - n) System cabling (minimum of one of each shown below or as shown on Drawings)
 - (1) 2' CAT5 network patch cable
 - (2) 2' RCA to captive screw audio cable
 - (3) 2' DB9 Female to captive screw RS-232 cable
 - (4) VGA cables
 - (5) HDMI cable
 - (6) RS-232 cable with appropriate connectors based on display

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

- (7) 2 conductor speaker cable (length as needed)
 - o) Teacher Client plus interfaces:
 - (1) AMX SP-08 8 button keypad (1 per classroom)
 - (2) AMX Licenses for handheld device, Android/PC/Mac (30 rooms)
- 3. The Unified Campus classroom includes the teacher interface and toolbar PC/Mac based interfaces. Classroom control features vary with interface, but shall include these as MINIMUM REQUIREMENT:
 - a) Display Power Control
 - b) Input Select
 - c) Volume Up / Down
 - d) Mute
 - e) Push-to-Talk (for Intercom)
 - f) Channel Up / Down
- 4. Classroom Display
 - a) OFCI projector
 - b) Must support RS232 control, using a published protocol
 - c) Network control shall be delivered via Audio Decoder's Ethernet bridge function
- U. Classroom Installation
 - a) The slotted tray shall be available to mount all Unified Campus System hardware in the casework. All interconnect cables shall be connected and tested offsite. IP addresses shall be assigned and projector drivers shall be loaded offsite. Once the facility is secure and classroom construction is complete, the classroom equipment mounted to the slotted tray shall be installed to the equipment enclosure on-site.
- V. NetLinx Masters
 - 1. NX3300 with Primary Master software
 - a) 1 per system
 - b) This item shall provide Primary controls and communications for the Unified Campus system.
 - 2. NX3200 with Source Master software
 - a) 1 per system
 - b) Located in Video Rack
 - c) This item shall provide IR controls of Campus Video sources (8 max)
 - d) Additional control devices may be added for 9+ controlled devices
 - 3. NX1200 with Room Master software
 - a) Classrooms / Zones shall be assigned to a zone master for distributed processing and management. Physical location and network topology to be determined during project design phase in conjunction with the site's network design team. Provide 5.
 - 4. NI700 with Flat Panel Software (FPS)

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION

- A. Equipment shall be furnished and installed in accordance with manufacturer's recommendations in compliance with all local, city, state and national codes.
1. Provide all hardware, framing members, etc. as required for mounting supports.
 2. All penetrations in smoke or firewalls shall be sealed with fire stop rated for this purpose.
 3. The installation of all work shall be neat and of professional quality. Cooperate with other trades in order to achieve well-coordinated progress and satisfactory final results. Execute without claim for extra payment minor moves or changes in equipment locations to accommodate equipment of other trades or the architectural symmetry of the facility.
 - a) It is the Contractors responsibility to coordinate necessary configuration details of the data network equipment (by others), such as:
 - (1) Configuration of IGMP snooping on all data switches which will receive IP multicast traffic, to prevent flooding of traffic to ports which do not need it
 - (2) Configuration of at least one IGMP querier on the network
 - (3) Allocation of reserved, static IP addresses for all system equipment
 - (4) Creation of port-based VLAN(s) for all system equipment, without DHCP service
 - (5) Assignment of all dedicated ports to the VLAN described above.
 4. Conductors And Cables
 - a) Microphone Cables: Neoprene jacketed, not less than 2/64 inch thick, over shield with filled interstices. Shield No. 34 AWG, tinned, soft-copper strands formed into a braid or approved equivalent foil. Shielding coverage on conductors is not less than 60 percent.
 - b) Plenum Cable: Listed and labeled for plenum installation.
 5. Raceways
 - a) Conduit and Boxes: Comply with Section 27 0528.33 - Raceway and Boxes for Communications Systems
 - b) Outlet boxes shall be not less than 2 inches wide, 3 inches high and 2-1/2 inches deep.
 6. Wiring Methods
 - a) Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - b) Install plenum cable in environmental air spaces, including plenum ceilings.
 - c) Comply with requirements for raceways and boxes
 - d) Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
 - e) Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

7. Installation Of Raceways
 - a) Comply with requirements in Section Raceway and Boxes for Electrical Systems for installation of conduits and wireways.
 - b) Install manufactured conduit sweeps and long-radius elbows whenever possible.
8. Installation of Cables
 - a) Comply with NECA 1.
 - b) General Cable Installation Requirements:
 - (1) Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.
 - (2) Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.
 - (3) Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - (4) Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
 - (5) Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - (6) Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used.
 - (7) Open-Cable Installation:
 - (a) Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 - (b) Suspend speaker cable not in a wire way or pathway a minimum of 8 inches above ceiling by cable supports not more than 60 inches apart.
 - (c) Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
9. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

3.02 PROGRAMMING / CONFIGURATION

- A. It is the Contractors responsibility to configure the system in this section according to the Owner's wishes. This includes the set up and assignment of channels, coordination of services, etc. The Contractor shall meet with the Owner and/or Engineer and reach agreement on the configuration. This agreement shall then be written out in detail and forwarded to the Engineer for approval. After approval is granted, proceed with final configuration.
- B. It is the Contractors responsibility to coordinate all IP multicast addresses and port numbers to be used with the Owner and/or Engineer to ensure that they are acceptable,

available and unrestricted on the Owners network. This information must be provided in order to create configuration files for the project.

3.03 TESTS

- A. Upon completion of installation and satisfactory testing of system by Contractor, the Contractor shall test the system in the presence of the Owner and the Engineer to demonstrate satisfactory performance.
- B. System shall be tested by and a certificate of inspection shall be furnished by a qualified manufacturer's representative or equipment vendor; Submit report indicating result to the Engineer.

3.04 IDENTIFICATION/LABELING

- A. Contractor shall identify all major items of equipment and tag all cables with permanent type markers to denote equipment served. Cables shall be tagged at both end and at each point where the cable is administered.
- B. The contractor shall be responsible for applying a permanent label to each cable to indicate source and destination.
- C. All labeling and recording shall be approved by the Owner and the Engineer prior to application.

3.05 TRAINING

- A. Provide step-by-step user instructions identifying operator controls for normal use operations. This shall be included with the O&M manuals.
- B. The contractor shall arrange for a total of sixteen (16) hours for end user training on the various A/V Systems. This training shall be planned and scheduled with the Owner. Training plan shall be pre-approved by the Engineer/Architect and shall include a review of the proposed syllabus.

3.06 OPERATION AND MAINTENANCE MANUALS

- A. Owner's manuals for every item of equipment when available from the manufacturer. These shall be the technical manuals provided by the manufacturer and shall not consist of generic sales brochures. Technical manuals shall provide complete specifications for the equipment as well as complete operating, maintenance, troubleshooting and product repair/replacement information. Where available only in electronic format, the contractor may provide a CD with electronic versions of Owner's manuals. CDs containing electronic versions of Owner's manuals must contain the proper software viewers for each document type.
- B. Technology drawings updated with final as-built information. This shall be in the form of a complete set of Technology drawings with as-built information indicated in colored pen based upon actual field conditions.
- C. System schematic and block diagrams for every system updated with final as-built information. These drawings shall define the exact arrangement of each system including wiring configuration, device locations and cable types
- D. Rack elevations for all systems with rack mounted equipment.
- E. System Operating Instructions: Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment and system.
- F. Provide statement of warranty with O&M Manuals.

3.07 WARRANTY

- A. This Contractor shall warrant all workmanship, equipment and material provided under this contract for a period of one (1) year from the date of approval of certificate of contract completion by the Owner. Provide statement of warranty with O&M Manuals.

INTEGRATED AUDIO VIDEO SYSTEMS AND EQUIPMENT

- B. During the warranty period, report to the site and repair or replace any defective materials or workmanship without cost to the Owner. Warranty service shall be rendered within 24 hours after request by the Owner. Equivalent replacement equipment shall be temporarily provided when immediate on-site repairs cannot be made.
- C. Where warranties on individual pieces of equipment exceed twelve months, the guarantee period shall be extended to the warranty period of the particular items.
- D. After completion of the work, the Contractor shall submit a Certificate of Warranty, stating commence and expiration dates and conditions of the warranty, for signature of both participating parties. Incremental warranties for complete portions of the work may be negotiated at the discretion of the Owner, if delays occur beyond the control of the Contractor.

END OF SECTION 27 41 19

SECTION 27 5113
PAGING SYSTEMS

PART - 1 - GENERAL

1.01 SUMMARY OF WORK

- A. It is the intent of this Section in conjunction with the applicable Drawings is to provide specifications for a complete and functional system. All locations, as detailed on the Drawings, shall be tested and balanced as to provide a reasonable level of volume to accommodate the paging needs of the school. This includes classrooms, administrative and general areas as well as the Commons, Gymnasium and, where specified, exterior areas of the building.

1.02 WORK INCLUDED

- A. Provide all labor, materials, tools, and equipment for a complete and operational overhead paging system as called for in the specifications and Drawings, specifically:
 - 1. Public address system amplifiers, zone controls, back boxes, and all equipment, cabling and support required to interface the Public Address System to the Owner's Telephone System (Not included in this contract).
 - 2. Public Address System Speakers, ceiling mounted, wall mounted horn, both interior and exterior.
 - 3. Volume attenuators where shown on the drawings to adjust the PA speaker sound level.
 - 4. PA override signal to local sound systems. Coordinate with 27 4116 contractor.
 - 5. Messaging calendar clock capable of receiving and scrolling up to 64 character custom messages without affecting or replacing display of time segments.
 - 6. Interactive Graphical User Interface (IGUI) to intercom functions including zone or all page, answering intercom call-ins, selecting and distributing program sources to predefined zones or all zones and facilitating single action activation of multiple system interface.

1.03 QUALITY ASSURANCE

- A. See Section 27 0513
- B. The Contractor shall currently maintain a locally run business for a minimum of five years and shall be an authorized distributor of the supplied equipment with full warranty privileges.
- C. The Contractor shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the equipment manufacturer to maintain and service the equipment being supplied.
- D. Contractor shall have attended the manufacturer's installation and service school.
- E. The Contractor shall furnish manufacturer's manuals of the completed system including individual specification sheets, schematics, inter-panel and intra-panel wiring diagrams. In addition, all information necessary for the proper operation of the system must be included. Any bidder using other than the specified equipment must provide this information prior to bidding.
- F. As built drawings that include any changes to wiring, wiring designations, junction box labeling and any other pertinent information shall be supplied both electronically in AutoCAD® 2010 (or later) and as a full size (30" x 42") drawing upon completion of project.

1.04 IN SERVICE TRAINING

- A. The Contractor shall furnish a minimum of four hours of in service training with the system. These sessions shall be broken into segments that will facilitate the training of individuals in operating station equipment, administrative devices, user programming functions, and program distribution equipment. Operating manuals and users guides shall be provided at the time of the training.

1.05 MAINTENANCE SERVICE

- A. The Contractor shall provide a one-year guarantee of the installed system against defects in material and workmanship. All labor and materials shall be provided at no expense to the Owner. Guarantee period shall begin on the date of acceptance by the Owner or engineer.
- B. A maintenance contract offering continued factory authorized service of this system shall be made available if requested by the Owner.

1.06 SUBMITTALS

- A. Data sheets shall be provided on all equipment being provided.
- B. Internal control cabinet drawings showing internal block diagram connections shall be provided.
- C. Wiring diagrams, detailing wiring for power, signal, and control, differentiating clearly between manufacturers installed wiring and field installed wiring. Identify terminals to facilitate installation, operation and maintenance.
- D. Provide a riser diagram for the system showing in technically accurate detail all connections, interconnections, and all provisions available and made for adaptability of all specified future functions and including all calculations, charts, and test data necessary to demonstrate that all systems and system components deliver the specified signals, grades, and levels at all required points and locations.

1.07 REGULATORY REQUIREMENTS

- A. The entire installation shall comply with all applicable and safety codes. All central equipment and additional applicable equipment shall be listed by Underwriters' Laboratories, per US requirements. Note: Furnish an original, dated specimen of the test agency's listing card with the submittal.
- B. All equipment with digital apparatus (microprocessors) that generate and use timing signals at a rate in excess of 9,000 pulses per second to compute and operate must be Federal Communications Commission (FCC) and DOC CSA standards C108.8 (Electromagnetic Emissions) compliant. Any non-compliant equipment supplied or installed shall not be accepted and shall nullify the contract. Note: Provide documents supporting and verifying compliance.
- C. Systems shall be considered non-compliant unless they completely meet the criteria as outlined in this section. All supporting documentation shall be included as part of the initial submittal package. Letters regarding "future approval" or "approval pending" shall not be considered.

PART - 2 PRODUCTS

2.01 GENERAL

- A. All materials and equipment installed under this contract shall be new, unused, free of defects, and of current manufacture. Equipment and material shall carry Underwriters Laboratory certification if required by local, state or national codes.
- B. The installation shall include a comprehensive programmable microprocessor based communications system consisting of a central switching exchange capable of handling up to 32 paging zone groups each capable of 99 zones.
- C. The Paging System Controller is to interface with AMX SchoolView in a manner that allows any telephone handset to be used as a microphone for access to the paging system upon entering the proper access code for the paging system. All components necessary to interface the paging system to the VoIP phone system shall be the responsibility of this contract.
- D. Interface with clock system for time synchronization.
- E. The central switch shall utilize standard dual tone multi-frequency type decoding (DTMF) for conformance with standard telephone practices.
- F. Provide an amplifier circuit for each of the paging zones. Provide separate paging zones as shown on drawings.

- G. Provide eight (8) separate time-tone schedules with a minimum of 1024 events. Individual events of each schedule shall be capable of sounding one of nine user defined tone types. These schedules can be run individually or simultaneously.
- H. Provide eight (8) internal relays which can be activated manually from any administrative phone or automatically via an optional integral Master Time Control Center.
- I. Program distribution of audio program sources to any one or group of paging zones.
- J. System shall be capable of nine (9) built in software definable signaling tones.
- K. Two (2), three (3) or four (4) digit programmable zone numbers for paging zones.
- L. Integral internal program clock for time tone distribution and other time related functions. It shall be possible to synchronize the program clock from an external master clock.
- M. Pre-announce tones will alert the listeners of incoming calls with distinct tones for each priority level. To prevent unauthorized monitoring, the tone will sound whenever an area is being monitored, and will repeat at regular intervals. Facilities shall also be provided to defeat the tone repeat function from the console if it is not desired.
- N. Emergency and All Call paging and a minimum of 32 zones of group paging - The paging zones shall be independent of the time tone and audio program distribution zones and a minimum of 8 clock messaging zone. Systems sharing zones for both paging and tone shall not be acceptable.
- O. As per FEMA SB-40, Call-in device in the classroom will be in the form of a call switch and shall include a privacy option. The system shall be capable of call-switch supervision as well as the ability to install multiple, supervised call-switches in a single room. Multiple call switch installation shall allow for each switch to be programmed to call separate console locations and have separate priorities. Systems that require additional cabling for this feature shall not be accepted.
- P. The paging speaker shall be 8" with integral transformer assembly. Provide with metal baffles and enclosures
- Q. Gym and Commons area speakers to be equipped with vandal resistant baffle.
- R. Weatherproof outside paging loudspeakers shall have a minimum power rating of five (5) watts. The speaker shall have a minimum frequency response of 80-10KHz and a dispersion angle of 120 x 60 degrees.
- S. It shall be possible to distribute paging, time tone class change, or emergency signal to all rooms or specific groups of rooms as programmed into the system software.
- T. Program sources for distribution shall be:
 - 1. An Owner provided MP3 player.
 - 2. Provide a Music input along with the emergency microphone located in the Main office.
- U. All programmable functions shall be located in battery backed ram to prevent loss in a power failure condition

2.02 PRE-APPROVED PART

- A. AMX SchoolView, Unified Campus system shall be accepted for both paging and master clock system (Section 27 5313) as a complete package.

2.03 LAN/WAN CONNECTIVITY

- A. Controller access and operation shall be one hundred percent compatible with IEEE 802.3 Ethernet and be equipped a LAN port for offsite programming and diagnostics.
- B. System must have the capability to add optional remote stations/ power supplies with LAN connectivity to main controller.

PART - 3 EXECUTION

3.01 INSTALLATION

- A. Complete system shall be installed in strict accordance with manufacturer's recommendations.
- B. All wiring shall be installed in raceways or plenum rated, where routed through plenum ceiling areas.
- C. All cable shall be as per manufacturer specification.

3.02 DISTRICT COORDINATION

- A. Contractor shall be responsible for coordination of all IP address requirements with District.
- B. Contractor shall coordinate all routing and firewall requirements and verify proper operation with District IT staff.

3.03 INSPECTION AND TEST UPON COMPLETION

- A. Check-out and final connections to the system shall be made by a factory trained technician in the employ of a manufacturer of the products installed. In addition, factory trained technicians shall demonstrate operation of the complete system and each major component to the Owner. At a minimum, the following must be demonstrated:
 - 1. Paging of each zone to verify volume and clarity of message
 - 2. Synchronization of clocks, bells and paging to same (exact) time.
 - 3. Paging from telephone handsets from any location within the school.
 - 4. Ability to program multiple, different schedules for bells to heard throughout he buildings speakers and horns.
 - 5. Remote access capability
- B. System field wiring diagrams shall be provided to this subcontractor by the system manufacturer prior to installation.
- C. All materials and installation shall be guaranteed to be free of defects in material and workmanship for one year after final acceptance of installation and test.
- D. As-built drawings: 3 sets. They should include up-to-date drawings that include any changes made to the system during installation. Circuit diagrams and other information necessary for the proper operation and maintenance of the system shall be included. Drawings must be provided on CD in AutoCAD® 2010 format.
- E. Upon completion of the installation, four (4) copies of complete operational instructions shall be furnished, complete with record drawings. Instructions shall include part numbers and names, addresses, and telephone numbers of parts source. Final payment shall not be made until operational manuals have been received.
- F. Upon completion of the installation of the equipment, the Contractor shall provide to the Owner or the Owner's Representative a signed statement from the equipment supplier that the system has been wired, tested, and functions properly according to the specifications.
- G. Nothing herein contained shall be construed to relieve the Contractor from furnishing a complete and acceptable electrical wiring system in all its categories. The Owner or the Owner's Representative will condemn and reject any materials or labor which are or may become detrimental to the accomplishment of the intentions of these specifications.

END OF SECTION

SECTION 27 5313
CLOCK SYSTEMS

PART - 1 - GENERAL

1.01 GENERAL

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.

1.02 WORK INCLUDED

- A. Master Clock / Transmission System
 - 1. Primary Encoder with GPS Receiver
 - 2. Primary Internal Transmitter
 - 3. Primary External Transmitter
- B. Wireless Synchronized Devices
 - 1. Analog Clock
 - 2. Digital Clock
 - 3. Alphanumeric Data Display

1.03 RELATED SECTIONS

- A. Section 27 0500 - Communications
- B. Section 27 5113 – Paging System

1.04 QUALITY ASSURANCE

- A. See Section 27 0513
- B. All clocks and associated equipment shall be installed in a neat and workmanlike manner.
- C. All secondary clocks will be tested and certified for synchronization and Daylight Savings Time adjustment.

1.05 DEFINITIONS

- A. GPS: Global Positioning System, a worldwide system that employs 24 satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits atomic time, the most accurate and reliable time.

1.06 SYSTEM DESCRIPTION

- A. GPS synchronized wireless time system shall continually synchronize clocks, data display units and PA speakers time throughout the facility and wireless PA voice messaging where needed.
- B. The system shall synchronize all clocks to each other. The system shall utilize GPS technology to provide atomic time to all its components. The system shall not require any hard wiring (beside AC power) for all its components. Analog clocks shall be battery operated. Clocks shall automatically adjust for Daylight Savings Time.
- C. The system shall provide a text messaging to a specific or group of Alphanumeric Data Display units.
- D. Analog Clocks shall be synchronized within 2 milliseconds up to 6 times per day, and each clock shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that overall clock accuracy shall not exceed plus or minus 0.05 seconds.
- E. The system shall include an internal real time clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating the right time.
- F. The system shall provide an 802.3 Ethernet based network interface to enable system remote programming and maintenance.

- G. The system shall incorporate a "fail-proof" design so that a temporary power interruption shall not cause failure of the all system. Upon restoration of power, the system shall resume normal operation without the need to reset the system or any of its components.
- H. The system shall include a test pager, to notify maintenance personnel of any system malfunction.

1.07 REGULATORY REQUIREMENTS

- A. Equipment and components furnished shall be of manufacturer's latest model.
- B. Encoder, Transmitter and receiver shall comply with Part 90 of FCC rules, as follows:
 - 1. This device may not cause harmful interference, and
 - 2. This device must accept interference received, including interference that may cause undesired operation.
 - 3. Transmitter frequency shall be governed by FCC Part 90.35.
 - 4. Transmitter output power shall be governed by FCC Parts 90 and 74.
- C. System shall be installed in compliance with local and state authorities having jurisdiction.

1.08 SUBMITTALS

- A. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure showing available colors and finishes of clocks.
- B. Operating License: If license is required, submit evidence of application for operating license prior to installing equipment. Furnish the license, or if the license has not been received, a copy of the application for the license, to the Owner prior to operating the equipment. When license is received, deliver original license to Owner.
- C. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed at the location directed.
- D. Manufacturer's Instructions: Submit complete installation, set-up and maintenance instructions.

1.09 SUBSTITUTIONS

- A. Proposed substitutions, to be considered, shall be manufactured of equivalent materials that meet or exceed specified requirements of this Section.
- B. Proposed substitutions shall be identified not less than 10 days prior to bid date.
- C. Other systems requiring wiring and/or conduit between master and clocks will not be acceptable.

1.10 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing commercial wireless systems with a documented experience of minimum of 10 continuous years.
 - 2. Installer: Company with documented experience in installation of commercial wireless systems.

1.11 DELIVERY STORAGE AND HANDLING

- A. Deliver all components to the site in the manufacturer's original packaging. Packaging shall contain manufacturer's name and address, product identification number, and other related information.
- B. Store equipment in finished building, unopened containers until ready for installation.

1.12 PROJECT SITE CONDITIONS

- A. Clocks shall not be installed until painting and other finish work in each room is complete.
- B. Coordinate installation of GPS receiver and external antenna (if used) for access to the roof or exterior side-wall so that the bracket and related fasteners are watertight.

PART - 2 PRODUCTS

2.01 MANUFACTURER

- A. GPS synchronized wireless time, voice and data system and its components shall be manufactured by Sapling, Inc, 1633 Republic Road Huntingdon Valley, PA 19006, (215).322.6063 , or approved alternate. Where Sapling parts are called out, appropriate AMX products are acceptable and considered equal.
- B. AMX SchoolView, Unified Campus shall be accepted as equal substitution for both master clock and paging system (Section 27 5113) as a complete package.

2.02 CLOCK CONTROLLER

- A. The Master Clock / Transmitter shall be the Sapling SAM 3000 or approved alternate. The transmitter shall be:
 - 1. Capable of transmitting data to wireless analog clock and wireless digital clock
 - 2. Capable of receiving a signal from an atomic clock web site via the Internet
 - 3. Controlled via the web
- B. Additionally, the master clock shall have software that allows it to:
 - 1. Act as a (S)NTP Server
 - 2. Activate a countdown feature on digital clock models
- C. The transmitter shall have a programmable auxiliary relay and shall be programmed anywhere from 1—99 seconds. Upon utilization of the relay, the transmitter will be capable of interfacing with a once a day closure or interfacing with intercom systems.
- D. The transmitter shall be capable of acting as a repeater while receiving a signal wired or wirelessly from the main transmitter.
- E. Web Interface – The master clock shall be able to be programmed completely from a web interface that can be accessed through any typical web browser such as Microsoft Internet Explorer or Mozilla Firefox. The interface shall allow the user to program all bell schedules, events, display features, IP settings of the master clock and any system setting that the master clock has.
- F. The transmitter shall be capable of transmitting data to the SAL wireless analog clock and the SBL wireless digital clock. The master clock shall be capable of receiving a signal from any SNTP time server via the Internet. The transmitter shall utilize 915–928 MHz frequency–hopping technology. The master clock shall be capable of acting as a repeater while receiving a signal wired or wirelessly from the main master clock. The transmitter shall be FCC compliant, part 15 Section 15,247.

2.03 WIRELESS REPEATER

- A. Wireless repeater shall be Sapling SMA 1000 locate in IDF2..

2.04 ANALOG CLOCK

- A. The secondary clock shall be a Sapling SAL Series wireless clock or approved alternate. The clock will be capable of receiving a signal from multiple clocks. The clock shall receive and transmit with 915–928 MHz frequency–hopping technology.
- B. The clock is to be capable of transmitting the time simultaneously without interfering with each other. The clocks shall include automatic calibration and a diagnostic function that allows the user to view the quality of the signal, the last time the clock received a correction signal, a gearbox test and a comprehensive analysis of the entire clock.
- C. The clock shall have a maximum correction time of five (5) minutes. It shall be designed to be used with the Sapling Transceiver or the Sapling Repeater, which can be regulated via Sapling wireless communication protocol. Upon receipt of the wireless signal, the clock will immediately self–correct.
- D. The clock shall have a semi–flush smooth surface ABS case. The dial is to be made of durable polystyrene material. The crystal is to be shatterproof, side molded polycarbonate. Glass and visible molding marks are unacceptable.

- E. The classroom and administrative area clocks shall be 12 inches in diameter (minimum), have black hour and minute hands.
- F. The Gymnasium clocks shall be 16 inches in diameter (minimum), have black hour and minute hands. Gymnasium clocks shall be protected by a cage specifically designed for such purpose that does not interfere with the readability of the clock.

2.05 DIGITAL CLOCK

- A. The digital clocks shall be 24 volts AC/DC; the clock receives and transmits time every one (1) minute.
- B. The elapsed timer shall be capable of working in conjunction with either the four (4) digit or six (6) digit digital clocks and shall have the ability to count down or count up.

PART - 3 EXECUTION

3.01 INSTALLATION

- A. Provide Clocks in all rooms as noted. Final placement may be field determined. Coordinate with Architect elevations.
- B. Clock headend equipment shall be installed in Main Equipment Room (MDF).
- C. Wireless repeater shall be located in the Telecommunications Room (IDF.2).

3.02 START-UP

- A. Synchronize secondary clocks with master clock and Intercom System.
- B. Cycle through Daylight Savings Time and verify correct time change on all clocks. Document results and include in as-built documentation.

3.03 TRAINING

- A. Provide system training to Owner which addresses all phases of operation including:
 - 1. System programming from local PC using a networked connection from the Main Office
 - 2. Remote access methodology
 - 3. Build standard daily schedule for purposes of test and verification of operation.
- B. Provide two follow-up sessions of one hour each as requested by the Owner. These sessions shall be within 60 days of system acceptance.

END OF SECTION

**SECTION 28 0500
COMMON WORK RESULTS FOR SECURITY**

PART 1 GENERAL

1.01 DIVISION INCLUDES

- A. Access Control
- B. Intrusion Detection
- C. Video Surveillance
- D. Integration with AMX AV system, Lighting and DDC controls
- E. Wiring

1.02 RELATED WORK BY OTHERS

- A. All rough-in category 6a data cabling to support the system will be provided by Division 27 – Communications Horizontal Cabling

1.03 RELATED REQUIREMENTS

- A. 27 4116 Integrated Audio Video Systems
- B. 28 1313 Access Control Applications
- C. 28 1316 Access Control Database Management
- D. 28 1319 Access Control Infrastructure
- E. 28 1326 Access Control Remote Devices
- F. 28 1333 Access Control Interfaces
- G. 28 1343 Access Control ID Management
- H. 28 1613 Security Controls and Management Systems
- I. 28 1619 Security Systems Infrastructure
- J. 28 1633 Security Systems Remote Devices

1.04 SUMMARY

A. LABOR AND MATERIALS

- 1. Unless otherwise provided in the Drawings and Specifications, the Contractor shall provide and pay for all labor, materials, equipment, tools, utilities, construction equipment and machinery, transportation and other facilities and services necessary for the proper execution, operation and completion of the Work.

B. SPECIFICATION LANGUAGE

- 1. Specifications and notes are written in imperative and abbreviated form. Imperative language of the technical specifications is directed at the Contractor, unless specifically noted otherwise. Incomplete sentences shall be completed by inserting “shall”, “shall be”, “the Contractor shall”, and similar mandatory phrases by inference. The words “shall be” shall be supplied by inference where a colon (:) is used within product specifications.

C. DRAWINGS AND SPECIFICATIONS

- 1. Contractor shall be provided up to three (3) sets of the Drawings and Specifications for their use. Additional sets, if requested by Contractor, shall be furnished to the Contractor for the actual cost of reproduction.
- 2. Contractor shall carefully study the Drawings and Specifications, and shall at once report any error, unforeseen circumstances, inconsistency or omission he may discover.

3. The Eugene School District Project Manager shall be the interpreter of the requirements of the Drawings and Specifications, subject to the final approval of Eugene School District. All interpretations and opinions of the Security Consultant shall be made in writing or in the form of drawings.

D. INTENT AND CORRELATION

1. The intent of the Project Drawings and Specifications is to include all items necessary for the proper execution and completion of the Work.
2. The Project Drawings and Specifications are complementary, and what is required by any one shall be as binding as if required by both.

1.05 REFERENCES

- A. Submit the names and phone numbers of customers for at least three other projects of similar size and complexity using similar technologies.

1.06 DEFINITIONS

- A. Words that are in common use are used throughout the Drawings and Specifications, except:
 - B. Words which have well-known technical or trade meanings are used in accordance with such recognized meanings.
 - C. Whenever the following listed words and phrases are used, they shall be mutually understood to have the following respective meanings:
 - D. The words "as indicated." means: as shown on the Drawings, and in accordance with the Specifications.
 - E. The words "as required." means: as required to provide a complete and satisfactory Work in full conformance with the Drawings and Specifications.
 - F. The word "New" means: new Work to be provided by Contractor.
 - G. The word "Provide" means: furnish, install, connect, test and make ready for use.
 - H. The words "Relocate existing" means: remove existing item from present location. Reinstall, re-connect, and test existing item and make ready for use at new location as shown on the Drawings.
 - I. The words "Remove existing" means: remove existing item and return item to Eugene School District.
 - J. The word "Replace" means: remove existing item and return item to Eugene School District. Provide new item as indicated.
 - K. The word "Work": The Work is the completed construction required by the Drawings and Specifications, and includes all labor necessary to produce such construction, and all materials and equipment incorporated or to be incorporated in such construction.
 - L. The word "Furnish" means: supply item as specified.

1.07 CONTRACTOR DESIGN REQUIREMENTS

- A. The Project Drawings represent the level of system design to be provided by Eugene School District. Contractor shall provide all additional system design work required, including:
 1. Point-to-point equipment hook-up information.
 2. Equipment mounting details
 3. Design of equipment cabinets
 4. Other detailed design work required.

- B. Contractor's design shall conform to all applicable codes and ordinances. All electrical design, including the sizing and placement of conduit, raceways and conductors, shall be in accordance with NFPA 70: National Electrical Code, current version, unless local codes establish more stringent requirements.
- C. Contractor's design work is subject to review and approval by Eugene School District's Project Manager.
- D. Contractor's design shall also include:
- E. Complete "as-built" documentation of all security systems, including documentation of existing equipment, wiring, conduits, and raceways.
- F. Other Work as defined within the Project Drawings and Specifications.

1.08 SUBMITTALS

- A. Product Data
 - 1. Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended.
 - 2. Provide submittals to Eugene School District's Project Manager and Architect.
 - 3. Submit three (3) copies of each submittal.
- B. Manufacturers Installation and Programming Instructions
 - 1. Provide Manufacturers Installation and Programming Instructions as requested in the various Specification Sections.

1.09 PROJECT RECORD DRAWINGS

- A. Definition: Project Record Drawings are drawings that completely record and document all aspects and features of the Work. (Also known as "as-built" drawings.)
- B. The purpose of Project Record Drawings is to provide factual information regarding all aspects of the Work, to enable future service, modifications, and additions to the Work.
- C. Project Record Drawings are an important element of this Work. Contractor shall accurately maintain Project Record Drawings throughout the course of this project. Project Record Drawings shall include documentation of all Work, including the documentation of existing equipment, wiring, conduits, and raceways that are to be reused in the Work.
- D. Eugene School District Project Manager shall furnish Contractor with two (2) sets of site plans for Contractor's use in preparing Project Record Drawings. One set shall be used as a working set; the other shall be used to prepare the final record set.
- E. Contractor shall maintain the working set of Project Record Drawings at the project site throughout the course of the Work. The working set shall be updated on a daily basis as the Work progresses.
- F. Project Record Drawings shall accurately show the physical placement of the following:
 - 1. Equipment and devices
 - 2. Junction and pull box locations.
 - 3. Interfaces to external equipment
 - 4. Connections to power and data circuits

- G. Project Record Drawings shall show the physical placement of each device and conduit or aerial center line, to be accurate to within one foot (1') of the nearest landmark. Where the site plan furnished by Eugene School District Project Manager conflicts with actual conditions, Contractor shall amend site plan as required. Indicate exact description of conduit runs (above ground, two foot trench, along outside wall of building, etc.).
- H. Project Record Drawings shall show wire and cable runs, zone numbers, tamper circuit configuration, panel/circuit breaker numbers from which equipment is powered, and splice points. Such information may be shown on the site plans.
- I. Project Record Drawings shall be available for inspection by Eugene School District Project Manager on a daily basis. Incomplete or inaccurate Project Record Drawings may be cause for delay of Contractor's payment.
- J. Upon completion of Work, and prior to Final Acceptance, Contractor shall prepare and submit to Eugene School District Project Manager a final record set of Project Record Drawings. This set shall consist of all data transferred from the working set, supplemented by Riser Diagrams and other information. The final record set of Project Record Drawings shall be drafted by a skilled draftsman, under the supervision of Contractor. All final Project Record Drawings shall be provided to Eugene School District.
- K. System Documentation
 - 1. Definition: System Documentation is a complete collection of all installation, programming, operation, and maintenance manuals and work sheets relating to the equipment provided as part of the Work.
 - 2. Contractor shall maintain a file of System Documentation at the project site throughout the course of the Work. Such file shall be updated with new information as equipment is received and installed. System Documentation shall be available for inspection by Eugene School District Project Manager on a daily basis.
 - 3. Upon completion of Work, and prior to final Acceptance, Contractor shall prepare and submit to Eugene School District Project Manager three (3) sets of System Documentation.
- L. Closeout Submittals
 - 1. Provide a set of as-built drawings and manuals to the Eugene School District Project Manager
 - 2. As-Built Drawings
 - 3. Mounting Details
 - 4. Product Data
 - 5. Installation Manuals
 - 6. Operating Manuals
 - 7. Maintenance/Service Manuals
- M. Provide the Eugene School District Project Manager- with all programming sheets, keys to the equipment cabinets, as-built drawings, operating manuals, maintenance/repair manuals, spare fuses, all programming sheets and keys to the equipment cabinets, tools for tamper-resistant enclosures and tools for manual resetting devices.

1.10 QUALITY ASSURANCE

- A. Qualifications of Contractor
 - 1. Contractor shall be an installation and service contractor regularly engaged in the sale, installation, maintenance and service of access control systems.
 - 2. Contractor shall have three years' experience with the installation, start-up and programming of systems of a similar size and complexity to the one proposed.
 - 3. Contractor shall be a factory authorized dealer of the system proposed.

B. Supervision of Work

1. Contractor shall employ a competent Project Manager to be in responsible charge of the Work and be on project site during the execution of the Work.
2. Contractor's Foreman shall be a regular employee, principle, or officer of Contractor, who is thoroughly experienced in projects of a similar size and type. Contractor shall not use contract employees or Subcontractors as Foremen.
- 3.

C. Qualifications of Technicians

1. All electronic systems Work shall be performed by electronic technicians thoroughly trained in the installation and service of specialty low-voltage electronic systems.
2. Journeyman electricians may be used to install conduit, raceways, wiring, and the like, provided that final termination, hook-up, programming, and testing is performed by a qualified electronic technician, and that all such Work is supervised by the Contractor's Foreman.
3. All incidental Work, such as cutting and patching, lock hardware installation, painting, carpentry, and the like, shall be accomplished by skilled craftsperson regularly engaged in such type of work. All such Work shall comply with the highest standards applicable to that respective industry or craft.
4. All 120 VAC power wiring and connections are to be performed by a qualified Journeyman Electrician, licensed to perform such Work in the Eugene School District.

D. Subcontractors

1. Definition: A Subcontractor is a person or entity who has a direct contract with the Contractor to perform any of the Work at the site.
2. Use of any Subcontractor is subject to the approval of Eugene School District. The Contractor shall identify all Subcontractors on the Bid Form. The Contractor shall make no substitution for any Subcontractor previously selected without approval from Eugene School District.
3. Contractor's Foreman shall be on the project site daily during all periods when Subcontractors are performing any of the Work. Contractor's Foreman shall be in responsible charge of all Work, including any Work being performed by Subcontractors.
4. By an appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Drawings and Specifications, and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these documents, assumes toward Eugene School District.

E. Supervision and Construction Procedures

1. The Contractor shall supervise and direct the Work, using their best skill and attention. Contractor is solely responsible for all construction means, methods, and techniques.
2. The Contractor shall employ a competent foreman who shall be in attendance at the project site during the progress of the Work. The foreman shall represent the Contractor and all communications given to the foreman shall be as binding as if given to the Contractor.

F. Regulatory Requirements

1. All Work is to conform to all building, fire, and electrical codes and ordinances applicable in the Eugene School District. In case of conflict between the Drawings/Specifications and codes, the codes shall govern. Notify Eugene School District Project Manager of any such conflicts.
2. Contractor shall secure and pay for all licenses, permits, plan reviews, engineering certifications, and inspections required by regulatory agencies. Contractor shall prepare, at Contractor's expense, any documents, including drawings that may be required by regulatory agencies.

G. Permits

1. The Contractor shall make application for and obtain any and all permits required by federal, state, county, city, or other authority having jurisdiction over the work.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Security of Contractor's Tools and Equipment: Eugene School District is not responsible for the care, storage or security of any of the Contractor's tools or equipment.

1.12 PROJECT/SITE CONDITIONS

A. Environmental Conditions

1. Power: Electrical power will be supplied by Eugene School District to the extent that the usage is compatible with available facilities in the vicinity of the work.
2. Parking: Eugene School District reserves the right to limit or restrict Contractor parking based upon the daily requirements of the other contractors on site.
3. Dust Control: Make provisions to control all dust, dirt, and foreign material caused by the performance of the Work.
4. Notify Eugene School District immediately of any damage or possible damage to any other equipment.

B. Clean-Up

1. Contractor shall clean-up, on a daily basis as the Work progresses, all dirt, dust and debris caused by Contractor's operations. Clean-up shall be completed by the end of each workday to the satisfaction of Eugene School District's on-site representative.
2. In the event that Contractor fails to clean-up, Eugene School District may elect to have clean-up performed by others, with the costs of such clean-up being charged to the Contractor.

C. Construction Aids

1. Definition: Construction Aids are facilities and equipment required by personnel to facilitate the execution of the Work. Construction Aids include scaffolds, staging, ladders, platforms, hoists, cranes, lifts, trenchers, core drillers, protective equipment, and other such facilities and equipment.
2. Contractor shall provide all Construction Aids required in the execution of the Work. Construction Aids that are the property of Eugene School District or other contractors shall not be used without permission.
3. Storage of Construction Aids shall be coordinated with Eugene School District's on-site representative.

D. Safety

1. The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work.

2. Contractor shall comply with all local, state, and federal regulations and laws for the safety of the work place.

E. Existing Conditions

1. Eugene School District does not warrant the condition of any portion of the existing wiring, conduit or raceway systems. Prior to submitting their proposal, Contractor shall examine all existing conditions and determine to what extent the existing wiring, conduit, and raceway systems may be reused.

1.13 SEQUENCING

F. Description

1. This implementation plan describes the general approach that shall be followed in order to minimize the time for the access control systems to be operational.

G. Approach

1. Contractor shall plan and schedule all work in such a sequence as to minimize the time before the system is operational. The following is a suggested work sequence:
2. Order all equipment needed and notify any subcontractors to schedule their participation.
3. Perform all system layout work.
4. Insure there are an adequate number of power receptacles available to operate all security equipment and coordinate with Eugene School District as to where power is available.
5. Provide shop drawings to verify location of all equipment, conduit runs, power connections, etc. Submit shop drawings to Eugene School District Project Manager.
6. Coordinate with Eugene School District to provide space in each building's Communications Room for mounting of processors.
7. Provide training on how to fill out the programming sheets for access levels.
8. Prepare and pre-test all equipment to the greatest extent possible.
9. Install all equipment.
10. Provide training on the programming other various options.
11. Test and inspect all systems.
12. Perform all other Work as required.
13. Perform the Acceptance Test.
14. Provide training.
15. Provide as-built drawings.

1.14 SCHEDULING

- A. The Contractor, within five (5) days after being awarded the contract, shall prepare and submit for Eugene School District's information, an estimated progress schedule for the Work. The progress schedule shall be related to the entire project, and shall indicate start and completion dates.

1.15 WARRANTY

- A. Contractor warrants that all Work furnished (material and labor) under this Contract will be of good quality, free from faults and defects, and in conformance with the Project Drawings and Specifications.
- B. Contractor shall provide a parts and labor guarantee on all Work. Unless otherwise specified herein, Contractor's guarantee shall be for a period of two (2) years from date of

Acceptance, except where any specific guarantees from a supplier or equipment manufacturer extends for a longer time.

- C. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including costs of labor, transportation, lodging, materials, and equipment.
- D. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modification or repair by Eugene School District, or acts of god.
- E. Contractor shall promptly respond to Eugene School District's requests for service during the guarantee period. Contractor shall provide repair service as soon as reasonably possible upon request from Eugene School District, but in no case shall service response exceed 24 hours from time of request.

1.16 OWNER'S INSTRUCTIONS

- A. Coordination with Eugene School District
 - 1. Contractor shall closely schedule and coordinate their activities with designated Eugene School District representatives.
 - 2. Contractor shall provide Eugene School District's Project Manager with a work plan on a weekly basis. Such work plan will describe locations of intended activities, types of activities, and potential conflicts to facility operations.
- B. District's Right to carry out the Work
 - 1. If the Contractor defaults or neglects to carry out the Work in accordance with the Project Drawings and Specifications and fails within seven days after receipt of written notice from Eugene School District to commence and continue correction of such default or neglect with diligence and promptness, Eugene School District may, after seven days following receipt of an additional written notice and without prejudice to any other remedy Eugene School District may have, make good such deficiencies. In such case, an appropriate Change Order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies.
- C. Minor Changes in the Work
 - 1. Eugene School District shall have the authority to order minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time and not inconsistent with the intent of the Project Drawing and Specifications. Such changes shall be provided by written order.

1.17 COMMISSIONING

- A. After all Work is completed, and prior to requesting the Acceptance test, Contractor shall conduct a final inspection, and pre-test all equipment and system features. Contractor shall correct any deficiencies discovered as the result of the inspection and pre-test.
- B. Contractor shall submit a request for the Acceptance test in writing to the Eugene School District Project Manager, no less than fourteen days prior to the requested test date. The request for Acceptance test shall be accompanied by a certification from Contractor that all Work is complete and has been pre-tested, and that all corrections have been made.
- C. During Acceptance test, Contractor shall demonstrate all equipment and system features to Eugene School District. Contractor shall remove covers, open wiring connections, operate equipment, and perform other reasonable work as requested by Eugene School District.
- D. Any portions of the Work found to be deficient or not in compliance with the Project Drawing and Specifications will be rejected. Eugene School District Project Manager will prepare a list of any such deficiencies observed during the Acceptance test. Contractor shall promptly correct all deficiencies. Upon correction of deficiencies, Contractor shall submit a request in writing to Eugene School District Project Manager for another Acceptance Test.

- E. If, at the conclusion of the Acceptance Test, all Work is found to be acceptable and in compliance with the Project Drawings and Specifications, Eugene School District Project Manager will issue a letter of Acceptance to Contractor and Eugene School District.

1.18 MAINTENANCE

- A. Provide full procedures for all database back-ups.
- B. Provide full procedures for server/workstation hard drive maintenance, such as defrag, etc.
- C. Provide full procedures for maintaining physical and software firewalls.
- D. Provide full procedures for upgrading software.
- E. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

2.01 GENERAL

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.

2.02 RELATED REQUIREMENTS.

- A. Product Availability
 - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into their proposed Contract Time.
 - 2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify their ability to procure the products specified prior to submitting a proposal.

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. The system shall only be provided by Contractors who are factory authorized to install, service and maintain the system by the access control manufacturer.
- B. The Contractor must be a factory authorized dealer with the proposed manufacturer.
- C. The Contractor's installers and technicians shall also be factory trained and certified to perform such tasks.

3.02 EXAMINATION

- A. The Contractor shall be required to visit the installation site prior to bidding the job.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

3.03 PREPARATION

- A. The Contractor shall order all required parts and equipment upon notification of award of the Work.
- B. The Contractor shall bench test all equipment prior to delivery to the job site.
- C. The Contractor shall verify the availability of power where required. If a new source of power is required, a licensed electrician shall be used to install it.
- D. The Contractor shall arrange for obtaining all programming information including access times, free access times, door groups, operator levels, etc.

- E. The Access Contractor shall coordinate with the Door Hardware Contractor requirements at each door equipped with intrusion or access control components.

3.04 INSTALLATION

- A. The Contractor shall coordinate with the Eugene School District's IT Department when connecting to their network.
- B. The Contractor shall carefully follow the instructions in the manufacturers' Installation Manual to insure all steps have been taken to provide a reliable, easy to operate system.
- C. Perform all Work as indicated in the Drawings and Specifications.
- D. All communications cables shall be kept away from power circuits.
- E. The Contractor shall also execute adequate testing of the system to insure proper operation.
- F. The Contractor shall provide adequate training of the system users to insure adequate understanding to prevent operating errors.
- G. Coordinate with Division 27 for connections to paging, intercom and video systems for lockdown, lockout and emergency notifications.
- H. Coordinate with Division 28 fire alarm system for release of magnetically held doors.

3.05 WORKMANSHIP

- A. Comply with National Electric Code® as well as recognized industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform Work with persons experienced and qualified to produce workmanship specified.
- C. Maintain quality control over suppliers and Subcontractors.
- D. Quality of workmanship is considered important. Eugene School District Project Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.

3.06 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench test per manufacturer's installation instructions.

3.07 GROUNDING

- B. Provide earth-grounding of equipment as required by equipment manufacturer. Earth ground shall be connected to ground rod or approved cold water pipe. Electrical or telephone ground connections shall not be used as earth grounds. Connections to mounting posts or building structural steel shall not be used as earth grounds.

3.08 POWER TO SECURITY EQUIPMENT

- A. Power all equipment from 120 VAC circuit dedicated for security use, except as noted. Mark all panel circuit breakers with labels worded "Security Equipment - Do Not Operate", or equivalent.
- B. All plug-in transformers shall be located at the security control panels. Secure all low-voltage plug-in transformers to outlet with screw or strap. Clearly label all transformers to identify purpose and use.

3.09 CUTTING AND PATCHING

- A. The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work.

3.10 PLYWOOD BACKING

- A. Install the processor(s), power supplies, and all other related equipment on a plywood backboard (installed by Others) in the nearest Telecommunication Room.

3.11 FIELD QUALITY CONTROL

- A. Upon reaching Substantial Completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify Eugene School District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to Eugene School District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system, have personnel available with tools and equipment to remove devices from their mounts to inspect wiring connections. Provide wiring diagrams and labeling charts to properly identify all wiring.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify Eugene School District when ready to perform a re-inspection of the installation.

3.12 MANUFACTURER PROFESSIONAL SERVICES

- A. Contractor shall coordinate with the manufacturer to provide the manufacturer's professional services team to assist the Owner in coordinating the interfaces between the security management system and other on-site systems as necessary.
- B. Professional Services personnel shall be employed by the manufacturer of the security management system and shall be thoroughly knowledgeable of the security management system applications.
- C. Professional Services personnel shall be on-site and available to meet with Owner's representatives for a period of not less than two consecutive days. On-site visit shall be scheduled at the convenience of the Owner.

END OF SECTION 28 0500

**SECTION 28 1313
ACCESS CONTROL APPLICATIONS**

PART 1 GENERAL REQUIREMENTS

1.01 GENERAL

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.02 SECTION INCLUDES

- A. Head-end Software

1.03 RELATED SECTIONS

- A. 28 0500 Common Work Results for Safety and Security
- B. 28 1316 Access Control Database Management
- C. 28 1319 Access Control Infrastructure
- D. 28 1326 Access Control Remote Devices
- E. 28 1333 Access Control Interfaces
- F. 28 1343 Access Control ID Management
- G. 28 1613 Intrusion Detection Panels
- H. 28 1619 Intrusion Detection Remote Devices
- I. 28 1633 Intrusion Detection Interfaces

1.04 SYSTEM USER REQUIREMENTS

- A. System Overview
 - 1. The contractor shall provide and install a new integrated security management system that shall provide a simple and easy-to-use graphical user interface. The system shall provide local operational control of all access points and alarm sensors.
 - 2. The system shall carry the UL mark, and shall meet the requirements of UL-294.
 - 3. The manufacturer shall be ISO 14000 and 14001 certified indicating their commitment to conserve energy and reduce waste.
 - 4. The manufacturer shall be a Microsoft Certified Gold Partner. System shall meet Microsoft requirements for "Designed for Microsoft Windows Server 2014" or later and "Designed for Windows 8", or "Windows 10".
 - 5. The manufacturer of the proposed system shall require resellers to pass a formal training program prior to being certified as authorized to sell and install the system. Such certification shall require annual re-qualification. The system integrator proposing the system shall be in possession of such a certification.

6. The Security Management System (SMS) client and server software shall be used in conjunction with intelligent controllers to provide a distributed access control and alarms monitoring system. In the event of a communications failure between the host server and the field controllers, the controllers shall continue to make local access control decisions and save all transactions in memory until communications are restored. At that time the controller shall upload all stored transactions to the server.
7. The SMS shall seamlessly integrate the functions of access control, alarms monitoring and response, digital video imaging, badge design/creation, and visitor management. All SMS components shall run in an integrated application environment as part of a single application.

B. Bandwidth Utilization

1. The proposal shall include documented manufacturer's evidence of network bandwidth utilization including plots and supporting data, covering all aspects of normal system operation. Proposal submissions without supporting documentation shall not be considered or evaluated.

C. Required Standard Software Features

The following software features shall be part of the standard product offering without requiring additional purchase or licensing.

1. The installation of the server and client software shall utilize a "wizard" interface to guide users through the appropriate installation steps.
2. The SMS shall start up as part of the Operating System. The SMS server shall communicate to all clients (operator workstations and field hardware) through WIN32/WIN64 services. The SMS shall run as a service in the OS, and there shall be no requirement to run an application after the operating system is ready.
3. The SMS shall support a Graphical User Interface that minimizes training needs for even inexperienced users. The software shall include on line help displays to eliminate operator reference manuals.
4. It shall be possible to select any function, within a given Operators permission, independent of the currently displayed screen. Functions will be accessed via tool bar icons, which will include "Help" prompts that will appear when the mouse pointer dwells on the selection button. It shall also be possible to link any standard Windows application to a custom toolbar icon.
5. The system shall support an unrestricted number of time codes. A time code is defined as a set of hour definitions – one assigned to each day of the week (including Saturday and Sunday) as appropriate, and assigned to the various types of holidays (exceptions) defined in the system.
6. The system shall support a minimum of 9 holiday types. A holiday type shall be assignable to an unrestricted number of dates on the calendar.
7. The system shall be scalable to a multiple-server implementation where each region (either geographical or logical) has a server capable of making local decisions and configuration changes.

8. Operator Permissions
 - a. System operators shall be associated with a log in Name and Password. A system option will determine whether strong operator passwords will be used. The minimum definition of a strong password shall be a password that contains at least one upper case character, one lower case character, one numeral and one punctuation mark, with a minimum password length of six characters. Additionally the password cannot contain any full word of the operator's username.
 - b. The operator's account shall be assigned to a role in the system. The role is a permission profile. This will determine the functions that shall be available to that operator when logged-on to the system. Each operator is required to only see the functions for which s/he has access. The system shall support an option to hide Personal Identification Numbers of cardholders when an operator is viewing a record.
 - c. Card record data entry shall be divided into operator permission areas, allowing separate permission categories to be assigned for the viewing of personal data, ID badge printing and access right management.
 - d. For all operators, a means of re-arranging their Icon tool bar shall be provided to allow the most frequently used Icons to be repositioned by the operator.
 - e. The system shall store operator preferences based on logon information. This feature shall allow an operator to work with their preferred configuration independent of which workstation they occupy.
 - f. The system shall support an option to reset all window layouts to a pre-defined "Home Screen".

D. Required Available Software Options

1. Threat Level Manager Option
 - a. The TLM option shall provide the ability to make system-wide changes by simply changing the threat level.
 - b. The Threat Level shall be selected from one of five levels that can be labeled and defined by the user. Each threat level shall also have a specified color associated.
 - c. The present state of the system threat level shall be visible from any view within the software.
 - d. The system shall restrict the ability to change threat level to the appropriate operator(s).
 - e. The system shall allow the configuration option to require the approval of two authorized operators to change the threat level.
 - f. The ability to change the threat level shall be integrated into the site map by right clicking on an appropriate icon.
 - g. The system shall automatically disable access rights for individuals that have a threat level threshold below the selected level. The same access rights will automatically be enabled when the threat level changes to a level below their threshold.
 - h. The SMS directory synchronization shall support multiple, disparate directories and flat files simultaneously, and interact with each through agents.

2. XML Developer's Toolkit Option

The system shall support the ability to send and receive commands to/from external web services through an XML interface, the XML Developer's Toolkit. All operations through this interface shall be accompanied by a logon username and password that will be associated in the security management system with operator privileges, which will limit what is permissible. The interface shall use standard security provided by web services.

- a. The XML Developer's Toolkit shall support the import of cardholder details. An external software system may use web services, for example, to add new cardholders, delete cardholders, modify existing cardholder data, make cards inactive, and change access rights.
- b. The XML interface shall allow an external software system to obtain the details of cardholders that are already in the SMS database.
- c. The XML interface shall allow an external software system to view, acknowledge, and clear outstanding SMS alarms.
- d. The XML interface shall allow an external software system to send a command to a device already defined in the SMS (e.g. to open a door or switch on a CCTV camera).
- e. The XML interface shall allow an external software system to view the status of an SMS device (e.g. to determine whether a door is locked or unlocked).
- f. The XML interface shall allow an external software system to import alarms from external equipment, such as intrusion systems.

3. Thin Client Access Option

- a. The system shall provide for an option of thin client access to the security management system. The thin client interface shall utilize Microsoft Terminal Services to provide the same look and feel of the thick client to minimize training time and expense. The thin client shall be capable of the same functionality of a thick client with the exception of functionality that requires access to ports on the thin client computer – Microsoft Terminal Services does not sufficiently support such access.

4. Thin Client Visitor Management Access Option

- a. The system shall provide for an option of thin client access specifically for the visitor management system. The thin client interface shall utilize Microsoft Terminal Services to provide the same look and feel of the thick client to minimize training time and expense. The thin client shall be restricted to Visitor Management functions.

1.05 SUBMITTALS

A. Product Data

Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended.

B. Procedures

1. Provide submittals to Eugene School District's Project Manager.
2. Submit three (3) copies of each submittal.

- C. Manufacturers Installation and Programming Instructions
Provide Manufacturers Installation and Programming Instructions as requested in the various Specification Sections.

1.06 WARRANTY

- A. Contractor warrants that all Work furnished (material and labor) under this Contract will be of good quality, free from faults and defects, and in conformance with the Project Drawings and Specifications.
- B. Contractor shall provide a parts and labor guarantee on all Work. Unless otherwise specified herein, Contractor's guarantee shall be for a period of two (2) years from date of Acceptance, except where any specific guarantees from a supplier or equipment manufacturer extends for a longer time.
- C. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including costs of labor, transportation, lodging, materials, and equipment.
- D. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modification or repair by Eugene School District, or Acts of God.

1.07 MAINTENANCE

- A. Provide full procedures for all database back-ups.
- B. Provide full procedures for maintaining physical and software firewalls.
- C. Provide full procedures for upgrading software.
- D. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- D. Product Availability
 - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
 - 2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.

2.02 ACCESS CONTROL SYSTEM - SYSTEM SPECIFICATIONS

- A. Head-end Hardware and Software, the current District standard system Lenel. No substitutions will be allowed. Access software licenses are Owner Provided.
- B. Access Door Control interface – equip for card access doors as shown on the drawings.
- C. Coordinate ADA interface operation with Division 8.
- D. Interface SMS system with the DMP XR550DNL-G intrusion panel and AMX controls.

PART 3 EXECUTION

3.01 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench test per manufacturer's installation instructions.

3.02 INITIAL PROGRAMMING AND CONFIGURATION

- A. Contractor shall provide initial programming and configuration of the security management system. Programming shall include defining hardware, doors, monitor points, clearance codes, time codes, door groups, alarm groups, operating sequences, camera call-ups, and the like. Input of all program data shall be by Contractor. Contractor shall consult with Consultant and Owner to determine operating parameters.
- B. Contractor shall develop and input system graphics, such as maps and standby screens. Owner shall provide floor plan drawings as the basis for the creation of maps. Development of maps shall include the creation of icons for all doors, monitor points, and tamper circuits. Owner shall provide floor plan drawings, in the form of AutoCAD® .DWG or .DXF files, as the basis for the creation of maps.
- C. Owner, with the cooperation and assistance of Contractor, will input the cardholder data for each access card.
- D. Contractor shall maintain hard copy worksheets which fully document the system program and configuration. Worksheets shall be kept up to date on a daily basis by Contractor until final Acceptance by Owner. Worksheets shall be subject to inspection and approval by Owner. Provide final copies to Owner prior to Project Close-out.

3.03 TRAINING

- A. Contractor shall provide complete operator training on the Security Management System. Training shall consist of 2 hours of classroom instruction for ten people selected by Owner, plus two (2) hours of individual hands-on training for each of ten people selected by Owner. Hands-on training shall include the opportunity for each person to operate the system, and to practice each operation that an operator would be expected to perform.
- B. Training shall cover all operating features of the system, including the following:
 - 1. System set-up and cardholder database configuration.
 - 2. Access control features
 - 3. Alarm monitoring features
 - 4. Report generation and searches
 - 5. Card management and Badge Design/Printing
 - 6. Routine maintenance and adjustment procedures
- C. Training sessions are to be held at Owner's facility, and are to be scheduled at the convenience of Owner. Contractor shall provide written training outline and agenda for each training session prior to scheduling.
- D. Weekly format of training sessions shall be as follows:
 - 1. Monday: 2 hour Control Center Training
 - 2. Tuesday: 2 hour System Administrator Training
 - 3. Wednesday: 2 hour System Administrator Training
 - 4. Thursday: 2 hour System Administrator Training
 - 5. Friday: 2 hour Control Center Training

E. Contractor shall provide written training materials for each of ten (10) people.

3.04 OPERATOR REFRESHER TRAINING

A. Contractor shall provide complete operator training on the Security Management System. Two types of operator training shall be provided:

1. Contractor shall provide follow-up training after project closeout.
2. Training as requested by the Owner shall take place within 180 days of project close out.

B. Training sessions shall include the opportunity for each person to operate the system, and to practice each operation that an operator would be expected to perform.

C. Training sessions are to be held at Owner's facility, and are to be scheduled at the convenience of Owner. Some training sessions may be required to be held during evening hours and on weekends to accommodate users whose schedule does not permit attendance during regular hours.

D. Contractor shall provide written training outline and agenda for each training session prior to scheduling.

END OF SECTION – 28 1313

SECTION 28 1316
ACCESS CONTROL SYSTEMS DATABASE MANAGEMENT

PART 1 GENERAL REQUIREMENTS**1.01 GENERAL**

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.02 SECTION INCLUDES

- A. Head-end Software for Security Management Systems, (SMS).
- B. Integration to the existing Owner security database.

1.03 RELATED SECTIONS

- A. 28 0500 Common Work Results for Safety and Security
- B. 28 1319 Access Control Infrastructure
- C. 28 1326 Access Control Remote Devices
- D. 28 1333 Access Control Interfaces
- E. 28 1343 Access Control ID Management
- F. 28 1613 Intrusion Detection Panels
- G. 28 1619 Intrusion Detection Remote Devices
- H. 28 1633 Intrusion Detection Interfaces

1.04 SYSTEM USER REQUIREMENTS

- A. Required Access Control Hardware Features
 - 1. The SMS intelligent database controller shall support a minimum of 10,000 cardholders with expansion capabilities of up to 50,000 cardholders.
 - 2. The SMS intelligent database controller shall support a minimum of 65,000 offline transactions.
 - 3. The SMS hardware shall be comprised of modular components that connect over standard interfaces to one another. There shall be database storage and processing module (DBU), and once data has been downloaded to the DBU it shall locally make access control decisions. Access granted or denied decisions shall be made in under 0.5 seconds.
 - 4. The DBU shall store firmware in non-volatile flash memory to allow for convenient updates through the head-end software application. The DBU shall store the cardholder and configuration database information in battery-backed memory so that loss of primary power will not cause the loss of the database.
 - 5. The SMS hardware shall be capable of expansion via 2-, 4-, and 8- door controllers (DC). Door controllers shall support one or more input/output module "daughter" card that requires no additional addressing and provides 8 monitored input points or 8 auxiliary output points.
 - 6. The DBU shall support configurations that include: 16 card readers, 96 monitored input points, or 96 auxiliary output points.

ACCESS CONTROL SYSTEMS DATABASE MANAGEMENT

7. There shall be an intelligent controller option to provide control of 8 readers/doors from a single circuit board (communications, memory, CPU, and reader/door functions integrated) with an available 8-reader/door add-on to provide a 16-door controller from two circuit boards. The 8-door controller shall provide an integrated on-board RS-232 interface, and shall have provisions for modular expandable memory.
8. System must support the installation of readers at any distance from 3 feet to 1000 feet from the reader interface board. Systems that require additional, separately mounted components to achieve the requirement shall not be acceptable.
9. When using the vendor's proprietary readers, the SMS shall optionally annunciate door forced and held conditions using the reader's onboard sounder, Systems that do not offer this behavior, or that require additional wiring, use additional relay outputs, or require external sounders to accomplish it shall not be acceptable. This requirement applies only to non-biometric reader devices.
10. Efficient Memory Management
 - a. Controllers shall be capable of supporting cardholder populations of at least 250,000, or be configured to a learning mode that allows the cards most frequently used to have their access rights stored locally in the panel's memory.
 - b. When a card is presented which is not resident in the local panel, a verification request shall be made to the central database; if the card is valid the details shall be downloaded. If the card memory is full, the card with the oldest transaction date shall be deleted to make space for the card requested. This shall allow automatic management of cardholders, based upon frequent users having "instant" response and infrequent users learned when required.
11. Database Synchronization
 - a. To ensure synchronization of the distributed controllers' databases with a region's main database an internal checking process shall be provided within each controller. In the event of corruption of a controller's local database then it shall be able to detect this condition and automatically request the relevant data to be downloaded from its local server. This action shall not require Operator intervention.
 - b. The system shall continue to provide access control functionality during this re-synchronization process.
12. Door lock release relays shall be minimally rated for 3 A @ 30 VDC.
13. Readers supporting various technologies shall provide data from card presentations through a door control unit (DCU) that includes the electrical interface to the reader as well as inputs for door sensors and form C relays for outputs.
14. The DCU shall support Wiegand communications to the reader. In order to provide higher levels of security, the DCU shall support bi-directional, supervised, and encrypted communications to the reader. Door controllers that do not support encryption and supervision of reader communications are not considered equal.
15. The controller shall support a direct serial connection to the Network Video Server (NVS) for alarm transmission.

ACCESS CONTROL SYSTEMS DATABASE MANAGEMENT

16. Clients
 - a. The system shall support up to 10 clients to suit growing enterprise requirements. The system shall provide the means for multiple operators to simultaneously administer the system from convenient locations connected via a local area network (LAN) or across a wide area network (WAN).
 - b. Clients shall not use mapped drives for server connections.
 - c. Clients shall not use UDP messaging.
 - d. System shall support a minimum of two pc monitors per client. The system shall additionally store the last position and size of all open dialog boxes and screens upon exiting the application on a per operator basis. The next time the operator logs into the application, the screen positions shall be restored. Such operation shall be independent of which workstation the operator uses.
17. Serial Device Interface
 - a. The software shall allow the definition of ASCII commands to be sent out over a computer serial port (physical or virtual) or through the RS-232 interface of the DBU. These serial commands shall be available through the user interface as well as in the conditional logic described herein.
18. Automatic Holiday Override
 - a. The software shall be programmed by the operator to recognize special or holiday dates, which in turn can be linked to operational changes in how the site is to be managed on these specific days. This feature shall notify a system operator of individual holiday dates up to seven days prior provides a useful check on the date's current validity. Multiple types of holiday dates shall also be provided so that partial days or early closing requirements on specific dates can be accommodated.
 - b. The SMS shall provide a calendar function to enable scheduling of events up to five (5) years into the future.
19. System Partitioning
 - a. The access point readers, monitor points, and auxiliary outputs shall be managed on a partition basis by simply defining which devices are to be included in a partition.
 - b. The SMS shall be supplied with the ability to manage up to 64 partitions, and shall have an option to manage up to 999 partitions.
 - c. Operator permissions shall be created and assigned globally or by the owning company. When created and assigned globally an Operator's password shall be associated with one or more companies.
20. Alarm Management
 - a. Alarm handling shall be efficiently managed with up to 99 priority levels and user definable instruction messages to ensure the operator monitoring the site takes appropriate responses. The facility shall have the ability to customize audible alerts for each type of alarm is provided using standard or custom generated multimedia wave files. Each alarm type shall also be presented in a user-defined color.
 - b. The SMS shall be optionally configured to require operator comments when acknowledging alarms.
 - c. The SMS shall support the ability to selectively choose alarms to acknowledge and/or clear.

ACCESS CONTROL SYSTEMS DATABASE MANAGEMENT

- d. Each alarm shall be capable of linking video from digital video recorders (if applicable) for incident playback.
 - e. The Alarm Monitor screen shall provide an indication that cardholder information is available for a specific alarm. A "Card" button shall be available that when pressed will display the cardholder badge image.
 - f. Alarm monitor screen shall support the display of alarm statistics, shall provide up to ten alarm filters to be displayed in different tabs on the alarm screen, and shall provide the ability to sort based on each different column.
 - g. Each alarm shall be time-stamped in the local time zone (not the server time zone), and the system shall support the additional display of labels associated with different geographical time zones such as PST, EST, GMT, etc. The labels for time zones shall be customizable.
 - h. The system shall permit the routing and display of real time activity at any standard client machine. Activity shall be shown in a dedicated activity window that is updated automatically when new transactions occur. This option shall not be limited to routing transactions to one location and shall support the simultaneous routing and display of real time activity at multiple locations.
 - i. Alarms shall be capable of being routed to specific client machines by time of day or day of week.
 - j. Unacknowledged alarms shall be capable of being routed to alternate client or Email based on age and priority of alarm.
 - k. The display of reader door alarms shall be automatically enabled or disabled by the use of timed commands, either by reader or by a group of readers.
 - l. The system shall support a generic ASCII input capability that allows the system administrator to define specific ASCII input strings as alarms to be displayed in the alarm monitoring window as well as on the graphical map interface if so configured.
21. E-mail Alarms
- a. The SMS shall support the ability to automatically e-mail alarm condition messages.
 - b. Each alarm definition shall allow a destination e-mail address to be defined. The e-mail address may be an address group as defined in the e-mail MAPI application.
 - c. E-mail alarm messages shall be controlled by time of day and day of the week. For example, e-mail to the Facility Security Supervisor would only be generated when alarms occur during after-hours times.
22. Graphical Site Maps
- a. To further enhance the presentation to the operator, the system shall have the ability to import and use graphical maps. Maps shall be linked together using a tiered tree structure. To speed the location of an incident, each map level shall contain a clearly visible indicator as to which sub map the operator should select next to find the device that is in alarm.
 - b. Maps shall also have the ability to be configured to appear automatically on presentation of a new alarm, providing the operator with prompt visual indication that an alarm has occurred.

ACCESS CONTROL SYSTEMS DATABASE MANAGEMENT

- c. The status of readers, doors, monitor points and auxiliary outputs shall be requested from any map by simply selecting the icon representing the device and its current state will be displayed.
 - d. The icons on the graphic map shall dynamically indicate the status of the device they represent. For example, a door icon shall change to show the door open when the door position sensor indicates such, and shall change to the original icon when the door is again secure. Additionally, monitor points shall also change to show their current state.
 - e. Should the operator wish to change the current setting, simply pressing the right mouse button shall cause the appropriate command options list to appear for selection.
 - f. Having selected a command, confirmation shall be provided by reflecting the change in status on the display.
 - g. Maps shall be created using standard office tools such as Paint[®] or drawing packages such as AutoCAD[®]. It shall be possible to import drawings in the following formats: JPEG, Bitmap, Windows metafile or DXF.
 - h. Icons representing access points, monitoring points, switching outputs, alarm inputs, CCTV cameras or intercom call stations shall be placed on any map at the required location in a drag and drop manner.
 - i. It shall be possible to define on the map the location of readers, access doors, alarm monitored points, output switching relays, CCTV cameras, Digital Video Recorder Cameras, Intercom call stations and alarm panel devices. The map display shall allow the operator to switch the video display of any defined CCTV camera to any defined CCTV monitor. The map display shall allow the display of stored and live Digital Video Clips.
 - j. It shall be possible to define on the map the location of reader groups and camera groups. Such groups shall be placed and appear as a single icon, but actions taken on them shall affect the entire group.
 - k. It shall also be possible to change the status of readers, reader groups, floor groups, alarm monitored points or output switching relays and confirm the successful execution of such commands from the map display. This functionality shall be capable of being restricted per device based on operator permission.
 - l. The map display shall include the option to display a group of similar devices as a single icon. Once devices are grouped it shall be possible to change their status. For example, it shall be possible to unlock all entrance doors by executing a single command from the map display.
23. Device Configuration
- a. The system shall support a notes field to be associated with each device configured on the system. The notes field shall be free-form text, and shall support a minimum of 256 characters. The notes field may be used for detailed device descriptions or for maintenance history. The notes field shall also allow files to be associated.
 - b. The system shall provide a hierarchical tree view of the system configuration supporting expansion and collapse of any and all branches.

ACCESS CONTROL SYSTEMS DATABASE MANAGEMENT

24. Windows Daylight Saving Auto Adjustment
 - a. The system shall support Windows TimeSrv or Windows time management.
25. History Archive and System Back up
 - a. The system shall allow on line archiving of history logs, along with database back up of system configuration and cardholder details. To further ease the burden of remembering to back up your system's database, this function shall be able to be automated to occur without intervention at a pre-set time.
 - b. The system backup and history archive shall be to a destination drive and path located on a different PC accessible to the Database machine via the network.
26. The manufacturer of the SMS shall make available documentation on Server Hardening, which shall, at a minimum, detail the TCP/IP ports that are utilized by the system to allow other ports to be closed.

1.05 SUBMITTALS

- A. Product Data

Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended.
- B. Procedures
 1. Provide submittals to Eugene School District's Project Manager.
 2. Submit three (3) copies of each submittal.
- C. Manufacturers Installation and Programming Instructions
 1. Provide Manufacturers Installation and Programming Instructions as requested in the various Specification Sections.

1.06 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

1.07 MAINTENANCE

- A. Provide full procedures for all database back-ups.
- B. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

PART 2 PRODUCTS**2.01 GENERAL**

- A. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- B. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- C. Product Availability
 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
 2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.

2.02 SMS and Intrusion Software

- A. Software – Lenel OnGuard product set. Contractor shall integrate the security, intrusion, access systems to the existing Owner provided software.
- B. Licensing – Lenel SMS. Owner to provide all required software licenses for a complete and functional system.

PART 3 EXECUTION**3.01 ACCEPTABLE INSTALLERS**

- A. The system shall only be provided by Contractors who are factory authorized to install, service and maintain the system by the access control manufacturer.
- B. The Contractor must have been a factory authorized dealer with the proposed manufacturer for a period of at least two (2) years before the Bid Opening Date.
- C. The Contractor's installers and technicians shall also be factory trained and certified to perform such tasks.

3.02 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench test per manufacturer's installation instructions.

3.03 POWER TO SECURITY EQUIPMENT

- A. Power all equipment from 120 VAC circuit dedicated for security use, except as noted. Mark all panel circuit breakers with labels worded "Security Equipment - Do Not Operate", or equivalent.
- B. All plug-in transformers shall be located at the security control panels. Secure all low-voltage plug-in transformers to outlet with screw or strap. Clearly label all transformers to identify purpose and use.

3.04 INITIAL PROGRAMMING AND CONFIGURATION

- A. Contractor shall provide initial programming and configuration of the security management system. Programming shall include defining hardware, doors, monitor points, clearance codes, time codes, door groups, alarm groups, operating sequences, camera call-ups, and the like. Input of all program data shall be by Contractor. Contractor shall consult with Consultant and Owner to determine operating parameters.
- B. Contractor shall develop and input system graphics, such as maps and standby screens. Owner shall provide floor plan drawings as the basis for the creation of maps. Development of maps shall include the creation of icons for all doors, monitor points, and tamper circuits. Owner shall provide floor plan drawings, in the form of AutoCAD® .DWG or .DXF files, as the basis for the creation of maps.
- C. Owner, with the cooperation and assistance of Contractor, will input the cardholder data for each access card.
- D. Approximately sixty (60) days after start-up of system, Contractor shall return to project to provide follow-up assistance with system configuration as requested by Owner. Contractor shall include an allowance of forty (40) hours of labor for follow-up assistance in his Base Bid price.

END OF SECTION – 28 1316

**SECTION 28 1319
ACCESS CONTROL INFRASTRUCTURE**

PART 1 GENERAL REQUIREMENTS

1.01 GENERAL

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.02 RELATED SECTIONS

- A. 28 0500 Common Work Results for Safety and Security
- B. 28 1313 Access Control Applications
- C. 28 1316 Access Control Database Management
- D. 28 1326 Access Control Remote Devices
- E. 28 1333 Access Control Interfaces
- F. 28 1343 Access Control ID Management
- G. 28 1613 Intrusion Detection Panels
- H. 28 1619 Intrusion Detection Remote Devices
- I. 28 1633 Intrusion Detection Interfaces

1.02 SCOPE INCLUDES

- A. Division 28 is responsible for installation of wiring to ancillary devices at the door including but not limited to; door contacts, card readers, request to exit sensor and magnetic strikes.
- B. Division 28 is responsible for installation of wiring to door strike, lock down buttons, sirens, motion sensors, keypads and door contacts.

1.03 SYSTEM USER REQUIREMENTS

- A. The SMS hardware wiring shall support all of the following options for supervision of the monitored input points:
- B. 2-state supervision – in which only secured and alarm state are indicated
- C. 3-state supervision – in which the input state can be secure, alarm or open circuit
- D. 4-state supervision – supports secure, alarm, short circuit and open circuit states

1.04 ACCESS MONITORING & CONTROL SCHEDULES

- A. See drawings for device locations and quantities.

1.05 SUBMITTALS

- A. Product Data
Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended.

- B. Procedures
 - 1. Provide submittals to Eugene School District's Project Manager and Architect.
 - 2. Submit three (3) copies of each submittal.
 - 3. Shop Drawings
 - 4. General Shop Drawings for the project as described elsewhere.
 - 5. Provide other Shop Drawings only if specifically requested by Eugene School District's Project Manager

1.06 WARRANTY

- A. Contractor warrants that all Work furnished (material and labor) under this Contract will be of good quality, free from faults and defects, and in conformance with the Project Drawings and Specifications.
- B. Contractor shall provide a parts and labor guarantee on all Work. Unless otherwise specified herein, Contractor's guarantee shall be for a period of two (2) years from date of Acceptance, except where any specific guarantees from a supplier or equipment manufacturer extends for a longer time.
- C. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including costs of labor, transportation, lodging, materials, and equipment.
- D. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modification or repair by Eugene School District, or acts of god.
- E. Contractor shall promptly respond to Eugene School District's requests for service during the guarantee period. Contractor shall provide repair service as soon as reasonably possible upon request from Eugene School District, but in no case shall service response exceed 8 hours from time of request.

1.07 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.

2.02 PRODUCT AVAILABILITY

- A. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
- B. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.

2.03 WIRE AND CABLE

- C. Wiring by Division 28 – Cable is Owner Furnished. The contractor is responsible for providing to the Owner the estimated cable amounts required for the project. Contractor shall notify district 6 weeks prior to beginning cable installation.
1. Door controller to reader 4-pair 22AWG shielded or per manufacture instructions – Orange outer jacket
 2. Door controller to electric panic 2-conductor 12AWG or per manufacture instructions – Orange outer jacket.
 3. Door controller to door status switch 4-conductor 22AWG homerun to intrusion panel or per manufacture instructions – Orange outer jacket
 4. 12V Panel to power supply 2-conductor 16AWG or per manufacture instructions – Orange outer jacket.
 5. Door controller to electric strike 2-conductor 16AWG or per manufacture instructions – Orange outer jacket.
 6. Data Bus to LNL 1300/1320 24AWG 2-pair shielded with orange outer jacket, Belden 88102 or equal.
- D. Conduit and Raceway Systems
1. General: The placing of surface mounted conduit on the exterior of any building shall be approved by Eugene School District prior to its installation.
 2. Interior Conduit:
 - a. Electrical Metallic Tubing (EMT)
 - b. Flexible Metal Conduit
 - c. Provide fittings and connectors as required for installation of EMT or flexible conduit.
 1. Surface Raceways:
 - a. Sheet metal channel with fitted cover, suitable for use as surface metal raceway, Wiremold or approved equal.
 - b. Provide fittings, elbows, and connectors designed for use with raceway system.
 2. Exterior Conduit: (any of the following as determined by local code requirements):
 - a. Rigid Steel Conduit
 - b. Rigid Aluminum Conduit
 - c. Rigid Nonmetallic Conduit (only if buried 18" below ground surface).
 - d. Intermediate Metal Conduit
 - e. Provide rain-tight fittings and connectors as required for installation of exterior conduit.
 3. Exterior Flexible Conduit:
 - a. Liquidtight Flexible Conduit: Flexible metal conduit with PVC jacket.
 - b. Provide rain-tight fittings and connectors as required for installation of Liquidtight Flexible Conduit.
 4. Junction and Pull Boxes
 - a. Interior Boxes: Sheet Metal Outlet Boxes: Sizes to be determined in accordance with code requirements for conductor fill. No box shall be smaller than a single gang 1-1/2 deep. Provide box covers as required.

- b. Exterior Boxes: All exterior boxes shall NEMA 4 or NEMA 3R, watertight and dust-tight
 - c. All interior and exterior boxes shall have their covers fastened using security screws.
- E. Lightning Protection
- 1. The Contractor shall provide suitable lightning protection for all processors/controllers.
 - 2. All lightning protection equipment shall be UL listed.

PART 3 EXECUTION

3.01 WIRE AND CABLE

- A. All wire and cable from the processors to all devices at each door shall be "home-run" unless otherwise specified.
- B. All wire and cable, including any wire and cable that is existing and will be reused in the Work, shall be installed in conduit or surface metal raceway.
- C. Wire or cable, in lengths of less than ten (10) feet, that is "fished" within walls, ceilings, and door frames.
- D. All wire and cable passing thru metalwork shall be sleeved by an approved grommet or bushing.
- E. All splices shall be made in junction boxes (except at equipment). Splices shall be made with an approved crimp connection. Wire nuts shall not be used on any low-voltage wiring.
- F. Identify all wire and cable at terminations and at every junction box. Identification shall be made with an approved permanent label, Brady or equal.

3.02 WIRE AND CABLE TERMINATIONS

- A. Identify all inputs and outputs on terminal strips with permanent marking labels.
- B. Neatly dress and tie all wiring. The length of conductors within enclosures shall be sufficient to neatly train the conductor to the terminal point with no excess. Run all wire and cable parallel or normal to walls, floors and ground.
- C. Install connectors as required by equipment manufacturers.
- D. Terminations shall be made so that there is no bare conductor at the terminal. The conductor insulation shall bear against the terminal or connector shoulder.
- E. Do not obstruct equipment controls or indicators with wire or cable. Route wire and cable away from heat producing components.

3.03 CONDUIT AND RACEWAY INSTALLATION

- A. Design, lay-out, size and plan new conduit and raceway systems as required.

- B. Indoor Requirements:
 - 1. Route exposed conduit and raceway parallel and perpendicular to walls and adjacent piping.
 - 2. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps.
 - 3. Use conduit bodies to make sharp changes in direction, as around beams. Fasten conduits and raceways to structural steel using approved spring clips or clamps.
 - 4. Where conduit penetrates fire-rated walls and floors, seal opening with UL listed fire rated sealer or other methods as approved by codes.
 - 5. No exposed conduit, raceway, or junction box shall be installed within any office area.
 - 6. Install all boxes straight and plumb.
 - 7. Do not support conduit from mechanical, plumbing, or fire sprinkler systems.
 - 8. Do not use flexible conduit in lengths longer than six (6) feet.
- C. Outdoor Requirements:
 - 1. Where conduit penetrates exterior walls, seal opening around conduit in an approved manner to make watertight
 - 2. Use galvanized straps and fasteners on all exterior conduits.
 - 3. All exterior boxes will only be used to aid in pulling the cable between points.

3.04 PENETRATIONS

- A. Do not penetrate any roof, flashing, exterior wall, or parapet without prior approval from Eugene School District's designated Construction Project representative.
- B. When penetrating a fire wall for passage of cables and/or conduit, always provide a fire-stop system that complies with code and the local authority having jurisdiction.

3.05 FIRE RATED DOORS AND FRAMES

- A. Do nothing to modify a UL[®] rated door or frame that would void the UL[®] label or fire rating.

END OF SECTION 28 13 19

SECTION 28 1326
ACCESS CONTROL REMOTE DEVICES

PART 1 GENERAL REQUIREMENTS**1.01 GENERAL**

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.02 SECTION INCLUDES

- A. Field Panels
- B. Cards & Readers
- C. Keypads
- D. Electric Locks, Strikes
- E. Request-to-Exit Devices

1.03 RELATED SECTIONS

- A. 28 0500 Common Work Results for Safety and Security
- B. 28 1313 Access Control Applications
- C. 28 1316 Access Control Database Management
- D. 28 1319 Access Control Infrastructure
- E. 28 1333 Access Control Interfaces
- F. 28 1343 Access Control ID Management
- G. 28 1613 Intrusion Detection Panels
- H. 28 1619 Intrusion Detection Remote Devices
- I. 28 1633 Intrusion Detection Interfaces

1.04 SYSTEM USER REQUIREMENTS

- 1. Door lock release relays shall be minimally rated for 3 A @ 30 VDC.
- 2. Readers supporting various technologies shall provide data from card presentations through a door control unit (DCU) that includes the electrical interface to the reader and inputs for door sensors and form C relays for outputs.
- 3. Enclosures and Power Supplies
 - 1. All electronic circuits supplied, with the exception of the Single Door PoE Edge Network Controller, or those which are PoE powered or within a client or server or recorder PC, shall be mounted on standoffs inside the manufacturer-supplied enclosures. All such enclosures must include a key lock on a removable hinged door, and must include a tamper switch to detect when the door is opened. Systems without key locking of enclosure doors or without doors which are both hinged and removable shall not be acceptable.
 - 2. All electronic circuits supplied for the access control system, except those which are PoE powered or within a client or server or recorder PC, shall be powered by 18-20VAC through supplied 120VAC to 20VAC molded case, fully insulated isolating transformers. The transformer shall be mountable inside the supplied enclosure or separately. Systems which require 120VAC power to be brought directly to the enclosure shall not be acceptable.

1.05 ACCESS MONITORING & CONTROL SCHEDULES

- A. See drawings for device locations and quantities. Coordinate door hardware with Division 8.

1.06 SUBMITTALS

- A. Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended.
- B. Provide submittals to Eugene School District's Project Manager.
- C. Submit three (3) copies of each submittal.
- D. Shop Drawings
 - 1. General Shop Drawings for the project as described elsewhere.
 - 2. Provide other Shop Drawings only if specifically requested by Eugene School District's Project Manager.
- E. Manufacturers Installation and Programming Instructions
- F. Provide Manufacturers Installation and Programming Instructions as requested in the various Specification Sections.

1.07 WARRANTY

- A. Contractor warrants that all Work furnished (material and labor) under this Contract will be of good quality, free from faults and defects, and in conformance with the Project Drawings and Specifications.
- B. Contractor shall provide a parts and labor guarantee on all Work. Unless otherwise specified herein, Contractor's guarantee shall be for a period of two (2) years from date of Acceptance, except where any specific guarantees from a supplier or equipment manufacturer extends for a longer time.
- C. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including costs of labor, transportation, lodging, materials, and equipment.
- D. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modification or repair by Eugene School District, or acts of God.

1.08 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

1.09 MAINTENANCE

- A. Provide full procedures for maintaining physical and software firewalls.
- B. Provide full procedures for testing battery condition on all field panels for adequate back-up time.
- C. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

PART 2 PRODUCTS**2.01 GENERAL**

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed

ACCESS CONTROL REMOTE DEVICES

for complete and satisfactory operation.

- D. Product Availability
 - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.
 - 2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.

2.02 ACCESS CONTROL SYSTEM - SYSTEM SPECIFICATIONS

- B. Card Readers
 - 1. Lenel-Security Reader Interface – LNL-1300 for single door application, LNL-1320 for dual door application – Provide 1 per card reader door indicated on the drawings.
 - 2. Card Reader – HID Thinline II, 5395CG100.
 - 3. Card Reader – HID MiniProx 5365, mullion mounted.
 - 4. Card Reader – HID 5355AGN00 with HID 5455AGM00 glass mount kit.
 - 5. Pin Pad – HID 5355AGK09 for Arm/Disarm.
 - 6. Pin Pad – HID 5355ABK09 for door control.
- C. Access Panels
 - 1. Lenel- Enterprise Series
- D. HID Proximity Series
 - 1. Proxpro II
- E. Proximity Cards
 - 1. 1326 standard proximity cards
 - 2. 1386 ISO series proximity cards
 - 3. The Contractor shall provide 500 cards with the system.
- F. Division 8 provided and installed equipment with final cabling connection by Division 28.
 - 1. Electric Locks – Field verify requirements on a door by door basis
 - 2. Electric strikes
 - a. 12VDC Field Verify Manufacturer
 - 3. Electric mortise locks
 - a. 12VDC Field Verify Manufacturer
 - b. 24VDC Field Verify Manufacturer
 - 4. Electric hinges
 - a. 12VDC Field Verify Manufacturer
 - b. 24VDC Field Verify Manufacturer
 - 5. Electric power transfers
 - 1. 12VDC Field Verify Manufacturer
 - 2. 24VDC Field Verify Manufacturer
 - 6. Request-to-Exit Devices – Field Verify Requirements
 - 7. Touch sense bars
 - 8. Electronic push bars

PART 3 EXECUTION**1.01 COORDINATION WITH DIVISION 8**

- A. Contractor shall coordinate with the door hardware contractor prior to procurement of any door related electronic components.

1.02 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench test per manufacturer's installation instructions.
- B. Outdoor Requirements:
- C. Where conduit penetrates exterior walls, seal opening around conduit in an approved manner to make watertight
- D. Use galvanized straps and fasteners on all exterior conduits.
- E. All exterior boxes will only be used to aid in pulling the cable between points.

1.03 PENETRATIONS

- A. Do not penetrate any roof, flashing, exterior wall, or parapet without prior approval from Eugene School District's designated Construction Project representative.
- B. When penetrating a fire wall for passage of cables and/or conduit, always provide a fire-stop system that complies with code and the local authority having jurisdiction.

END OF SECTION 28 1326

**SECTION 28 1333
ACCESS CONTROL INTERFACES**

PART 1 GENERAL REQUIREMENTS

1.01 GENERAL

- A. Drawings and general provision of the Contract, including General and other Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.02 SECTION INCLUDES

- A. Head-end Software
- B. Field Panels

1.03 RELATED SECTIONS

- A. 28 0500 Common Work Results for Safety and Security
- B. 28 1313 Access Control Applications
- C. 28 1316 Access Control Database Management
- D. 28 1319 Access Control Infrastructure
- E. 28 1326 Access Control Remote Devices
- F. 28 1343 Access Control ID Management
- G. 28 1613 Intrusion Detection Panels
- H. 28 1619 Intrusion Detection Remote Devices
- I. 28 1633 Intrusion Detection Interfaces

1.04 SYSTEM USER REQUIREMENTS

- A. Network Communications
 - 1. The first field panel in a chain of panels shall have the ability to communicate with its monitoring client PC over the local or wide area network. This shall be achieved by the addition of a network interface card and provide a cost effective alternative configuration to a direct connection via a client PC's serial port. The network interface shall support both "10 base T" and "100 base TX" (10/100) communications speeds. The network interface shall support encryption utilizing AES algorithm.
 - 2. A modem and telephone line shall be configured to provide an alternative path for the reporting of alarms in the case of unavailability of the network. The fallback to dial-up alarms reporting shall be automatic in the event of detecting a network communications failure.
- B. Manual and Automatic Commands
 - 1. Operators shall be provided with a wide choice of manual commands embracing the control of readers, monitor points, output switching relays and door locking devices. The operator shall have the ability to check the status of single, or multiple devices to ensure the operator is always able to check the operational status of the system and make adjustments as requirements change. When graphical maps are utilized, status requests shall be simply initiated by "clicking" on the device icon within the map. This functionality shall be capable of being restricted per device based on operator permission.
 - 2. Automatic commands shall be included and may operate on a timed or

event basis.

3. Scheduled commands shall easily be defined linking complimentary commands to occur at the start and stop times of any chosen timecode.
4. Event triggered commands shall provide an extremely powerful means of creating IF/THEN/WHEN associations encompassing a wide selection of IF conditions to the automatic execution of THEN commands subject to a WHEN timecode being active. A minimum of 10 THEN actions shall be available per trigger command.
5. The SMS shall support an unrestricted number of automatic (scheduled and trigger) and manual commands. These commands shall be capable of spanning across multiple field controllers.

C. Card Initiated Commands

1. The software shall allow authorized cardholders to initiate powerful trigger commands manually from selected reader locations when certain models of readers are used in conjunction with the field panels.
2. Up to 99 predefined commands shall be invoked by an authorized card allowing, for example, a patrolling guard to switch on outputs, disable monitor points, lock doors, providing remote management of the system during a patrol of the site.
3. The system shall only permit assigned users to enter command codes at keypad readers. Such assigned users shall not be restricted as to when or where they can enter a command code – such restrictions may be placed on the commands themselves.

D. Building Control Module Option

1. The system shall provide an option, the Building Control Module, to allow the definition of one or more building controls, each used to control a separate HVAC or other building system. Readers and/or motion detector inputs shall be used to determine the occupancy of the area represented by the building control.
2. The Building Control Module shall support BACnet communications. The module shall use the BACnet communications protocol to project current status of building controls, monitor points, doors and the last alarm generated to third-party building systems.
3. The system shall allow manual commands to interface with building controls through the BACnet protocol. It shall be possible to issue these commands from on-screen graphical maps or plans of the building.
4. The system shall allow scheduled commands to interface with (turn on or off) building controls through the BACnet protocol. It shall be possible to issue these commands automatically at any time of the day, any day of the week or holiday dates.
5. It shall be possible to view the current status of a building control from the View/Status screen in the SMS software.
6. The system shall allow the definition of groups of building controls, which enables, for example, a single command to switch on several building controls in one operation.

- E. Dial-In/Out Alarms Option
 - 1. The SMS shall support a dial-out (alarm transmission) alarms reporting capability. A complimentary dial-in (alarm receipt) capability shall also be supported. This option would be used, for example, when an alarms monitoring client is unmanned outside of normal office hours and alarms generated at these times to be copied to a central manned system located elsewhere not on the LAN/WAN.
 - 2. The alarm messages copied to the alarms-receiving (dial-in) site shall be the same as those displayed at the local (dial-out) site. However, the alarm instructions (as displayed when acknowledging an alarm) may be different.
- F. Intrusion Detection System Integration Option
 - 1. The SMS shall support a high-level integration to an Intrusion Detection System (IDS). The SMS shall support events to be recorded and displayed from the IDS system on the alarm management screen and in the transaction history reports.
 - 2. The integration to the IDS shall support, at a minimum, secondary monitoring of all IDS alarm transactions while allowing it to still be monitored by a central station, if desired.
 - 3. The IDS integration shall also include the ability to arm and disarm the IDS from the SMS user interface. This feature must be available with all IDS products.
 - 4. IDS alarms shall be capable of triggering a series of SMS events. For instance, when the IDS reports that the system was armed, the SMS shall be able to lock all doors.
 - 5. IDS alarms shall be viewable on the SMS map interface.
 - 6. The communication with the IDS control panel shall be monitored, and the SMS shall produce an alarm in the event of a communications failure.
 - 7. The SMS must provide integration with both the DMP communication with the IDS control panel shall be monitored, and the SMS shall produce an alarm in the event of a communications failure.

1.01 SUBMITTALS

- A. Product Data
Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended.
- B. Procedures
 - 1. Provide submittals to Eugene School District's Project Manager.
 - 2. Submit three (3) copies of each submittal.
- C. Manufacturers Installation and Programming Instructions
Provide Manufacturers Installation and Programming Instructions as requested in the various Specification Sections.

1.02 DELIVERY, STORAGE, AND HANDLING

- A. Security of Contractor's Tools and Equipment: Eugene School District is not responsible for the care, storage or security of any of the Contractor's tools or equipment.

1.03 WARRANTY

- A. Contractor warrants that all Work furnished (material and labor) under this Contract will be of good quality, free from faults and defects, and in conformance with the Project Drawings and Specifications.
- B. Contractor shall provide a parts and labor guarantee on all Work. Unless otherwise specified herein, Contractor's guarantee shall be for a period of two (2) years from date of Acceptance, except where any specific guarantees from a supplier or equipment manufacturer extends for a longer time.
- C. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including costs of labor, transportation, lodging, materials, and equipment.
- D. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modification or repair by Eugene School District, or acts of God.
- E. Contractor shall promptly respond to Eugene School District's requests for service during the guarantee period. Contractor shall provide repair service as soon as reasonably possible upon request from Eugene School District, but in no case shall service response exceed 8 hours from time of request.

1.04 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- D. Product Availability
 - 1. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.
- E. See Section 281316 Part 2 for software requirements.
- F. See Section 281326 Part 2 for hardware requirements.

PART 3 EXECUTION

3.01 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation.
- B. Bench test per manufacturer's installation instructions.

3.02 INITIAL PROGRAMMING AND CONFIGURATION

- A. Contractor shall provide initial programming and configuration of the security management system. Programming shall include defining hardware, doors, monitor points, clearance codes, time codes, door groups, alarm groups, operating sequences, camera call-ups, and the like. Input of all program data shall be by Contractor. Contractor shall consult with Consultant and Owner to determine operating parameters.
- B. Contractor shall develop and input system graphics, such as maps and standby screens. Owner shall provide floor plan drawings as the basis for the creation of maps. Development of maps shall include the creation of icons for all doors, monitor points, and tamper circuits. Owner shall provide floor plan drawings, in the form of AutoCAD® .DWG or .DXF files, as the basis for the creation of maps.
- C. Owner, with the cooperation and assistance of Contractor, will input the cardholder data for each access card.
- D. Contractor shall maintain hard copy worksheets which fully document the system program and configuration. Worksheets shall be kept up to date on a daily basis by Contractor until final Acceptance by Owner. Worksheets shall be subject to inspection and approval by Owner. Provide final copies to Owner prior to Project Close-out.
- E. Approximately sixty (60) days after start-up of system, Contractor shall return to project to provide follow-up assistance with system configuration as requested by Owner. Contractor shall include an allowance of forty (40) hours of labor for follow-up assistance in his Base Bid price.

END OF SECTION 28 13 33

SECTION 28 1343
ACCESS CONTROL IDENTIFICATION MANAGEMENT SYSTEMS

PART 1 GENERAL REQUIREMENTS**1.01 GENERAL**

- A. Drawings and general provision of the Contract, including General and other Conditions and other General Requirements sections, apply to the work specified in this section.
- B. This section and all related sections shall be performed by a qualified Contractor as outlined in the specifications.

1.02 SECTION INCLUDES

- A. Head-end Hardware and Software
- B. Field Panels
- C. Cards & Readers
- D. Electric Locks, by Division 8
- E. Request-to-Exit Devices
- F. Wiring

1.03 RELATED WORK BY OTHERS

- A. All required category 6a data cabling to support the system will be provided as 27 1500 – Communications Horizontal Cabling. Refer to drawings.

1.03 RELATED SECTIONS

- A. 28 0500 Common Work Results for Safety and Security
- B. 28 1313 Access Control Applications
- C. 28 1316 Access Control Database Management
- D. 28 1319 Access Control Infrastructure
- E. 28 1326 Access Control Remote Devices
- F. 28 1333 Access Control Interfaces
- G. 28 1613 Intrusion Detection Panels
- H. 28 1619 Intrusion Detection Remote Devices
- I. 28 1633 Intrusion Detection Interfaces

1.04 SYSTEM USER REQUIREMENTS

- A. Video Imaging
 - 1. The system shall incorporate video imaging as a fully integrated function to customize access control cards by printing an identity badge directly onto the card. The badge design and image capture capabilities shall combine with the latest technology card printers to allow the production of an ID badge pass for each card holder at the time of registration.

ACCESS CONTROL IDENTIFICATION MANAGEMENT SYSTEMS

2. For each cardholder both a facial image and a signature shall be able to be captured, or imported, and stored as part of the card record. These images shall be captured from a standard CCTV camera connected to the computer via a Video Card supporting DirectX 10 (or later) or MCI format, or imported if available as a bit map or JPEG file. The system shall use data compression techniques to ensure efficient use of the available hard disk space to maximize the number of images that can be stored on the hard disk.
 3. System shall provide the ability to crop the image (live capture or imported from JPG, BMP, or WMF) to the desired area maintaining the proper aspect ratio.
- B. Badge Design and Printing
1. A comprehensive integrated badge design facility shall also be provided, allowing an unrestricted number of custom badge layouts to be defined then saved with a suitable description as a reference. This shall make full use of the card record details such as name, card number, inactive date as well as allowing personal data to be included in the badge design. Company logos shall be imported as bitmaps (BMP) or JPEG images to provide a personalized corporate appearance to the card.
 2. All elements incorporated into the design shall be able to be rotated.
 3. When creating a new card record a badge preview screen shall also be included that displays the specific card's details on the selected badge design to allow confirmation prior to requesting the badge to be printed.
 4. Each new cardholder record shall have the option to be flagged for future printing. Cards flagged in this manner shall be easily recalled at a later stage and processed for output to the printer in a single action. Selecting multiple cards for bulk printing shall also allow each card to be printed either with its specific badge design, as defined within each card's record, or alternatively printed with a selected common badge design. Encoding of magnetic stripe cards shall also be included as part of the bulk printing process.
 5. The SMS shall support any manufacturer's ID badge printer with a Windows compatible printer driver.
 6. The SMS shall provide the option to encode a proximity card during the print cycle shall also be incorporated. Applications that require on-site encoding can combine both actions in a single process. Encoding may only be supported on a limited set of printer models defined by the SMS manufacturer.
 7. Each badge design shall include a default printer, validity period, and access rights.
 8. Objects (images, or other fields to be printed to the card) shall support the ability to be enabled or disabled by the presence of a specific label in the cardholder record. For instance, a logo indicating certain training would be printed only if the personal data field identified indicated such a certification for that cardholder. Solutions requiring a separate badge design for any change in badge graphical content shall not be acceptable.

C. Video Verification

1. The Video Imaging option shall also provide a monitoring screen that will automatically display the stored image for a card when used at a reader. This screen shall operate in conjunction with a live video input from a CCTV camera viewing the selected access point, allowing the operator to verify that each card offered is in fact being used by the person to whom it was issued.
2. This screen shall also be frozen and printed to provide a hard copy evidence of any abuse observed by the operator. For high security access points, the system shall be configured to not grant access until the operator has verified the stored and live images are the same person, with the door release being controlled by the system operator.
3. Video verification shall include the ability to monitor at least 4 portals on the same screen (for application with turnstiles, for example). This feature shall also provide the operator with a means of granting access to the individual with a single mouse click.

D. Report Generation

1. Extensive history reporting shall be a standard integrated feature; and shall include the ability to review all system alarms, access control activity, and operator actions. These reports shall be made available for review via the operator's display screen, or to a printer, or to another disk media. Extensive sort parameters shall include by any of the "Personal Details" fields or Titles, for example by "Department", and only Names commencing with "SM*".
2. The system shall support generation of reports detailing the system operation. The following reports shall be available in the software:
 - a. Cards on site
 - b. Hours on site
 - c. Cardholders with access to each door
 - d. Access rights of each cardholder
 - e. System Configuration
 - f. Scheduled and Conditional Commands defined
 - g. System operator transaction history
3. It shall be possible to replay video clips associated with events by directly interacting with the report as published to the computer screen.
4. The system shall demonstrate the ability to export data, for example reports, to other standard office word processing packages such as Microsoft Word®.
5. The system shall provide system management reporting, including detailed listings for all the operator actions and the current cardholder database for output to the display screen, printer or disk media.
6. The system shall have the ability to save frequently used report configurations and associate them with a "Title". Such predefined reports shall be available from a list to simplify the report selection. It shall be possible to request these reports to run immediately or schedule them to occur at a specified date and time.

ACCESS CONTROL IDENTIFICATION MANAGEMENT SYSTEMS

7. Scheduled reports shall additionally have the option to be automatically repeated by specifying the number of days and reporting period to be included, for example a weekly report of Alarms to run at 10:30 am each Monday and including the previous 7 days of Alarms.
8. The system shall allow custom reporting options by providing an interface to a commercially available 'off the shelf' reporting product. The interface shall present all database fields in a structured format, which does not require detailed knowledge of the database design and table relationships.
9. History Reporting
 - a. Extensive reporting shall be included to provide the ability to review all system alarms, access control activity and operator actions. These reports shall be available for review on the operator's display, to a printer, or to a file.
 - b. Frequently run report configurations shall be saved allowing them to be selected and run on demand, or scheduled to run automatically as required. When scheduled to run automatically this shall have the ability to be repeated.
10. Cards On-Site Reporting
 - a. This report shall provide a list of cardholders currently on the site. This may be for all persons within the site or just who, for a particular department or a particular contractor company, is currently present. The report may also be run to cover just a part of the site, for example, cardholders in a particular building or room.
11. Report Auditing/Archiving
 - a. The SMS shall have the option to automatically and without user intervention keep a separate archival copy of each generated report, whether the report is sent to screen, printer, or file. The archival copy must be generated at the time of each request and stored unmodified thenceforth. Systems that attempt to reconstruct the archival copy only when it is requested are not acceptable.
12. Addition of Cardholders to the System Database
 - a. The system shall provide a means of assigning access control rights to each cardholder. Access control rights determine which access points are accessible to the cardholder based on date and time of day. The system shall support an unrestricted number of access rights.
 - b. Each cardholder shall either be associated with standard door timings, for door release, door open and door pre-held or be given extended timings for disabled persons or someone who has to push a cart.
 - c. Cardholders who have not used a reader for some time shall be readily listed to allow their card's status to be reviewed. An additional feature shall allow cardholders to be automatically set inactive and therefore access denied should the card have not been presented at any reader on the system for a defined number of days.

ACCESS CONTROL IDENTIFICATION MANAGEMENT SYSTEMS

- d. Cardholders shall be assigned an expiration date, and more specifically an expiry time, after which a card shall automatically become inactive and therefore be rejected at all readers on the system. To further simplify card administration, the system shall have the ability to be configured to automatically purge expired cardholder records after a configurable number of days from the date of expiration.
 - e. The system shall allow for the definition of Access control rights to be associated with a badge design. Each user that selects that badge design shall be provided with the associated access control rights that can further be customized for the specific cardholder.
 - f. The system shall allow access control rights to be defined for a cardholder on a reader group basis. Reader groups are groups of readers. A time code will be associated with each reader group as it is assigned to the cardholder's access control rights.
 - g. The system shall allow access control rights to be defined for a cardholder on an access code basis. An access code is a group of access control rights.
 - h. The system shall have a note field associated with each cardholder record. The note field shall be free form text and shall support a minimum of 256 characters. The note field shall further support the ability to attach a file (of any type or size) to the cardholder record.
 - i. When viewing a cardholder record the last twenty-five (25) valid door access transactions shall be displayed to help locate a cardholder.
 - j. The system shall support a field for assigning an approving official to the cardholder record that defines the individual who authorized the assignment of a credential. Approving officials shall have an associated validity period and image of their signature. As an option, the assignment of an approving official shall be mandatory.
13. Cardholder Details
- a. Cardholder information shall include first and last name, card number, PIN code and valid period to provide automatic expiration. Each cardholder record shall also incorporate at least 50 user-defined personal data fields, independent of user-defined fields for visitor management.
 - b. Data entry shall be simplified by remembering previous entries of personal data and allowing selection from a pick list to minimize repetitive typing when creating each cardholder's record. The cardholder database and the history log shall also be sorted by any of the additional fields of information making them a powerful tool for filtering data.
 - c. Personal data fields shall support free entry text, picking an entry from a previously configured list, or picking an entry from an updatable list. Each of these entries shall further be categorized as a date, a time, general input, or customized input. Each category shall support the masking of input data to assure data integrity. For instance, a date mask might look like "mm/dd/yyyy" to indicate that the date input should be a two-digit month followed by a two-digit day followed by a four-digit year all separated by the slash character. The mask shall be required for customized input.

ACCESS CONTROL IDENTIFICATION MANAGEMENT SYSTEMS

- d. Personal data fields shall have the option of being configured as mandatory.
14. Card Watch Feature
- a. Any cardholder shall be easily tracked as they move around a large site by selecting card watch. As the person uses their access control card, the system shall have the ability to automatically notify the operator of the person's presence at each location.
15. Key Card Mode
- a. Key card mode authority shall be assigned to special cardholders, such as site key holders, and can be enabled on a per reader basis. This shall allow a person when vacating an area or building to change the reader's mode of operation from normal access control to Key Card Out operation.
 - b. When in this condition only persons with key card privileges shall gain access through the door, all non-key card users are rejected regardless of their card's current access rights.
 - c. This special feature shall be activated / deactivated by the key cardholder, using a card swipe followed by a special code entered via the reader's keypad.
16. Visitor management
- a. Visitor Management shall be incorporated as a standard feature of software. Operators shall be able to pre-enroll visitors using a Web (thin) or Standard (thick) client. The thin client shall connect to the server via Microsoft™ Terminal Services and Microsoft™ Internet Explorer to permit any operator with visitor permissions assigned the ability to pre-enroll visitors without the need to install client software on their local machine.
 - b. Visitor Management shall be fully integrated with other key areas of the system, such as access, alarms management, muster and Video ID Badging. Visitor records shall have 50 personal data fields with user definable data titles independent from the personal data fields defined for cardholders. All visitor transactions and movements shall be recorded and may be reported on and filtered, using the extensive reporting capabilities of the software. Visitors may exist without being assigned a card number if access control is not required.
 - c. Data entry shall be simplified by remembering previous entries of personal data and allowing selection from a pick list to minimize repetitive typing when creating each visitor's record. The cardholder database and the history log shall also be sorted by any of the additional fields of information making them a powerful tool for filtering data.
 - d. Visitor time of arrival and time of departure shall be tracked by the system. This feature shall be available even if a visitor is not issued a card or card number in the system.
 - e. The SMS shall support capture of a business card image.
 - f. The SMS shall support the inclusion of a custom message for each visitor record.

1.05 SUBMITTALS

- A. Product Data
Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended.
- B. Procedures
 - 1. Provide submittals to Eugene School District's Project Manager.
 - 2. Submit three (3) copies of each submittal.
- C. Shop Drawings
 - 1. General Shop Drawings for the project as described elsewhere.
 - 2. Provide other Shop Drawings only if specifically requested by Eugene School District's Project Manager.
- D. Manufacturers Installation and Programming Instructions
Provide Manufacturers Installation and Programming Instructions as requested in the various Specification Sections.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Security of Contractor's Tools and Equipment: Eugene School District is not responsible for the care, storage or security of any of the Contractor's tools or equipment.

1.07 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

1.08 MAINTENANCE

- A. Provide full procedures for all database back-ups.
- B. Provide full procedures for upgrading software.
- C. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- D. Product Availability
 - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into his proposed Contract Time.

2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify his ability to procure the products specified prior to submitting a proposal.

E. See Section 281316 Part 2.

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. The system shall only be provided by Contractors who are factory authorized to install, service and maintain the system by the access control manufacturer.
- B. The Contractor must have been a factory authorized dealer with the proposed manufacturer for a period of at least two (2) years before the Bid Opening Date.
- C. The Contractor's installers and technicians shall also be factory trained and certified to perform such tasks.

3.02 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench test equipment per manufacturer's installation instructions.

3.03 FIELD QUALITY CONTROL

- A. Upon reaching Substantial Completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify Eugene School District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to Eugene School District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system, have personnel available with tools and equipment to remove devices from their mounts to inspect wiring connections. Provide wiring diagrams and labeling charts to properly identify all wiring.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify Eugene School District when ready to perform a re-inspection of the installation.

3.04 INITIAL PROGRAMMING AND CONFIGURATION

- A. Contractor shall provide initial programming and configuration of the security management system. Programming shall include defining hardware, doors, monitor points, clearance codes, time codes, door groups, alarm groups, operating sequences, camera call-ups, and the like. Input of all program data shall be by Contractor. Contractor shall consult with Consultant and Owner to determine operating parameters.
- B. Contractor shall develop and input system graphics, such as maps and standby screens. Owner shall provide floor plan drawings as the basis for the creation of maps. Development of maps shall include the creation of icons for all doors, monitor points, and tamper circuits. Owner shall provide floor plan drawings, in the form of AutoCAD® .DWG or .DXF files, as the basis for the creation of maps.
- C. Owner, with the cooperation and assistance of Contractor, will input the cardholder data for each access card.

3.05 MANUFACTURER PROFESSIONAL SERVICES

- A. Contractor shall coordinate with the manufacturer to provide the manufacturer's professional services team to assist the Owner in coordinating the interfaces between the security management system and other on-site systems as necessary.
- B. Professional Services personnel shall be employed by the manufacturer of the security management system and shall be thoroughly knowledgeable of the security management system applications.
- C. Professional Services personnel shall be on-site and available to meet with Owner's representatives for a period of not less than two consecutive days. On-site visit shall be scheduled at the convenience of the Owner.

END OF SECTION 28 1343

**SECTION 28 1613
INTRUSION DETECTION CONTROL PANELS**

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

- A. Head-end Hardware and Software
- B. Field Panels

1.02 RELATED WORK BY OTHERS

- A. All rough-in category 6a data cabling to support the system will be provided by Division 27 – Communications Horizontal Cabling where noted.

1.03 RELATED REQUIREMENTS

- A. 28 0500 Common Work Results for Safety and Security
- B. 28 1313 Access Control Applications
- C. 28 1316 Access Control Database Management
- D. 28 1319 Access Control Infrastructure
- E. 28 1326 Access Control Remote Devices
- F. 28 1343 Access Control ID Management
- G. 28 1619 Intrusion Detection Remote Devices
- H. 28 1633 Intrusion Detection Interfaces

1.04 SYSTEM USER REQUIREMENTS

- A. System Overview
 - 1. The contractor shall provide and install a new integrated security management system that shall provide a simple and easy-to-use graphical user interface. The system shall provide local operational control of all access points and alarm sensors.
 - 2. The system shall meet the requirements of UL[®]-294.
 - 3. The manufacturer of the proposed system shall have been producing access control products for at least 10 years and shall be ISO 9000 and 9001 certified.
 - 4. The manufacturer shall be a Microsoft Certified Gold Partner. System shall meet Microsoft requirements for “Designed for Microsoft Windows Server 2008, 2011 32 and 64 bit” and “Designed for Windows 7”, or “Windows 8”.
 - 5. The manufacturer of the proposed system shall require resellers to pass a formal training program prior to being certified as authorized to sell and install the system. Such certification shall require annual re-qualification. The system integrator proposing the system shall be in possession of such a certification.
 - 6. User Code Mode
 - a. The Security Management Software, SMS shall support the ability to put a keypad-equipped reader into User Code Mode. This feature shall allow a cardholder to gain access by entering a valid card’s number at a reader keypad, therefore not requiring the holder to carry a card.
 - b. User code mode shall be enabled on a per reader basis.

7. Data Connect Option
 - a. The system shall provide an option to import and/or export both cardholder details (including facial images and signatures) and system alarm information to/from an external source. This option may be used to speed initial commissioning of the security management system's database, or in some cases, to allow synchronization with other employee management systems. This option may also be used to pass common data to other employee-related systems or databases. It shall be possible to manually start or schedule the data import. It shall also be possible to start the data import process from an external application, thus providing the means for real time import.
 - b. The interface requirements shall be fully defined and support either a comma delimited ASCII text file or a Microsoft SQL® database import mechanism. Fully detailed supporting documentation shall be provided to enable a third party to design and implement this facility without needing reference to the system's manufacturer.
 - c. Imported data shall reside in an intermediary table within the database until an integrity check can be applied to the data. Only after satisfying this test will data be included in the SMS data tables.

1.05 SUBMITTALS

- A. Submittals shall be as per 28 0500.

1.06 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

1.07 MAINTENANCE

- A. Provide full procedures for upgrading software.
- B. Provide full procedures for testing battery condition on all field panels for adequate back-up time.
- C. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- D. Product Availability
 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into their proposed Contract Time.
 2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify their ability to procure the products specified prior to submitting a proposal.

2.02 INTRUSION DETECTION SYSTEM - SYSTEM SPECIFICATIONS

- A. Security Panel – DMP XR550DNL-G equipped with;
 - 1. Model 332 18VDC Transformer, provide 1 per panel
- B. Zone Expanders – as required
 - 1. DMP-714-18T – Four zone.
 - 2. DMP-714-8 – Eight Zone
 - 3. DMP-714-16 – Sixteen Zone
- C. Dialer – DMP 893 Dual Phone Module
- D. Relay Module – DMP 860
- E. Zone Output Module – DMP 716
- F. Keypad DMP 7063W.

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. The system shall only be provided by Contractors who are factory authorized to install, service and maintain the system by the access control manufacturer.
- B. The Contractor must have been a factory authorized dealer with the proposed manufacturer for a period of at least two (2) years before the Bid Opening Date.
- C. The Contractor's installers and technicians shall also be factory trained and certified to perform such tasks.

3.02 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench test per manufacturer's installation instructions.

3.03 INITIAL PROGRAMMING AND CONFIGURATION

- A. Contractor shall provide initial programming and configuration of the security management system. Programming shall include defining hardware, doors, monitor points, clearance codes, time codes, door groups, alarm groups, operating sequences, camera call-ups, and the like. Input of all program data shall be by Contractor. Contractor shall consult with Consultant and Owner to determine operating parameters.
- B. Contractor shall develop and input system graphics, such as maps and standby screens. Owner shall provide floor plan drawings as the basis for the creation of maps. Development of maps shall include the creation of icons for all doors, monitor points, and tamper circuits. Owner shall provide floor plan drawings, in the form of AutoCAD® .DWG files, as the basis for the creation of maps.
- C. Owner, with the cooperation and assistance of Contractor, will input the cardholder data for each access card.
- D. Contractor shall maintain hard copy worksheets which fully document the system program and configuration. Worksheets shall be kept updated daily until final Acceptance by Owner. Worksheets shall be subject to inspection and approval by Owner. Provide final copies to Owner prior to Project Close-out.
- E. Contractor shall maintain a complete, up-to-date magnetic tape backup of the system configuration and cardholder database. Backup shall be maintained throughout programming period until final Acceptance by Owner. Submit back-up data in electronic format to the Owner upon Final Acceptance.

- F. Approximately sixty (60) days after start-up of system, Contractor shall return to project to provide follow-up assistance with system configuration as requested by Owner. Contractor shall include an allowance of forty (40) hours of labor for follow-up assistance in their Base Bid price.

END OF SECTION 28 1613

**SECTION 28 1619
INTRUSION DETECTION REMOTE DEVICES**

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

- A. Motion Sensors
- B. Duress Buttons
- C. Door Position Sensors
- D. Wiring

1.02 RELATED WORK BY OTHERS

- A. All related category 6a rough-in data cabling to support the system will be provided by Division 27.
- B. All siren, sensor, door, cardreader, keypad cable and non-category 6a cable as required shall be installed by Division 28.
- C. ADA push buttons will be installed by Division 8, coordinate final connection in the field.

1.03 RELATED REQUIREMENTS

- A. 28 0500 Common Work Results for Access and Security
- B. 28 1613 Intrusion Detection Panels
- C. 28 1633 Intrusion Detection Interfaces

1.04 INTENT AND CORRELATION

- A. The intent of the Project Drawings and Specifications is to include all items necessary for the proper execution and completion of the Work.
- B. The Project Drawings and Specifications are complementary, and what is required by any one shall be as binding as if required by both.

1.05 REFERENCES

- A. Submit the names and phone numbers of customers for at least three other projects of similar size and complexity using similar technologies.

1.06 SUBMITTALS

- A. Product Data
Product Data submittal shall only be required if the Contractor requests a substitution or a particular brand product is not specified or recommended.
- B. Procedures
 1. Provide submittals to Eugene School District's Project Manager and Architect.
 2. Submit three (3) copies of each submittal.
 3. Provide other Shop Drawings only if specifically requested by Eugene School District's Project Manager.

1.07 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

1.08 MAINTENANCE

- A. Provide full procedures for all database back-ups.
- B. Provide full procedures for upgrading software.
- C. Provide full procedures for testing battery condition on all field panels for adequate back-up time.
- D. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- D. Product Availability
 - 1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into their proposed Contract Time.
 - 2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify their ability to procure the products specified prior to submitting a proposal.

2.02 INTRUSION CONTROL SYSTEM

- A. Keypads
 - 1. DMP Keypad – White model 7063
- B. Motion Sensors
 - 1. Bosch DS970 or approved equal for wall mounted applications.
 - 2. Bosch B328 gimbal mount bracket.
 - 3. Bosch DS 9360 or approved equal for ceiling mounted applications.
- C. Siren
 - 1. Ademco 747.
- D. Power Supply
 - 1. Altronix AL1012ULX with PD4CB or PD8CB Distribution module.
 - 2. Altronix Maximal 33E power supply where required.
- E. Door Contacts
 - 1. Standard doors - Aritech 1078CW Series or approved equal
 - 2. Storefront doors – Aritech 1840
 - 3. Surface mount - Aritech 2505-L Series or approved equal

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. The system shall only be provided by Contractors who are factory authorized to

install, service and maintain the system by the access control manufacturer.

- B. The Contractor must have been a factory authorized dealer with the proposed manufacturer for a period of at least two (2) years before the Bid Opening Date.
- C. The Contractor's installers and technicians shall also be factory trained and certified to perform such tasks.

3.02 EXAMINATION

- A. The Contractor shall be required to visit the installation site prior to bidding the job.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

3.03 PREPARATION

- A. The Contractor shall order all required parts and equipment upon notification of award of the Work.
- B. The Contractor shall bench test all equipment prior to delivery to the job site.
- C. The Contractor shall verify the availability of power where required. If a new source of power is required, a licensed electrician shall be used to install it.
- D. The Contractor shall arrange for obtaining all programming information including access times, free access times, door groups, operator levels, etc.

3.04 INSTALLATION

- A. The Contractor shall coordinate with the Eugene School District's IT Department when connecting to their network.
- B. The Contractor shall carefully follow the instructions in the manufacturers' Installation Manual to insure all steps have been taken to provide a reliable, easy to operate system.
- C. The Administrator Terminal shall be connected to the remote terminals before connecting to any card reader processors.
- D. The Contractor shall coordinate Division 8 for door strike and ADA functionality requirements.
- E. Perform all Work as indicated in the Drawings and Specifications.
- F. The Contractor shall install the appropriate cable from the CPU to readers, door contacts, request-to-exit devices, and electric locks at each door and/or gate.
- G. All communications cables shall be kept away from power circuits.
- H. The Contractor shall install the power supply(s) for electric locks in locations where they won't interfere with other operations.
- I. The Contractor shall also execute adequate testing of the system to insure proper operation.
- J. The Contractor shall provide adequate training of the system users to insure adequate understanding to prevent operating errors.

3.05 WORKMANSHIP

- A. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
- B. Perform Work with persons experienced and qualified to produce workmanship specified.
- C. Maintain quality control over suppliers and Subcontractors.
- D. Quality of workmanship is considered important. Eugene School District Project Manager will have the authority to reject Work which does not conform to the Drawings and Specifications.

3.06 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench testing shall be per manufacturer's installation instructions.

3.07 GROUNDING

- A. Provide earth-grounding of equipment as required by equipment manufacturer. Earth ground shall be connected to ground rod or approved cold water pipe. Electrical or telephone ground connections shall not be used as earth grounds. Connections to mounting posts or building structural steel shall not be used as earth grounds.

3.08 POWER TO SECURITY EQUIPMENT

- A. Power all equipment from 120 VAC circuit dedicated for security use, except as noted. Mark all panel circuit breakers with labels worded "Security Equipment - Do Not Operate", or equivalent.
- B. All plug-in transformers shall be located at the security control panels. Secure all low-voltage plug-in transformers to outlet with screw or strap. Clearly label all transformers to identify purpose and use.

3.09 CUTTING AND PATCHING

- A. The Contractor shall be responsible for all cutting, fitting or patching that may be required to complete the Work.

3.10 FIELD QUALITY CONTROL

- A. Upon reaching Substantial Completion, perform a complete test and inspection of the system. If found to be installed and operating properly, notify Eugene School District of your readiness to perform the formal Test & Inspection of the complete system.
- B. Submit the Record Drawings (as-builts) to Eugene School District for review prior to inspection.
- C. During the formal Test & Inspection (Commissioning) of the system, have personnel available with tools and equipment to remove devices from their mounts to inspect wiring connections. Provide wiring diagrams and labeling charts to properly identify all wiring.
- D. If corrections are needed, the Contractor will be provided with a Punch-List of all discrepancies. Perform the needed corrections in a timely fashion.
- E. Notify Eugene School District when ready to perform a re-inspection of the installation.

END OF SECTION 28 1619

**SECTION 28 1633
INTRUSION DETECTION INTERFACES**

PART 1 GENERAL REQUIREMENTS

1.01 SECTION INCLUDES

- A. Intrusion Detection Management Software (IDS)
- B. Field Panels

1.02 RELATED WORK BY OTHERS

- A. All rough-in category 6a data cabling to support the system will be provided by Division 27 – Refer to drawings for specific locations.

1.03 RELATED REQUIREMENTS

- A. 28 0500 Common Work Results for Safety and Security
- B. 28 1316 Access Control Database Management
- C. 28 1319 Access Control Infrastructure
- D. 28 1326 Access Control Remote Devices
- E. 28 1333 Access Control Interfaces
- F. 28 1343 Access Control ID Management
- G. 28 1613 Intrusion Detection Panels
- H. 28 1619 Intrusion Detection Remote Devices

1.04 SYSTEM USER REQUIREMENTS

- A. System Partitioning
 - 1. The access point readers, monitor points, and auxiliary outputs shall be managed on a partition basis by simply defining which devices are to be included in a partition.
 - 2. The IDS shall be supplied with the ability to manage up to 64 partitions, and shall have an option to manage up to 999 partitions.
 - 3. Operator permissions shall be created and assigned globally or by the Owner. When created and assigned globally an Operator's password shall be associated with one or more companies.
- B. Alarm Management
 - 1. Alarm handling shall be managed with up to 99 priority levels and user definable instruction messages to ensure the operator monitoring the site takes appropriate responses. The facility shall have the ability to customize audible alerts for each type of alarm is provided using standard or custom generated multimedia wave files. Each alarm type shall also be presented in a user-defined color.
- C. E-mail Alarms
 - 1. The IDS shall automatically e-mail alarm condition messages.
 - 2. Each alarm definition shall allow a destination e-mail address to be defined. The e-mail address may be an address group as defined in the e-mail MAPI application.
 - 3. E-mail alarm messages shall be controlled by time of day and day of the week. For example, e-mail to the Facility Security Supervisor would only be generated when alarms occur during after-hours times.

- D. User Code Mode
1. The IDS shall support the ability to put a keypad-equipped reader into User Code Mode. This feature shall allow a cardholder to gain access by entering a valid card's number at a reader keypad, therefore not requiring the holder to carry a card.
 2. User code mode shall be enabled on a per reader basis.
 3. This mode shall support card number only, or card number and its assigned PIN code.
- E. Dial-In/Out Alarms Option
1. The IDS shall support a dial-out (alarm transmission) alarms reporting capability. A complimentary dial-in (alarm receipt) capability shall also be supported. This option would be used, for example, when an alarms monitoring client is unmanned outside of normal office hours and alarms generated at these times to be copied to a central manned system located elsewhere not on the LAN/WAN.
 2. The alarm messages copied to the alarms-receiving (dial-in) site shall be the same as those displayed at the local (dial-out) site. However, the alarm instructions (as displayed when acknowledging an alarm) may be different.
- F. Intrusion Detection System Integration Option
1. The IDS shall support a high-level integration to an intrusion detection system (IDS). The third-party IDS shall be UL 1076 listed. The IMS shall support events to be recorded and displayed from the IDS system on the alarm management screen and in the transaction history reports.
 2. The integration to the IDS shall support, at a minimum, secondary monitoring of all IDS alarm transactions while allowing it to still be monitored by a central station, if desired.
 3. The IDS integration shall also include the ability to arm and disarm the IDS from the IMS user interface. This feature must be available with all IDS products.
 4. IDS alarms shall be capable of triggering a series of IMS events. For instance, when the IDS reports that the system was armed, the IMS shall be able to lock all doors.
 5. IDS alarms shall be viewable on the IMS map interface.
 6. Lockdown function shall integrate with the IDS, Mass Notification and Integrated Communications System.
 7. The communication with the IDS control panel shall be monitored, and the IMS shall produce an alarm in the event of a communications failure.
 8. The IMS must provide integration with both the DMP communication with the IDS control panel shall be monitored, and the IMS shall produce an alarm in the event of a communications failure.
- G. Thin Client Access Option
1. The system shall provide for an option of thin client access to the IMS. The thin client interface shall utilize Microsoft Terminal Services to provide the same look and feel of the thick client to minimize training time and expense. The thin client shall be capable of the same functionality of a thick client with the exception of functionality that requires access to ports on the thin client computer.

1.05 SUBMITTALS

- A. Submittals shall be as per 28 0500

1.06 WARRANTY

- A. Contractor warrants that all Work furnished under this Contract will be of good quality, free from faults and defects, and in conformance with the Project Drawings and Specifications.
- B. Contractor shall provide a parts and labor guarantee on all Work. Unless otherwise specified herein, Contractor's guarantee shall be for a period of two (2) years from date of Acceptance, except where any specific guarantees from a supplier or equipment manufacturer extends for a longer time.
- C. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including costs of labor, transportation, lodging, materials, and equipment.
- D. Guarantee shall not cover any damage to material or equipment caused by accident, misuse, unauthorized modification or repair by Eugene School District, or acts of God.

1.07 SYSTEM STARTUP

- A. Power shall only be applied to the system after re-checking for proper grounding of the system and measuring all loops for lack of shorts, grounds, and open circuits.

1.08 MAINTENANCE

- A. Provide full procedures for upgrading software.
- B. Provide full procedures for testing battery condition on all field panels for adequate back-up time.
- C. Provide full procedures for any other tasks that must be performed to ensure the warranty remains intact.

PART 2 PRODUCTS

2.01 GENERAL

- A. All products not provided by Eugene School District shall be new and unused, and shall be of manufacturer's current and standard production.
- B. Where two or more equipment items of the same kind are provided, all shall be identical and provided by the same manufacturer.
- C. Drawings and Specifications indicate major system components, and may not show every component, connector, module, or accessory that may be required to support the operation specified. Contractor shall provide all components needed for complete and satisfactory operation.
- D. Product Availability
1. Contractor, prior to submitting a proposal, shall determine product availability and delivery time, and shall include such considerations into their proposed Contract Time.
 2. Certain products specified may only be available through factory authorized dealers and distributors. Contractor shall verify their ability to procure the products specified prior to submitting a proposal.
- E. Products
1. DMP XR550DNL-G.
 - a. Intrusion detection panel interface fully compatible with the Security Management Software, Lenel Enterprise Series

PART 3 EXECUTION

3.01 ACCEPTABLE INSTALLERS

- A. The system shall only be provided by Contractors who are factory authorized to install, service and maintain the system by the access control manufacturer.
- B. The Contractor must have been a factory authorized dealer with the proposed manufacturer for a period of at least two (2) years before the Bid Opening Date.
- C. The Contractor's installers and technicians shall also be factory trained and certified to perform such tasks.

3.02 EXAMINATION

- A. The Contractor shall be required to visit the installation site prior to bidding the job.
- B. The Contractor shall report any discrepancies between the Specifications, Drawings, and Site Examination prior to the Bid Opening Date.

3.03 EQUIPMENT PRE-TEST

- A. All equipment shall be bench tested prior to delivery to job site and prior to installation. Bench testing shall be per manufacturer's installation instructions.

END OF SECTION – 28 1633

SECTION 28 0800
COMMISSIONING FOR FIRE ALARM AND SECURITY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Section 26 0500, Common Work Results for Electrical apply to work specified in this Section.
- C. The Work of this Section is supplemental to and does not supersede any other requirements of the Contract Documents.

1.02 SUMMARY

- A. The commissioning process is described in Section 01 9113, General Commissioning Requirements.
- B. Provide all labor and materials required to complete the commissioning of those Division 28 systems and equipment identified as Commissioned Systems and Equipment in Section 01 9113, General Commissioning Requirements.
- C. Related Sections include:
 - 1. Section 01 9113, General Commissioning Requirements
 - 2. Division 28 Sections

1.03 SUBMITTALS

- A. Refer to Section 01 9113, General Commissioning Requirements.

1.04 COMMISSIONING SCOPE OF WORK - COMMISSIONING AGENT

- A. Refer to Section 01 9113, General Commissioning Requirements.

1.05 COMMISSIONING SCOPE OF WORK - CONTRACTOR

- A. Refer to Section 01 9113, General Commissioning Requirements.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Refer to Section 01 9113, General Commissioning Requirements.

PART 3 EXECUTION

3.01 MEETINGS

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.02 INSTALLATION, CHECK-OUT, START-UP AND PREFUNCTIONAL CHECKS

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.03 FUNCTIONAL TESTING

- A. Refer to Section 01 9113, General Commissioning Requirements.

3.04 TRAINING OF FACILITY OPERATING STAFF AND BUILDING OCCUPANTS

- A. Refer to Section 01 7900 Demonstration and Testing.

END OF SECTION

SECTION 28 3001
FIRE DETECTION AND COMMUNICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The provisions of Division 26 Section, Common Work Results for Electrical, apply to this section.

1.02 SUMMARY

- A. This Section includes:
 - 1. Replacing and expanding the existing facility fire alarm system.
 - 2. Design, install, and provide all labor, materials, and equipment required for a complete and operating system of manual and automatic initiating devices, audio/visual annunciation, voice communication with control panels, amplifier (s), speakers, auxiliary relays, power supplies, batteries and all accessories necessary to accomplish the desired sequence of events.
 - 3. The system shall be fully electronic and addressable as described below with monitoring and annunciation of all system alarms and troubles.
 - 4. Provide Fire Command Center and Fireman's Communication System.
 - 5. Provide Equipment Status and Control Panels.
 - 6. Interface each system with the attached adjacent building fire alarm system.
- B. Related Sections include:
 - 1. Section 26 0519, Low Voltage Electrical Power Conductors and Cables
 - 2. Section 26 0533, Raceways and Boxes for Electrical Systems
 - 3. Section 26 0553, Identification for Electrical Systems
- C. This Section calls for design-build work. Provide a complete working fire detection and communications system as specified and as required by applicable codes. Contractor shall be responsible for producing design drawings, coordinating with the project Architect, and submittal to AHJ for approval and permit.

1.03 QUALITY ASSURANCE

- A. Equipment shall be approved and installed in accordance with NFPA, ADA and IBC requirements and shall be UL listed both in individual components and as a system. All equipment shall be ISO-9000 certified; UL & FM listed and meet NFPA 72.
- B. The system supplier shall furnish evidence that there is an experienced and efficient service organization which carries a stock of repair parts for the system to be furnished and that the organization is capable of providing repair service within 24 hours of a trouble call.
- C. The system shall be installed by an electrical contractor experienced in the installation of addressable fire alarm systems and certified by the National Institute for Certification in Engineering Technologies (NICET) for fire alarm systems. The services of the control equipment factory representative shall be obtained to provide engineered system floor plans and point-to-point drawings on AutoCAD. The representative shall supervise the installation, system start-up, programming, make final adjustments and provide testing of the completed system. The factory representative shall provide a letter of system certification to the Architect.

1.04 CONTRACTOR DESIGN

- A. The equipment shown on the contract drawings indicate the general nature of the fire alarm system, but does not show all components required. Devices shown on plans which are above and beyond code requirements shall be included as a performance-based design, and shall be adjusted to meet NFPA 72 requirements if required to comply. Such additional devices shall not be excluded without advanced approval by the Owner. It is the responsibility of the contractor to provide a complete fire alarm and communications system as needed to meet all applicable codes and requirements under this section. The design-build contractor shall submit performance-based design documentation to AHJ and process code variance documentation if required to gain approval.
- B. It is the responsibility of the contractor to review various sets of drawings for initiating and notification devices, and provide devices as required to comply with the requirements of the specifications and NFPA 72.
- C. Raceway, routing, and wiring for field devices are not shown on the drawings except for a few specific design requirements.

1.05 SUBMITTALS

- A. AutoCAD shop drawings with Fire Marshal's stamp of approval.
- B. Product data with wiring schematics.
- C. AutoCAD wiring diagrams of each type of device.
- D. AutoCAD riser diagram of the complete system(s).
- E. Battery and voltage drop calculations based on intended routing and wiring.
- F. Amplifier sizing calculations.
- G. Shop drawings of the system shall be prepared by the manufacturer in AutoCAD and submitted to the Fire Marshal for approval. The approved shop drawings will be utilized as the installation drawings. The shop drawings shall show actual conduit routing and conductors as to be installed. These drawings shall be updated by the contractor to include any revisions and changes to the system during construction and installation.

1.06 SYSTEM DESCRIPTION

- A. The automatic fire detection systems shall operate in a local, supervised non-coded fashion. The system shall be low voltage operating at 24 volts DC. The system shall be fully addressable with analog technology for all sensors. Signal circuits shall be either class "A" or "B" without changing modules. System shall be designed class "B". All circuits shall be loaded to 75 percent capacity maximum.
- B. All signal, visual and audible alarms, communication circuits, flow and tamper circuits shall be supervised for all opens, shorts and grounds. Any open, short or ground shall cause a trouble on the system, sound the audible trouble sounder and annunciate at the control panel and remote annunciator: the device, location and nature of the trouble condition.

1.07 SYSTEM OPERATION

- A. Operation of any manual or automatic initiating device shall cause an audible and visual alarm to sound, activate the control-by-event program and perform all auxiliary functions.
- B. Fault in the circuits shall be annunciated at the control panel and the remote annunciators.
- C. System shall utilize a single pair of wires to power, transmit and receive data from the addressable analog initiating devices and to transmit commands to the remote control points. The wire shall be sized for the length of communications loop but in no event shall it be less than number 18-2 wire size.

1.08 SEQUENCE OF OPERATION

- A. The system alarm operation subsequent to the alarm activation of any manual station, automatic initiating device, or sprinkler flow/pressure switch is to be as follows:
 - 1. Audible alarm indicating appliances shall sound a digitized tone in the elevators, stairwells and the floor initiating the alarm until silenced by the alarm silence switch at the control panel.
 - 2. All visual alarm indicating appliances (xenon strobes) shall display a continuous pattern until extinguished by the alarm silence switch.
 - 3. All doors normally held open by door control devices shall release. Door lock systems shall be signaled to unlock.
 - 4. A supervised signal to notify an approved central station shall be activated.
 - 5. Combination fire/smoke dampers shall de-energize to normally closed position.
- B. The alarm activation of any elevator lobby, hoistway, or machine room smoke or heat detector shall in addition to the operations listed above, cause the elevator cab to be recalled according to the following sequence:
 - 1. If the alarmed detector is on any floor other than the preferred level of egress, the elevator cab shall be recalled to the preferred level of egress.
 - 2. If the alarmed detector is on the main egress level, the elevator cabs shall be recalled to the predetermined alternate recall level as determined by the local authority having jurisdiction.
 - 3. The activation of any heat detector in an elevator hoistway or machine room shall automatically disconnect power to the elevator motor via base-mounted contacts activating the elevator feeder shunt-trip circuit breaker. Refer to drawings.
- C. The control panel shall have a dedicated supervisory service indicator and a dedicated supervisory service acknowledge switch.
- D. The activation of any standpipe or sprinkler valve tamper switch shall activate the system supervisory service audible signal and illuminate the indicator at the control panel.
 - 1. Activating the supervisory service acknowledge switch will silence the supervisory audible signal while maintaining the supervisory serviced LED on indicating the tamper contact is still in the off-normal state.
 - 2. Restoring the valve to the normal position shall cause the supervisory service indicator to extinguish thus indicating restoration to normal position.
- E. The activation of any sprinkler pre-action system pressure or low air switch shall activate the system supervisory service audible signal and illuminate the indicator at the control panel.
 - 1. Activating the supervisory service acknowledge switch will silence the supervisory audible signal while maintaining the supervisory service indicator on indicating the pressure/air contact is still in the off-normal state.
 - 2. Restoring the air pressure to the normal shall cause the supervisory service indicator to extinguish thus indicating restoration to normal position.
- F. Alarm and trouble conditions shall be immediately displayed on the control panel front alphanumeric display and of remote annunciators. If more alarms or troubles are in the system the operator may scroll to display new alarms.
- G. The system shall have an alarm list key that will allow the operator to display all alarms, troubles, and supervisory service conditions with the time of occurrence.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Firelite

- B. Owner expected equipment as follows:
1. Control Panel: Firelite MS9600UDLS
 2. Voice Evacuation Panel: Firelite ECC-50/100
 3. Voice Evacuation Amplifier: Firelite ECC series
 4. Firefighter Interface: Firelite ECC-LOC
 5. Annunciator: Firelite ANN80
 6. Smoke Detector: Firelite SD355
 7. Thermal Detector: Firelite H355R
 8. Pull Station: Firelite BG12LX
 9. Duct Smoke Detector: Firelite D355PL with CRF300 relay module
 10. Monitor Module: Firelite MMF300
 11. Control Module: Firelite CMF300
 12. Relay Module: Firelite CRF300
 13. Speaker or Speaker/Strobe: Wheelock Exceder LED High Fidelity series in red
 14. Horn/Strobe: Wheelock HSR
 15. Strobe: Wheelock STR
 16. Exterior Horn: Wheelock AH-24WP-R
 17. NAC Power Supply: Silent Knight 5499
 18. Cable: 18 and 14 gauge solid FPLP (red) 2 or 4 conductors
- C. Contractor shall verify with fire alarm system manufacturer the list above and related part numbers and provide complete fire alarm system head-end, controls and devices with are compatible with and listed for operation with each other.
- D. Any deviations should be noted at time of bidding through a substitution or information request.
- E. CONTROL PANEL
- F. Provide processor, switches, relays, solid state indicator lamps and displays, wiring, terminals, etc., as required for operation, supervision and control of complete system.
- G. General: Microprocessor based, point identified system utilizing twisted pair 18 to 12 AWG, depending on distance, class B communication loop. Equip for a minimum of four loops.
- H. Cabinet: 16-gauge enameled steel designed for two level access. Level 1 to give access to the interface control panel. Level 2 to give access to the electronics.
- I. Outputs: Two general alarm signal circuits, programmable signal circuits, alarm contacts, trouble contacts, and RS485 annunciator line circuit.
- J. Controls and Displays: Alarm silence, trouble silence, alarm/trouble acknowledge, and reset switches, 80-character LCD display, touch keypad, and power indicator.
- K. Power Supply: Minimum 1.8 amperes of regulated, filtered power at 24 VDC plus 3.0 amperes unregulated.
- L. Failsafe Auxiliary Degrade Alarm Circuit: System will perform basic detection and alarm function and send a signal to the fire department with the CPU failed.
- M. Two-Way Loop: System capable of addressing and operating smoke detectors, manual pull stations, open contact devices and addressable auxiliary control relays on the same two-wire communication loop.
- N. Battery Back-up: Self-charging sealed lead battery backup for system auxiliary power supplies and remote annunciators in accordance with code requirements (operate 24 hours, then alarm for 10 minutes, minimum). Batteries to be monitored and initiate a trouble signal if disconnected or discharged more than 15 percent.

2.02 FIRE COMMUNICATIONS CONTROL PANEL

- A. Audio amplifiers shall be supervised, solid-state amplifiers having a frequency response of 100 to 6,000 Hz + 3dB with less than 5 percent distortion at rated output. The audio amplifiers shall be supervised and provide a distinct visible indication should failure occur and the system trouble signal will sound. The amplifiers shall have short-circuit protection to prevent damage due to inadvertent speaker line shorts. Upon amplifier failure, the system shall automatically switch to a backup amplifier. Capacity and number of amplifiers to be determined by total anticipated speaker load in building and provide a 5 percent spare capacity.
- B. Provide multiple circuits of parallel connected alarm speakers zoned as required. The speaker circuits shall be independently programmable and provide a distinct visible signal as a result of any shorts, opens or grounds in the speaker circuit wiring and the system trouble signal shall sound and the zone in trouble annunciated. Accessible controls shall be provided and identified to allow authorized personnel to transmit voice messages to individually selected signal zones. Visible indicators shall be provided to indicate that the individual signal circuit selector switch is in the voice position. Each output circuit shall have a modulation indicator for visual monitoring of circuit outputs.
- C. Provide a hand held press-to-talk microphone for transmission of messages. This module shall provide facilities to manually control the audio alarm system and transmit verbal instructions to all areas, zones, or floors, or any combination desired by the Fire Marshal.

2.03 CENTRAL STATION REPORTING

- A. Provide digital alarm communication transmitter (DACT) internal to FACP

2.04 STROBE SYNCHRONIZATION MODULE

- A. Synchronize all strobes to 1Hz flash to comply with the Americans with Disabilities Act (ADA).

2.05 SOFTWARE

- A. Field Configuration Program: Provide all of the programmable operating instructions for the system resident program stored on a non-volatile EEPROM.
- B. Programming: Perform at the location of the fire alarm control using a lap-top computer system; hard copy of the system configuration is to be updated and maintained at the site.
- C. Control-By-Event: Each address shall be programmed for selective alarm output, zone verification operation, control point activation on alarm or trouble and transmit alarm to the fire department. Report trouble to adjacent attached building fire alarm system. Programmed control point activation to provide selective control.

2.06 REMOTE EQUIPMENT

- A. Annunciator Control Panels: Alphanumeric display module:
 - 1. 80 character LCD display, back lighted.
 - 2. System acknowledge, signal silence, and system reset touchpad control switches.
 - 3. Time/date display.
 - 4. Integral sounder with subsequent alarm/trouble resound.
 - 5. Flush mounting.
- B. Transponders: Up to 26 field configurable circuits of any mix. Full LED/LCD display of alarm and trouble per point. Status displays and controls including power, on-line, local alarm and local trouble LED/LCD's plus reset and lamp test switches. Power supply, charger and battery as required for control panel.
- C. Lamp Driver Modules: Field selectable alarm and trouble or alarm only. Integral system trouble lamp on-line/power LED/LCD, alarm and trouble resound with flash function of new events, serial RS-485 interface to control panel, capable of being powered remotely or locally with supervision. Integral lamp test function.
- D. Power supplies, with integral chargers and batteries current limited low energy as recommended by the manufacturer but sized for 25 percent spare capacity.

2.07 ELECTROMAGNETIC DOOR HOLDERS

- A. Equipment shall consist of an armature contact plate with adjustable pivot mount, to be installed on door. A heavy-duty electromagnet, in a durable enclosure to be mounted behind the door on the wall or floor.
- B. Fail-Safe operation, loss of power shall release the door holder for the door to close.
- C. Unit shall accept 12VDC, 24VAC/VDC or 120VAC. Voltage shall be coordinated by the fire alarm system installer/supplier. Any circuitry required for the systems operation shall be provided by the system installer.
- D. All door holder equipment shall be of the same manufacturer as the fire alarm system to ensure system compatibility and proper UL compatibility listings.

2.08 DETECTION DEVICES

- A. Analog photoelectric smoke detectors shall provide for individual addressing of each detector. The sensor is constantly monitored to measure any change in its sensitivity due to the environment caused by dirt, aging, temperature, humidity, etc. It shall give an advanced indication to the control panel of the need for maintenance and can be specific as to where the maintenance is needed. It is to be mounted on a two wire standard device base. Photo electric detectors located within the elevator shaft shall be rated for installation within a pressurized shaft.
- B. Analog thermal detectors consist of a dual thermistor sensing circuit for fast response. The sensor is continually monitored to measure any changes in their sensitivity due to temperature. It shall give an advanced indication to the control panel of the need for maintenance and can be specific as to where the maintenance is needed. It is to be mounted on a two wire standard device base. Thermal detectors in elevator shafts and machine rooms shall be equipped with a set of auxiliary contacts for elevator equipment use. Thermal detectors located within elevator shaft shall be rated for installation within a pressurized shaft.
- C. Projected beam type smoke detectors shall be four-wire 24 VDC and powered from the control panel four-wire smoke power source. This unit shall consist of a separate transmitter and receiver capable of being powered separately or together. This unit shall operate in either a short range of 30 to 100 feet or a long range of 100 to 300 feet. The detector shall feature a bank of four alignment LEDs on both the receiver and transmitter that are used to ensure proper alignment without the use of special tools.
 - 1. The beam detector shall feature automatic gain control that shall compensate for gradual signal deterioration from dirt accumulation on lenses. Ceiling or wall mount as shown on the drawings. Testing shall be carried out using calibrated test filters. Provide a key activated remote test station.
 - 2. Provide monitor modules for alarm and trouble and control relay module for reset.
- D. Addressable monitor modules shall provide an address for a single, normally open initiating device such as a waterflow switch, manual station, etc. The monitor module shall be UL approved to extend the sensor loop to lengths up to 2,500'.
- E. Provide smoke detector duct housing assemblies to mount an analog/addressable detector along with a standard, relay or isolator detector mounting base. The housing shall also protect the measuring chamber from damage and insects. The housing shall utilize an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. Drilling templates and gaskets to facilitate locating and mounting the housing shall also be provided. The housing shall be finished in baked red enamel. Remote alarm LED indicators and remote test stations shall be provided.

2.09 MANUAL PULL STATIONS

- A. Single action, addressable, constructed of all metal construction with a key reset switch for positive authorized resetting action. The unit to be keyed the same as the control unit.

2.10 ANNUNCIATION DEVICES

- A. Strobes, speakers, and combination speaker/strobes mounted to a recessed box with an extension ring. Front of the unit shall allow for candela light levels as required by ADA for the spacing as installed. Horns shall provide a 100 dba peak sound output with field adjustable output level. Finish to be white or red as selected by the Architect.
- B. Strobe lights shall be triangular with "FIRE" on white plastic lens, polarized 24 VDC, mounting single gang on four square box. Front of the unit shall allow for candela light levels as required by ADA for the spacing as installed. Strobe candela level shall be field adjustable from 15-110 CD. Mount at 80" or as shown on drawings. Finish to be white or red as selected by the Architect.
- C. The candela rating of each strobe installed shall be apparent to the Fire Marshal and to qualified service personnel either as installed or with the removal of the faceplate. If faceplates are interchangeable between strobes of different ratings the indication of candela rating shall not be on the faceplate.
- D. Speakers shall be mylar cone-type supplied by the panel manufacturer to ensure system compatibility and proper UL compatibility listings. Screw terminals shall be provided for wiring. Speaker housings shall be white. Speakers shall have power taps at 1/4w, 1/2w, 1w, and 2w. Speakers shall provide 90 dBA peak sound output at 2w. Speakers shall mount in 4-inch electrical boxes with extension rings using the two screws provided with each ring.

2.11 ADDRESSABLE ACCESSORIES

- A. Control Modules: Connects to the same loop as the initiating devices and provides a form "C" relay contact. The module may be programmed to transfer from either a trouble or alarm input from any or combination of any addressable device.

2.12 CONTROLLED DEVICES

- A. Mechanical control system for control of air handlers and smoke/fire rated dampers.
- B. Fire protection tamper, flow, dry system and preaction system.

2.13 CABLE

- A. Cabling shall be multi-conductor solid copper, with red jacket, sized per manufacturer's recommendations, and as shown on approved fire alarm shop drawings.
- B. Plenum rated as recommended by System Manufacturer and the building construction methods.
- C. Circuit Integrity (CI) rated as and where required by NFPA 72 Ch 6.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install in accordance with code, IFC, IBC, NFPA 72, 101 and the manufacturer's instructions. Review proper installation of each type of device with manufacturer's agent. Install all wiring, raceway and outlet boxes required for a complete system as indicated in the Contract Documents. Comply with applicable requirements of Section 26 0533 for boxes and surface mounted raceways.
- B. Typical Wiring: Install manufacturer's recommended listed cable to connect all devices as recommended by the manufacturer. The cable shall be run in conduit where exposed to physical damage.
- C. Detectors: Locate 48" clear of supply air vents and 12" clear of lights and sprinkler heads. Install detector heads not more than two weeks prior to substantial completion. Verify the design locations shown conform to the actual construction. Do not locate detectors in close proximity to air supply vents. Bring cases of uncertain applicability to the attention of the Architect for resolution prior to roughing in.
- D. Install remote annunciator as indicated on plans and where required by Fire Marshall. Coordinate prior to rough-in.

- E. Provide auxiliary power supplies as required and extend the 120V power to the power supply as required and per NEC.
- F. Provide visual devices and alarm devices as required. Device locations are diagrammatic showing intent of area coverage. The exact quantity placement, sound or light level is to be per the requirements and the listing of the manufacturer's equipment and NFPA 72 installation requirements for the device(s) installed and the building conditions at and adjacent to the device(s). Provide ceiling mounted devices in lieu of wall mounted devices where desired by the Architect/Owner. Coordinate with Architectural ceiling and floor plans and obtain approval for dimensional locations prior to rough-in and device installation.

3.02 LABELING

- A. Label all alarm initiating devices with ½-inchx1-inch lamicoid nameplates, indicating control panel point designation. Locate nameplates in the vicinity of the device as approved by the Owner.
- B. Provide Brady type wire markers to identify all conductors at each junction or terminal. Use numbers indicated on the wiring diagrams.

3.03 TESTS

- A. Provide the service of a competent, factory-trained technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during the programming, final connections, adjustments and tests for the system.
- B. When the system is complete and prior to the substantial completion, furnish testing equipment and perform the following tests:
- C. Before energizing system, check for correct wiring connections and test for short circuits, ground faults, continuity, and insulation.
- D. Test the insulation on all installed wiring by standard methods as recommended by the equipment manufacturer.
- E. Open all supervised circuits to see if the trouble signal activates.
- F. Ground all supervised circuits and verify response of trouble signals.
- G. Check installation, supervision, operation and sensitivity of smoke detectors as recommended by the manufacturer to ascertain that they will avoid false alarm signals yet provide the required automatic detection.
- H. Test each device for proper operation and auxiliary function.
- I. Submit a print out of the entire test procedure to the engineer with the letter of certification for the completed fire alarm system.
- J. When any defects in the work are detected, make repairs and repeat the tests as required.
- K. Test system for NFPA standby and alarm runtime for the actual load on the system batteries and recharge time of system batteries.
- L. Perform all required and necessary verification of the system operating functions with the Architect and Owner's facility staff prior to turnover of the complete system for final test observed by the Fire Department. These tests shall be performed in the presence of the Owner or the Owner's Representative. A System Certification verifying the proper system operation is required prior to acceptance. Instruct Owner's personnel in system operation, maintenance and programming for a minimum of twenty (20) hours. The cost of any retesting as a result of the failure of the system to operate in accordance with these specifications, drawings, or applicable codes shall be paid for by the contractor to the Owner.

3.04 WARRANTY SERVICE AND INSTRUCTION

- A. The fire alarm system will be checked on a monthly basis by the fire alarm system service organization for a period of one year after beneficial occupancy. The monthly checks will consist of reviewing the operation of the system with the Owner's operating and maintenance personnel, providing additional hands on instruction, and assisting in execution of programming revisions. Each monthly visit will consist of not less than two hours of on-site time and no more than four hours. The monthly visits will be scheduled with the Owner not less than one week in advance.

3.05 EXTRA STOCK/SPARE PARTS

- A. Provide the following equipment to be turned over to the owner with the operation and maintenance manuals.
1. Two photoelectric smoke detector heads
 2. Two thermal heat detector heads
 3. One addressable dry contact modules
 4. Two horns
 5. Two horn/strobe
 6. Two speakers
 7. One manual pull stations
 8. One complete set of fuses to match panel counts

3.06 TRAINING

- A. Provide operation and maintenance training for Owner's personnel.
- B. Conduct a minimum of two maintenance training sessions upon completion of the work. Maintenance training sessions shall include a walk-thru of the completed facilities identifying the location, address, and means of access to every device monitored by the fire alarm system.
- C. Conduct training sessions for two operator levels.
- D. Operator training. Provide a minimum of three refresher and system update training sessions of on-the-job training.
- E. Supervisor training. Provide a system update training session for supervisory functions.
- F. Training sessions with fully qualified, trained representative, of the equipment manufacturer who is thoroughly knowledgeable of the specific installation.

END OF SECTION

**SECTION 31 2000
EARTH MOVING**

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. Excavation and fills, including compaction, of on-site private building, pavement, and landscaped areas.

1.03 RELATED SECTIONS

- A. Section 00 3100 - Available Project Information
- B. Section 01 2300 - Alternates
- C. Section 02 4100 - Demolition
- D. Section 31 2333 - Trenching and Backfill

1.04 REFERENCED SPECIFICATIONS

- A. ODOT Standard Specifications (latest revision).

1.05 REFERENCED DOCUMENTS

- A. Geotechnical Report: Geotechnical Investigation, River Road Elementary School, Eugene, Oregon, dated April 2, 2015.
- B. All earthwork operations shall comply with the recommendations and requirements of the Geotechnical Report.

1.06 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.07 DEFINITIONS

- A. Rock: Material that cannot be removed by one-yard shovel, by backhoe with 9,500 lb. digging force, by pick and shovel, or by 200 HP Crawler fitted with normal excavating equipment. Ripper attachment as might be hooked into seam is not considered "normal" excavating equipment.
- B. Unstable Soil: Soft, loose, wet, or disturbed ground that is incapable of supporting material, equipment, personnel, or structure.
- C. Wet Weather Conditions: Wet Weather Conditions apply to materials placed during dry weather but which are subsequently subjected to rainfall and equipment or construction traffic. The Contractor shall be responsible for the performance of the selected type of material.
- D. Dry weather conditions shall be assumed until October 15. Wet weather conditions are anticipated during the Wet Weather Period of October 15 through April 30. The contractor is responsible for providing the appropriate material and construction measures during the Wet Weather Period, and no additional monies will be paid to the contractor for construction during the Wet Weather Period.

1.08 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise noted.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, and manufacturing information.
 - 1. Submit for: Subgrade geotextile.

- C. Samples: Submit 2 material sample(s) (2 quart minimum) of the following product for approval prior to delivery to site.
 - 1. Select Fill.
 - 2. Granular Site Fill (if bar-run is used).
- D. Field Quality Control: Submittals as specified in Part 3 of this section.
 - 1. Field Tests.
 - 2. Special Inspections for Code Compliance.
- E. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.09 QUALITY REQUIREMENTS

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installers Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.
- C. Product/Material Qualifications:
 - 1. Design Data: Compaction testing shall be in accordance with Section 01 4000, QUALITY REQUIREMENTS.
 - 2. Test Reports: Provide imported material gradation test reports. Provide material compaction test reports.
- D. Regulatory Requirements:
 - 1. An erosion control permit is required. The Owner shall apply, pay for, and secure the permit. The contractor shall comply with the construction erosion control permit.
 - 2. Comply with 2008 Oregon Standard Specifications for Construction published by ODOT and the Oregon chapter of APWA and City of Eugene Amendment No. 1 for work within right-of-ways.
- E. Observation and Inspection: Owner will retain a Geotechnical Engineer to monitor earthwork operations.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.11 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section.

1.12 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 STABILIZATION FILL

- A. Imported, clean, angular quarry rock, 3-inch or 6-inch minus material, open-gradation.

2.02 SELECT FILL

- A. Shall consist of 1"-0 or 3/4"-0, clean, well-graded, durable, crushed rock that is free of plastic clay, organic matter and construction debris and with no more than 5 percent by weight passing the No. 200 sieve.

2.03 GRANULAR SITE FILL

- A. Shall consist of 3"-0, clean, well-graded, crushed (quarry) rock.
- B. Bar-run gravel approved by the Geotechnical Engineer may be used if placed during dry weather.

2.04 RAINWATER HARVESTING CISTERN PRIMARY BACKFILL

- A. Primary Backfill shall be select rounded stones conforming to the specifications of ASTM C 33, size numbers 6, 67, or 7. Material is to be clean, free-flowing, and free of dirt, sand, large rocks, roots, organic materials, debris, ice and snow. Backfill material shall not be frozen or contain lumps of frozen material at any time during placement.
- B. Written certification that the material conforms to ASTM C 33, ASTM D 448, AASHTO M 43, and any other applicable specifications is required.
- C. Material is to be placed per Construction Documents and Manufacture's recommendations.

2.05 INFILTRATION FACILITY PRIMARY BACKFILL

- A. Imported clean 1"-3/4" river-run rock (round), free from foreign material and less than 2 percent passing the No. 200 sieve.

2.06 NATIVE MATERIAL

- A. Excavated, on-site soil, native to project site, free of organics, solids larger than 3 inch diameter, weeds and other deleterious matter and approved by the Geotechnical Engineer for use as fill only during dry weather conditions.

2.07 SUBGRADE SEPARATION GEOTEXTILE

- A. The Separation Geotextile shall have Mean Average Roll Value (MARV) strength properties meeting the requirements of an AASHTO M 288-06 Class 2 woven geotextile. The geotextile shall have MARV hydraulic properties meeting the requirements of AASHTO M 288-2006 (geotextile for separation) with a permittivity greater than 0.05 per sec.⁻¹ and an AOS less than 0.6 mm. This geotextile is not suitable for construction during wet weather.

2.08 CONDUIT

- A. Irrigation sleeves as specified in Section 32 8000, IRRIGATION.
- B. Electrical conduit as specified in Division 26, ELECTRICAL.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting of the work of this section verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.
- B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 PRECONSTRUCTION CONFERENCE

- A. Hold a preconstruction conference with the Geotechnical Engineer, Owner's Representative and the earthwork subcontractor prior to beginning earthwork operations.
- B. Comply with the recommendations of the Geotechnical Engineer.

3.03 PROTECTION

- A. Monuments: Carefully maintain bench marks, monuments, and other reference points. If disturbed or destroyed, replace as directed.
- B. Existing Utilities: Existing utilities shall be field located. Protect active utility lines encountered. Repair or replace utility lines damaged by work of this Section.
- C. Pavement Cleaning: Maintain pavements and walkways clean at all times.
- D. Dust Control: Protect persons and property against damage and discomfort caused by dust; water as necessary and when directed.
- E. Other Work and Adjacent Property: Protect against damage caused by work of this section.

3.04 GENERAL REQUIREMENTS

- A. Contractor shall perform all excavation necessary or required for proper construction of the work and placement or installation of materials.
- B. Cutting Pavements: Cut vertical, straight-line joints using power saw designed for cutting pavements.
- C. Line and Grade: Excavate to lines and grades shown on the drawings or as established by the Engineer.
- D. Shoring: Shore excavations when necessary to prevent caving during excavation in unstable material, or to protect adjacent structures, property, workers, and the public or as required by local, state, or federal agencies. Shoring shall be removed, as the backfilling is done, in a manner that does not damage work or permit voids in the backfill. It shall be the sole responsibility of the Contractor to see that safety requirements are met.
- E. Temporary stockpiling of Excavated Materials: Excavated materials may be placed in approved areas. Do not obstruct roadways, bikeways, or pedestrian walkways. Conform to all federal, state and local codes governing the safe loading of excavated materials adjacent to excavations.
- F. Excess Excavation: Where excavation, through the Contractor's error, is carried to levels lower than those shown on drawings, backfill with specified bedding material to proper levels at Contractor's expense.
- G. Drainage: Except as otherwise permitted, excavation shall be done in a manner as to provide for adequate drainage. In excavation where gravity drainage is not practical, the Contractor shall provide pumps and accessories with which to remove and dispose of all water, including but not limited to, surface water from rainfall entering the excavations, as required to accomplish the work and as required by governing jurisdictions.
- H. Backfilling shall not commence until after excavations have been inspected. Backfill shall be placed in such a manner as not to disturb, damage, or subject such facilities to unbalanced loads or forces. Make fills as soon as feasible after Engineer's review and acceptance.
- I. If rock or unstable soil are encountered, notify Engineer. Removal of rock or unstable soil will be paid for as an addition to the contract.

3.05 GEOTEXTILE PLACEMENT

- A. Acquisition and Storage: Provide complete rolls of geotextile as furnished by the manufacturer, and protect against damage and deterioration. Store all geotextile rolls in a dry place and off the ground at all times according to ASTM D4873 (latest revision). Cover all rolls and partial rolls with a dark protective covering when received. The geotextile will be rejected for use if the Engineer determines it has defects, deterioration, or has been damaged.
- B. Surface Preparation: Prepare the surface receiving the geotextile to a smooth condition free of obstructions, depressions, and debris unless otherwise directed. Do not drag the geotextile on the ground or mishandle it in any way.
- C. Loosely place the geotextile without wrinkles so placement of the overlying material will not tear the geotextile. Lap or sew the geotextile at the ends and sides of adjoining sheets as specified.
- D. On Slopes: Place the geotextile with the machine direction oriented up-down the slope. Lap the upper sheets over the top of the lower sheets. When the geotextile is placed on a slope steeper than 6:1, securely anchor the laps to the ground surface with pins or stakes as necessary to prevent slippage and tearing of the geotextile. Start placement of fill material on the geotextile at the toe of the slope and proceed upwards.
- E. Overlap: Minimum overlap shall be 24 inches.
- F. If the Engineer determines the specified overlap is not sufficient, increase the overlap to provide adequate coverage or sew the geotextile together in the field. If field-sewn, the provisions of ODOT 00350.20 and 00350.41(a-3) apply.

- G. Protection of Geotextile: Protect the geotextile at all times from ultraviolet (UV) rays, contamination by surface runoff, and construction activities.
- H. Traffic or construction equipment will not be permitted directly on the geotextile except as authorized by the Engineer. When placed for construction, cover the geotextile with specified cover material as soon as possible.
- I. Place cover material on the geotextile in a manner that the geotextile is not torn, punctured, or shifted. Use a minimum 6-inch-thick cover layer or twice the maximum aggregate size, whichever is thicker. End-dumping cover material directly on the geotextile will not be permitted.
- J. Limit construction vehicles in size and weight so rutting in the initial layer above the geotextile is not more than three inches deep or one half the layer thickness, whichever is less. Turning of vehicles on the first layer will not be permitted.
- K. Repair of Geotextile: Repair or replace all torn, punctured, or contaminated geotextiles during construction at no cost to the Owner. Repair by placing a patch of the specified geotextile over the affected area. Where geotextile seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or special provisions or as directed.

3.06 CLEARING AND GRUBBING

- A. Clear and grub site in all areas to receive improvements. Clearing shall be the removal of all brush, grass, shrubs, trees, weeds, rubbish, structures, pavements, and debris flush with or slightly below original ground surface. Remove willow and blackberry, if any, to not less than 12 inches below original ground surface. Grubbing shall be the removal of all stumps and roots larger than 1-1/2 inches in diameter, rocks larger than 6 inches, and existing structures to 4 inches below existing grade.
- B. Dispose of all cleared and grubbed materials off site.

3.07 EXCAVATION AND FILLS AT PEDESTRIAN AND VEHICLE PAVEMENT AREAS (DRY WEATHER)

- A. Strip the existing ground approximately 4 inches or as required to remove roots, sod or other existing demolition debris. Stripping depth to be confirmed by the Geotechnical Engineer. Remove strippings from site.
- B. Excavate any additional existing material to the grades required on the drawings. Remove any additional excavated material from site.
- C. Over excavate any unsuitable fill or other deleterious material as directed by the Engineer and Geotechnical Engineer. Overexcavation will be paid for as an addition to the contract. Overexcavated material shall be removed from site. Use Select Fill or Granular Site Fill to fill the voids left after overexcavation. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ± 2 percent.
- D. Compact the subgrade to a depth of 12-inches where soft soils are present. Proof-roll the completed subgrade with a vehicle approved by the Geotechnical Engineer.
 - 1. Over excavate any unsuitable fill or other deleterious material as directed by the Engineer and Geotechnical Engineer. Overexcavation will be paid for as an addition to the contract. Overexcavated material shall be removed from site. Use Select Fill or Granular Site Fill to fill the voids left after overexcavation. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ± 2 percent.
 - 2. Do not compact the subgrade if wet weather construction is encountered. Instead, overexcavate the Subgrade to provide a minimum 24-inch thick base rock section.
- E. Place Separation Geotextile over entire subgrade.
- F. Use Select Fill to raise the grade to the bottom of the pavement section elevation. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum

moisture content of ± 2 percent. Fill that cannot be tested shall be compacted to the approval of the Engineer and Geotechnical Engineer.

- G. Place Crushed Rock Pavement Base. Place base material in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ± 2 percent.

3.08 EXCAVATION AND FILLS AT BUILDING AREAS

- A. A building pad was constructed under a previous bid package. Contractor to protect existing building until placement of final lift to bottom of finished floor elevation.
- B. Foundation Preparation:
 - 1. Building foundations shall be supported on a minimum 12 inches of Select Fill. The Select Fill shall extend horizontally on all sides of the footing a minimum distance as shown on the drawings.
 - 2. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ± 2 percent.
 - 3. It shall be the Contractor's responsibility to maintain and repair the building foundation fills after initial testing and approval.

3.09 EXCAVATION AT HAUL ROADS

- A. Strip the existing ground approximately 4 inches or as required to remove roots, sod or other existing demolition debris. Stripping depth to be confirmed by the Geotechnical Engineer. Remove strippings from site.
- B. Place subgrade separation geotextile over entire subgrade.
- C. Place Stabilization Fill, Select Fill or a combination of 12-inches of Granular Fill capped with 12-inches of Select Fill to provide a 24-inch thick pad. Place fill in 12-inch maximum loose lifts and compact to a minimum density of 95 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ± 3 percent. It shall be the contractor's responsibility to maintain and repair the building slab base after initial testing and approval. Fill that cannot be tested shall be compacted to the approval of the Engineer and Geotechnical Engineer.

3.10 EXCAVATION AND FILL AT LANDSCAPED AREAS

- A. Refer to landscape drawings and Section 32 9000, PLANTING.
- B. Excavate to the grades required on the drawings. Scarify subsoil to a depth of 6 inches at all plant beds and lawn areas.
- C. When necessary, eliminate uneven areas and low spots in subsoil. Remove debris, roots, branches, stones, etc. Notify Owner if subsoil contaminated with petroleum products is encountered.
- D. Place loam in relatively dry state at areas where scheduled. Fine grade loam within specified tolerances eliminating rough or low areas. Establish levels, profiles, slopes, and contours shown on drawings. Establish uniform gradients between given grade points.
- E. Remove stone, roots, grass, weeds, debris, and foreign material while spreading. Manually spread around existing trees, paving, and other structures to prevent damage.
- F. At plant beds, shall be compacted to a minimum density of 80 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ± 2 percent.
- G. At lawn areas, shall be compacted to a minimum density of 80 percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ± 2 percent.
 - 1. At natural turf play fields, Native Materials may be used to for mass grading only in Dry Weather conditions. Native Materials shall be compacted to a minimum density of 80

percent relative compaction, per a maximum dry density of ASTM D698 (latest revision) at an optimum moisture content of ± 2 percent.

3.11 GRADING

- A. Perform all earthwork to the lines and grades shown on the drawings. Shape and finish slopes to conform to the lines, grades, and cross sections as shown or approved by the Engineer. Provide positive drainage away from buildings and sidewalks.

3.12 MAINTENANCE OF EARTHWORK

- A. Contractor shall maintain all earthwork surfaces until all work has been completed and accepted. Such maintenance shall include, but not be limited to, addition of appropriate backfill material to keep backfilled surface smooth, free from ruts and potholes, and suitable for traffic flow.

3.13 DISPOSAL OF WASTE MATERIAL AND EXCESS EXCAVATION

- A. Remove from site excess material that is unsuitable for backfilling or stockpiling at the Contractor's expense.

3.14 SETTLEMENT

- A. Any settlement in earthwork which occurs during the warranty period and is attributable to construction procedures, such as improper removal of shoring or insufficient compaction, shall be corrected by the Contractor at his own expense. Any piping or facilities damaged by such settlement shall be restored to their original condition at the Contractor's expense.

3.15 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 - 1. Subgrade compaction testing.
 - 2. Material compaction testing.
 - 3. Imported material gradation testing.
- C. Field Inspections: Notify Engineer prior to work of this section.
- D. Special Inspections for Code Compliance: Obtain building inspector approvals.

3.16 CLEANING

- A. Upon completion of the work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.17 PROTECTION

- A. Protect all work installed under this section.
- B. Replace at no additional cost to Owner, any damaged work of this Section.

END OF SECTION

**SECTION 31 2333
TRENCHING AND BACKFILL**

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. Excavation and fills, including compaction, of on-site private storm drain, sanitary sewer, manholes, water distribution, and natural gas distribution systems.

1.03 RELATED SECTIONS

- A. Section 01 2300 - Alternates
- B. Section 31 2000 - Earth Moving

1.04 REFERENCED SPECIFICATIONS

- A. ODOT Standard Specifications (current edition).

1.05 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.06 DEFINITIONS

- A. Rock: Material that cannot be removed by one-yard shovel, by backhoe with 9,500 lb. digging force, by pick and shovel, or by 200 HP Crawler fitted with normal excavating equipment. Ripper attachment as might be hooked into seam is not considered "normal" excavating equipment.
- B. Unstable Soil: Soft, loose, wet, or disturbed ground that is incapable of supporting material, equipment, personnel, or structure.

1.07 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, and manufacturing information.
- C. Field Quality Control submittals as specified in Part 3 of this Section.
 - 1. Field Tests
 - 2. Special Inspections for Code Compliance

1.08 QUALITY REQUIREMENTS

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.
- C. Product/Material Qualifications:
 - 1. Design Data: Compaction testing shall be in accordance with Section 01 4000, QUALITY REQUIREMENTS.
 - 2. Test reports: Provide imported material gradation test reports. Provide material compaction test reports.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.10 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section.

1.11 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 CRUSHED ROCK

- A. Imported, clean, 3/4" - 0 crushed rock or crushed gravel, free from foreign material and meeting the requirements of ODOT Standard Specifications (current edition) 02630.
- B. To be used for Pipe Base Material, Pipe Zone Material, and Trench Backfill.

2.02 BLEND SAND

- A. Imported blend sand shall consist of sand and river rock naturally produced by the disintegration of rock or produced from crushed gravel. Shall be free of organic material, mica, clay, and other deleterious substances and approved by the Engineer and Geotechnical Engineer prior to delivery to site. Thirty percent of the material shall be within the 1/4 inch to 3/4 inch size. No more than 5 percent passing the No. 200 sieve.

2.03 NATIVE MATERIAL

- A. Excavated on-site soil, native to project site, free of organics, solids larger than 3 inch diameter, weeds and other deleterious materials and approved by the Geotechnical Engineer for use as on-site backfill only during dry weather conditions.

2.04 DRAIN ROCK

- A. Imported clean 1" open grade crushed rock or crushed gravel, free from foreign material and conform to the requirements of ODOT Standard Specification (latest revision) Section 02630.1 "Open Graded Aggregate." Material shall have less than 3% passing the #200 sieve.

2.05 RAINWATER HARVESTING CISTERN PRIMARY BACKFILL

- A. Refer to Section 31 2000, Earth Moving.

2.06 DRAINAGE GEOTEXTILE

- A. Non-woven geotextile; grab tensile strength 90 lb minimum per ASTM D4632 each direction; burst strength 185 psi minimum per ASTM D3786; puncture strength 55 lb minimum per ASTM D4833 or ASTM D3787 OSHD TM 816; No. 70 sieve or smaller opening per ASTM D4751; minimum 150 gal/min/ft². Amoco 4545 or approved.

2.07 IMPERMEABLE LINER

- A. Manufacturer:
 1. Hercushield 2400 by In-Line Plastics, LC.
 2. RPE 15 by Layfield.
 3. Substitutions: See Section 01 60 00, PRODUCT REQUIREMENTS.
- B. Material: Liner shall be UV resistant and shall have the following average properties (values from individual rolls should not vary from these values by more than +/- 10%):

<u>Property</u>	<u>Test Method</u>	<u>Requirements</u>
Appearance		Black or Black/Silver
Nominal Thickness		12 mils
Weight		6 oz/SY
Tensile Strength	ASTM D751 (Method A)	215 lbs. Warp 175 lbs. Weft
Tear Strength (Tongue)	ASTM D751 (Method B)	60 lbs. Warp 64 lbs. Weft

Accelerated Weathering/UV	ASTM G53-84	More than 80% strength retention after
Mullen Burst	ASTM D751	2,000 hrs 350 psi 350 psi

- C. Accessories:
1. Tape: As approved by the manufacturer.

2.08 TRACER WIRE

- A. Electrically conductive tracer wire, 18 - gauge, insulated copper or heavier, green in color, or other approved material. To be placed full length of trench with non - metallic pipe.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting work of this section, verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.
- B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 PROTECTION

- A. Monuments: Carefully maintain bench marks, monuments, and other reference points. If disturbed or destroyed, replace as directed.
- B. Existing Utilities: Existing utilities shall be field located. Protect active utility lines encountered. Repair or replace utility lines damaged by work of this section.
- C. Pavement Cleaning: Maintain pavements and walkways clean at all times.
- D. Dust Control: Protect persons and property against damage and discomfort caused by dust; water as necessary and when directed.
- E. Other Work and Adjacent Property: Protect against damage caused by work of this section.

3.03 GENERAL REQUIREMENTS

- A. Contractor shall do all trenching and excavating necessary or required for proper construction of the work and placement or installation of materials. Tunneling or jacking shall not be used unless approved in writing by the Engineer.
- B. Cutting Pavements: Cut vertical, straight - line joints using power saw designed for cutting pavements. Cut minimum one foot beyond each side of trench.
- C. Obstructions: Remove all obstructions encountered within the trench area or adjacent thereto. If requested by Contractor, Engineer may make minor changes in trench alignment to avoid major obstructions, provided such alignment changes can be made without adversely affecting the intended function of the facility. Contractor shall pay any additional costs resulting from such alignment changes.
- D. Trenching: Minimum trench width to be 12 inches greater than outside diameter of pipe. Maximum trench width at top of trench shall not be limited except where excess width of excavation would cause damage or create damage to adjacent structures or facilities.
- E. Line and Grade: Excavate trench to lines and grades shown on the drawings or as established by the Engineer with proper allowances for pipe thickness and special bedding when required.
- F. Shoring: Shore trench when necessary to prevent caving during excavation in unstable material, or to protect adjacent structures, property, workers, and the public or as required by local, state, or federal agencies. Shoring shall be removed, as the backfilling is done, in a manner that will not damage pipe or permit voids in the backfill. It shall be the sole responsibility of the Contractor to see that safety requirements are met.

- G. Temporary Stockpiling of Excavated Material: Locate at least 2 feet from trench edges. Place excavated material only within approved areas. Do not obstruct roadways, bikeways, or pedestrian walkways. Conform to all federal, state and local codes governing the safe loading of excavated materials adjacent to trenches.
- H. Excess Excavation: Where excavation, through Contractor's error, is carried to levels lower than those shown on drawings, backfill with specified bedding material to proper levels at Contractor's expense.
- I. Drainage: At all times keep trenches dry. Provide and operate pumping equipment necessary to keep excavations free from standing water. Dispose of water in manner to prevent damage to adjacent property and as required by governing jurisdiction.
- J. If rock or unstable soils are encountered, notify Engineer. Removal of rock or unstable soil will be paid for as an addition to the contract.

3.04 EXCAVATION

- A. Excavate trenches to the line and grades shown on the drawings.

3.05 IMPERMEABLE LINER

- A. Place in trenches as noted on Drawings.
- B. Acquisition and Storage: Provide complete rolls of liner as furnished by the manufacturer, and protect against damage and deterioration. Store all liner rolls in a dry place and off ground at all times according to ASTM D4873. Cover all rolls and partial rolls with a dark protective covering when received. The liner will be rejected for use if the Architect determines it has defects, deterioration, or has been damaged.
- C. Installation: The subgrade surface is to be uniform and free of rocks, depressions, voids, and irregularities that might damage liner. Install impermeable liner in accordance with liner manufacturer's written recommendations.
 - 1. Overlap joints a minimum of 8 inches. All laps shall be overlapped in direction the water flows.
 - 2. Continuously tape all joints to provide an impermeable liner.
 - 3. Repair punctured or torn liner by overlapping additional fabric and joining in accordance with manufacturer's recommendations.
 - 4. The liner must completely line perimeter trench in a continuous manner.
- D. Repair of Liner: Repair or replace all torn, punctured, or contaminated liners during construction at no cost to the Owner. Repair by placing a patch of the specified liner over the affected area. Where liner seams are required to be sewn, repair any damaged sheet by sewing unless otherwise indicated on the plans or special provisions, or as directed.

3.06 BACKFILL

- A. Backfilling shall not commence until after pipe, conduit, structures, and other equipment and appurtenances placed in trench or similar excavations have been properly constructed or installed, as applicable, and inspected. Backfill shall be placed in such a manner as not to disturb, damage, or subject such facilities to unbalanced loads or forces. Make fills as soon as feasible after Engineer's review and acceptance.
- B. Pipe Base: Place required thickness of Pipe Base Material over full width of trench. Provide uniform bearing under entire length of each pipe.
- C. Pipe Zone: Place required thickness of Pipe Zone Material over full width of trench.
- D. Above Pipe Zone: Backfill full width of trench to paving subgrade elevation or to within depth of loam in landscaped areas with Trench Backfill.
- E. Compaction: Trench backfill shall be compacted in maximum 24 inch lifts to:
 - 1. 95 percent compaction under pavement areas per ASTM D698 at an optimum moisture content of ± 2 percent.

2. 90 percent compaction elsewhere per ASTM D698 at an optimum moisture content of ± 2 percent.
3. Water settling of trench backfill will not be considered an acceptable compaction procedure.

3.07 MAINTENANCE OF TRENCH BACKFILL

- A. Contractor shall maintain all backfilled trench surfaces until all work has been completed and accepted. Such maintenance shall include, but not be limited to, addition of appropriate backfill material above the pipe zone to keep backfilled trench surface smooth, free from ruts and potholes, and suitable for traffic flow.

3.08 DISPOSAL OF WASTE MATERIAL AND EXCESS EXCAVATION

- A. Remove from site excess material and that unsuitable for backfilling.

3.09 SETTLEMENT

- A. Any settlement in trench backfill which occurs during the warranty period and is attributable to construction procedures, such as improper removal of shoring or insufficient compaction, shall be corrected by the contractor at his own expense. Any piping or facilities damaged by such settlement shall be restored to their original condition at the Contractor's expense.

3.10 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 1. Material compaction testing:
 - a. Trench Compaction: A minimum of one field density test shall be conducted on compacted material for every 100 linear feet, or fraction thereof, of trench and for every 3 feet, or fraction thereof, of fill placed.
 2. Imported material gradation testing.
- C. Field Inspections: Notify Engineer prior to work of this section.
- D. Special Inspections for Code Compliance: Obtain building inspector approvals.

3.11 CLEANING

- A. Upon completion of the work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.12 PROTECTION

- A. Protect all work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

SECTION 31 2500
EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventative measures.
- D. Compensation of owner fines levied by authorities having jurisdiction due to non-compliance by contractor.

1.03 RELATED SECTIONS

- A. Section 00 3100 - Available Project Information
- B. Section 01 2300 - Alternates
- C. Section 31 2000 - Earth Moving

1.04 REFERENCED SPECIFICATIONS

- A. ODOT Standard Specifications (current edition).

1.05 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.06 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise noted.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, and manufacturing information.
 - 1. Submit for: Inlet protection products.
- C. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.

1.07 QUALITY REQUIREMENTS

- A. Maintain erosion control measure installed under previous contracts.
- B. All measures indicated in this specification may not be required. Contractor responsible for implementing erosion and sediment controls adequate to comply with permit requirements.
- C. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- D. Installers Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.
- E. Regulatory Requirements:
 - 1. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained.
 - 2. An erosion control permit is required from the City of Eugene and DEQ. The Owner shall apply, pay for, and secure the permit. The contractor shall comply with the construction erosion control permit.
 - 3. Owner will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.

4. Action Plan: Contractor shall prepare and submit an Action Plan when Erosion and Sediment Control Measures are modified after permit registration is approved. The Action Plan shall identify revisions made to the approved Erosion and Sediment Control Plan, and shall identify corrective actions taken to cease the discharge of sediment into surface waters or stormwater systems. The Action Plan shall be prepared in accordance with the *1200-C Construction Stormwater Permit Registration Guidance* document published by Oregon DEQ in June 2006. An Action Plan shall be required under the following circumstances:
 - a. Emergency Situations: Emergency change in erosion control measures due to emergency situations, where immediate corrective action is required to cease the discharge of significant amounts of sediment from entering surface waters or nearby properties. In emergency situations, contractor shall take immediate action to correct the stormwater discharge. Contractor shall submit action plan to City of Eugene within 10 calendar days of the discharge identifying the corrective actions taken to cease the discharge.
 - b. Non-Emergency Changes Made Once Project is Underway: Submit Action Plan for changes in the project design affecting stormwater discharges, local conditions, project schedule, weather conditions, or other appropriate reasons. Action Plan shall be required for changes to the Erosion and Sediment Control Measures identified in the Drawings, their location, maintenance required, and any other revisions necessary to prevent and control erosion and sediment runoff. Contractor shall submit action plan to City of Eugene at least 10 calendar days before implementing the revisions.
 5. Comply with 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon chapter of APWA and City of Eugene Amendment No. 1 for work within rights-of-way.
- F. Stormwater Runoff: Control increased stormwater runoff due to disturbance of surface cover due to construction activities for this project.
1. Prevent runoff into storm sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- G. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
1. Control movement of sediment and soil from temporary stockpiles of soil.
 2. Prevent development of ruts due to equipment and vehicular traffic.
 3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- H. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
1. Prevent windblown soil from leaving the project site.
 2. Prevent tracking of mud onto public roads outside site.
 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.
- I. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways and storm sewers.
1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments and relocate on site; comply with requirements of authorities having jurisdiction.
- J. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.

1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments and relocate on site; comply with requirements of authorities having jurisdiction.
- K. Open Water: Prevent standing water that could become stagnant.
- L. Monitoring and Inspection:
1. Contractor shall be responsible for monitoring the construction erosion control measures and shall make adjustments to measures, in accordance with the drawings and permit, to accommodate changes in earthwork operations and weather conditions.
 2. Contractor shall be responsible for appointing an Erosion Control Inspector. Inspector shall be a person knowledgeable in the principles and practice of erosion and sediment controls, who possesses the skills to assess conditions at the construction site that could impact stormwater quality, is knowledgeable in the correct installation of the erosion and sediment controls, and is able to assess the effectiveness of any sediment and erosion control measures selected to control the quality of stormwater discharges from the construction activity. Erosion Control Inspector shall submit periodic inspection reports as noted on the Drawings.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.
1. Protect from damage by the elements and construction procedures.

1.09 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section.

1.10 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 BARK/MULCH BIO BERM

- A. The compost filter berm material consists of compost or a blend of compost and mulch materials according to the specifications as follows.
- B. The filter berm material shall meet particle sizing specifications that when used in a filter berm system are tested in conformance with the outlined methods and scope of ASTM D6459 (latest revision), standard test method for determination of Erosion Controlled Blanket (ECB) Performance in Protecting Hill Slopes from Rainfall Erosion.
- C. The compost portion of the filter berm shall be derived from well-decomposed organic matter source produced by controlled aerobic (biological) decomposition that has been sanitized through the generation of heat and stabilized to the point that it is appropriate for this particular application. Compost material shall be processed through proper thermophilic composting, meeting the U.S. Environmental Protection Agency's definition for a 'process to further reduce pathogens' (PFRP). The compost portion shall meet the chemical, physical and biological properties outlined below.
1. The pH shall be between 5.0 and 8.5 for berms to receive vegetation.
 2. Nitrogen Content: 0.5 - 2.0%.
 3. Soluble Salts: Maximum 5 mmhos/cm.
 4. Compost shall be weed and pesticide free, with manmade materials comprising less than 1%.

2.02 SEDIMENT FENCE

- A. Sediment Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths.
- B. Apparent Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751 (latest revision).

- C. Permittivity: 0.05 sec⁻¹, minimum, when tested in accordance with ASTM D4491 (latest revision).
- D. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355 (latest revision) after 500 hours exposure.
- E. Grab Tensile Strength-Supported: 100 lb-f, minimum, in cross-machine direction; 120 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632 (latest revision).
- F. Grab Tensile Strength-Unsupported: 90 lb-f, minimum, in cross-machine direction; 100 lb-f, minimum, in machine direction; when tested in accordance with ASTM D4632 (latest revision).
- G. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- H. Manufacturers:
 - 1. BP Amoco, Amoco Fabrics and Fibers; www.geotextile.com.
 - 2. TC Mirafi; www.tcmirafi.com.
 - 3. Synthetic Industries; www.fixsoil.com.

2.03 BIO-FILTER BAGS

- A. Provide minimum size 18" x 6" x 30" plastic mesh bags with 1/2 inch openings filled with approximately 45 pounds of clean, 100% recycled wood-product waste.

2.04 CATCH BASIN INSERT BAG / CURB INLET SEDIMENT DAM

- A. Provide prefabricated filter inserts manufactured specifically for collecting sediment in drainage inlets. Include handles and/or fasteners sufficient to keep the insert from falling into the inlet during maintenance and removal of the insert from the inlet. Insert bags shall be included on the Oregon Qualified Products List (QPL) for Type 3 Inlet Protection, or approved. Curb Inlet Sediment Dams shall be included on the Oregon QPL for Type 6 Inlet Protection, or approved.

2.05 STRAW MULCH COVER

- A. Straw mulch for non-hydroseeding applications from bentgrass, bluegrass, fescue or ryegrass, singly or in combination. If grass seed straw is not available within a reasonable distance of the project, straw from barley, oat or wheat may be allowed upon approval of the Agency. Provide straw that is not moldy, caked, decayed, or of otherwise low quality. Submit certification from the supplier that the straw is free of noxious weed seeds or plant parts. Acceptable documentation will show either (1) that the straw source is from an "Oregon Certified Seed" field, or (2) the seed lab test results of the seed harvested from the straw meet minimum Oregon Certified Seed quality for weed seed content. Use a straw binder or tackifier.

2.06 SUBGRADE GEOTEXTILE

- A. Subgrade geotextile shall meet the requirements of Geotechnical Investigations, and Section 31 2000, EARTH MOVING.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.
- B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 INSTALLATION OF EROSION AND SEDIMENT CONTROL MEASURES

- A. Install as shown on drawings, or as directed by Engineer, Erosion and Sediment Control Inspector, or Local Authority Having Jurisdiction. All measures included in this specification or details shown on Drawings may not be necessary. Contractor to utilize measures, as needed, to meet the requirements of erosion control permit(s) and the intent of this specification.

3.03 PROTECTION

- A. Monuments: Carefully maintain bench marks, monuments, and other reference points. If disturbed or destroyed, replace as directed.
- B. Existing Utilities: Existing utilities shall be field located. Protect active utility lines encountered. Repair or replace utility lines damaged by work of this Section.
- C. Pavement Cleaning: Maintain pavements and walkways clean at all times.
- D. Dust Control: Protect persons and property against damage and discomfort caused by dust; water as necessary and when directed.
- E. Other Work and Adjacent Property: Protect against damage caused by work of this section.

3.04 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Special Inspections for Code Compliance:
 - 1. Obtain building approvals from Local Authority Having Jurisdiction.
 - 2. Provide periodic inspection reports as noted on the Drawings.

3.05 MAINTENANCE

- A. Maintain temporary measures until permanent measures have been established.
- B. Repair deficiencies immediately.

3.06 CLEANING

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

3.07 PROTECTION

- A. Protect all work installed under this section.
- B. Replace at no additional cost to Owner, any damaged work of this Section.

END OF SECTION

**SECTION 32 1200
FLEXIBLE PAVING**

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. Asphaltic concrete pavements and crushed rock pavement base for on-site private improvements.

1.03 WORK INCLUDED BUT SPECIFIED IN OTHER SECTIONS

- A. Section 31 2000 - Earth Moving
- B. Section 32 1713 - Parking Bumpers
- C. Section 32 1723.13 - Painted Pavement Markings

1.04 REFERENCED SPECIFICATIONS

- A. 2015 Oregon Standard Specifications for Construction, HMAC Pavement Reference, Section 00744.

1.05 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.06 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, and fabrication information.
 - 1. Submit for job mix formulas (JMF).
- C. Field Quality Control submittals as specified in Part 3 of this Section:
 - 1. Field Tests.
- D. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Special warranties
 - 2. Provide record documents.

1.07 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.
- C. Pre-installation Conference: Contractor, installer, Engineer, and representatives of other affected trades shall meet at site to review paving operations, acceptance of substrata surfaces, and coordination with other trades.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect materials and maintain product temperature during delivery.

1.09 SPECIAL WARRANTIES

- A. Contractor shall warrant installed pavement for a period of 2 years from date of Substantial Completion. When notified in writing from Owner, they shall promptly and without inconvenience and cost to Owner correct said deficiencies to comply with requirements.

1.10 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

1.11 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section at each site.

PART 2 PRODUCTS

2.01 CRUSHED ROCK PAVEMENT BASE

- A. Under Dense Graded HMAC Mixture: Imported Clean 3/4"-0 or 1-1/2"-0 dense graded crushed rock or crushed gravel, free of foreign material and meeting the requirements of ODOT Standard Specifications (current edition) 02630, Base Aggregate.

2.02 HOT MIXED ASPHALT CONCRETE (HMAC)

- A. Asphalt Mixture: The asphalt concrete mixture shall be a well-graded, uniform coated, durable mix of the mix type(s) as shown on the plans or approved by the Engineer.

**BROADBAND LIMITS
DENSE GRADED MIXTURE**

Sieve Size Passing	Percentage of Total Aggregate (by weight) 1/2" Dense	Percentage of Total Aggregate (by weight) 3/8" Dense
1"	--	--
3/4"	99-100	--
1/2"	90-100	--
3/8"	--	100
1/4"	52-80	--
No. 4	--	90
No. 8	--	67
No. 10	21-46	--
No. 40	8-25	--
No. 200	3-8	3-8
Asphalt Cement	Per JMF	Per JMF

- B. Asphalt Cement (Binder):
 1. Per Oregon Standard Specifications for Construction, (current edition). Use PG (Performance Grade) 58-22 for base and wearing courses.
 2. If using less than 20% RAP, binder grade will need to be modified, and special approval is required.
- C. Aggregate for Base Course Mix: Per Oregon Standard Specifications for Construction (current edition).
- D. Aggregate for Wearing Course (Top Lift of HMAC) Mix: Per Oregon Standard Specifications for Construction (current edition).
- E. Fine Aggregate: Per Oregon Standard Specifications for Construction (current edition).
- F. Mineral Filler: Finely ground particles of limestone, hydrated lime, or other mineral dust, free of foreign matter.
- G. Asphalt Tack Coat: Type CSS-1, CSS-1h, CMS-2, CMS-2S, CMS-2h, CRS-2, HFRS-2 or HFMS-2 emulsified asphalt (EA) conforming to Standard Specifications for Highway Construction (current edition).
- H. Reclaimed Asphalt Pavement (RAP) Material: Shall not exceed 30% in the new pavement. Rap material not permitted in Level 4 HMAC pavement, in accordance with Standard Specifications for Highway Construction (current edition). Asphalt mixtures including RAP to meet all normal

specification and Oregon Standard Specifications for Construction (current edition) requirements.

2.03 JOB MIX FORMULA (JMF)

- A. Mix Formula: The Contractor shall submit a JMF for each mixture to be used on the project and meeting the Level 2 criteria of Oregon Standard Specifications for Construction, Current Edition.
- B. The Contractor shall supply the job mix design to the Engineer ten (10) work days prior to production. The job mix formula shall be no more than five (5) years old.
- C. Approval: No paving shall occur until the Contractor receives written approval of the Contractor's job mix formula.

2.04 HMAC ACCEPTANCE

- A. The mixture will be accepted by visual inspection of the Engineer. If the mixture is considered suspect, the Contractor shall obtain samples under the observation of the Engineer and tested as per Oregon Standard Specifications for Construction, Current Edition (section 00744.16). Testing shall be performed by an independent testing agency paid for by the Contractor. Contractor to be reimbursed by Owner if testing shows HMAC is within the specified limits and tolerances.

2.05 HMAC PRODUCTION QUALITY CONTROL/ASSURANCE

- A. As specified for Level 2 HMAC in the Oregon Standard Specifications for Construction, Current Edition. Submit the appropriate documentation/reports to Engineer for review.

2.06 MODIFICATION OF MIXES

- A. Modification: The Engineer reserves the right to modify specified mixes for use under various traffic conditions on various segments of the work and for feathering, spot patching, and other special purposes. The Contractor shall provide mixes proportioned as directed by the Engineer for such purposes.

2.07 WHEEL STOPS

- A. Refer to Section 32 1713, Parking Bumpers.

2.08 PAVEMENT MARKINGS

- A. Refer to Section 32 1723.13, Painted Pavement Markings.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting of the work of the section verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.
- B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 WEATHER LIMITATIONS

- A. Surface Temperature: Asphalt concrete shall be placed on a dry prepared surface when the surface temperature is not less than specified below.
Nominal Specified
Compacted Thickness
of Individual Courses
2" to 2-1/2" 50°F
2-1/2" and over 40°F
- B. Weather: Asphalt concrete shall not be placed during rain or other adverse weather conditions. However, if approved by the Engineer, the mix in transit at the time the adverse conditions

occur may be laid if the mix has been covered during transit and is at the specified temperature, if the foundation is free from pools or flow of water, and if all other requirements of these specifications are met. Asphalt concrete mixtures shall not be placed when the foundation is frozen or when, in the opinion of the Engineer, existing or expected weather conditions will prevent the proper handling, finishing, or compaction of the mixtures. Dense mixes shall only be placed from 3/15 – 9/30.

- C. Ambient Temperature Caution: The Contractor is cautioned that placing asphalt concrete on cool days when the temperature is less than 60°F may require an adjustment in Contractor's normal placing and compaction procedures so that specified minimum compaction requirements will be met. The temperatures shown in the table in this section are not recommended temperatures for paving, but paving may be allowed at these temperatures on the condition that specified pavement compaction is achieved.

3.03 ASPHALT CONCRETE PAVING MACHINE

- A. Pavers: Pavers shall be self-contained, power-propelled units with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing layers of asphalt concrete material to the widths thicknesses, lines, grades, and cross sections required.

3.04 COMPACTORS

- A. Rollers: Rollers shall be steel wheel, pneumatic tire, vibratory or a combination of these types. They shall be in good condition and capable of reversing without backlash.

3.05 PREPARATION OF FOUNDATION

- A. Bases: All bases and foundations on which the pavement is to be constructed shall meet the applicable specifications and be approved prior to the start of paving. Existing bases and foundations shall be reconditioned as specified or directed.
- B. Edges: Broken or ragged edges of existing paved surfaces underlying or abutting the new pavement shall be trimmed back to firm material. Surfaces against which asphalt concrete is to be placed shall be treated with an asphalt tack coat.
- C. Tack Coat: Prior to placing each lift of asphalt concrete, tack coat asphalt shall be applied to completely cover all cold longitudinal joint and all prepared existing asphalt and portland cement concrete surfaces. Immediately before applying the tack coat, the surface to be tacked shall be clean and dry. The application rate shall be between 0.05 and 0.20 gallons per square yard of surface area to achieve uniform, thorough coverage and as approved by the Engineer. Emulsified asphalt temperature to be between 140 and 185°F and application to be in accordance with manufacturer's recommendations.

3.06 CRUSHED ROCK PAVEMENT BASE PLACEMENT

- A. Placement and compaction shall conform to the requirements of Section 31 2000, EARTH MOVING.

3.07 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Place asphalt within 24 hours of applying tack coat. Do not place HMAC pavement on the tack coat until the asphalt separates from the water (breaks), but before it loses its tackiness.
- B. Place up to 3 inch compacted thickness in one lift.
- C. Install drainage covers and frames in correct position and elevation.
- D. Compact pavement by rolling. Do not displace or extrude pavement from position. Use hand-operated compacting equipment in areas inaccessible to rolling equipment.
- E. Develop rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.08 CONTROL OF LINE AND GRADE

- A. Line and Grade: The Contractor shall furnish, place, and maintain supports, wires, devices, and materials as necessary to provide continuous line and grade reference control to the automatic paver control system on either or both sides of the paving machine.

3.09 HAULING, DEPOSITING AND PLACING

- A. Hauling: Cover HMA if rain or cold air temperatures are encountered any time between loading and placement. Engineer may reject material compromised (below specified temperature, slumping or separating, solidifying or crusting). Rejected loads will be disposed of off-site at the Contractor's expense.
- B. Depositing: Material shall be deposited from vehicles to prevent segregation.
- C. Placing: Do not place material during rain or other adverse weather conditions, unless allowed by Engineer. Material placed in adverse conditions is to meet all normal contract specification requirements. Material in transit at the time adverse conditions occur may be placed if it has been covered during transport, it is placed in areas free of standing or flowing water, temperature and all other requirements are met.

3.10 TEMPERATURE CONTROL

- A. Temperature of Mixture:
 - 1. The temperature of the mixture at the time it is placed in final position shall be within 10 degrees of 280°F. The Engineer may adjust the lay-down temperature in 10-degree increments to attain maximum workability and compaction. In no case shall the lay-down temperature of mixture be less than 240°F.

3.11 COMPACTION

- A. Rolling: Immediately after the asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly rolled until the mixture is compacted. Complete breakdown and intermediate compaction before the mix temperature drops below 180°F.
- B. General:
 - 1. The type, number, and weight of rollers shall be sufficient to compact the mixture while it is still within the specified temperature range. Rollers shall not be operated in vibratory mode when the temperature of the mixture has dropped below 180 degrees.
 - 2. Steel roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture and not cause spotting or defacement of the surface of the mixture.
 - 3. Rollers shall be operated at speeds recommended by the roller manufacturer and slow enough to avoid displacement of the mixture. The maximum speeds shall be 3 miles per hour for steel-wheeled rollers and pneumatic-tired rollers, unless faster speeds are approved.
 - 4. Care shall be exercised not to displace the line and grade of edges. Displacement of any course occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of approved rakes and addition of fresh mixture when required.
 - 5. Any mixture that becomes loose and broken, contaminated, segregated, or is in any way defective, shall be removed and replaced with new mixture at no expense to the Owner.
 - 6. Finish rolling shall continue until all roller marks are eliminated.
 - 7. Along curbs and walls, on walks, irregular areas, and other areas not practicably accessible to specified rollers, the mixture shall be compacted with approved self-propelled rollers, mechanical tampers, hot hand tampers, or heavy hand rollers. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.
- C. Density Requirements:
 - 1. The Contractor is responsible for process control and shall conduct sampling, testing, measurement and inspection. The contractor shall provide daily nuclear density testing (ODOT Test Method 310C-87) to develop rolling patterns necessary to achieve the minimum compaction requirement of 91 percent as determined by Rice Density Test AASHTO T 209 as modified by ODOT TM 306. This is in addition to Owner's testing as necessary to ensure the finished pavement meets specifications. A copy of all compaction

test reports shall be provided to the Engineer. Contractor to immediately take corrective measures when it is determined that specified compaction density is not achieved. If specified compaction density cannot be achieved the Contractor shall remove and replace the defective asphalt areas at the Contractor's expense. The Owner has the option of accepting these areas with a reduced payment to the Contractor.

2. Asphalt compaction below 88 percent as determined by Rice Density Test AASHTO T 209 as modified by ODOT TM 306 is not acceptable.
3. The Architect will determine the suitability of the final product through final acceptance testing. Results of these tests will be used to determine payment deductions, if any to be assessed against the Contract. The final density of each paving project location will be determined by averaging the results of a minimum of five (5) density tests taken with a nuclear gauge (ODOT TM 310C-87) at randomly selected locations within each paving project.
4. Paving in areas 6 feet wide or less and irregular areas not accessible by large rollers are not subject to the minimum compaction per (2) above.
5. The Owner shall take acceptance tests to verify that the work meets specifications.

3.12 PAVEMENT SMOOTHNESS

- A. Utility Structures: The joint between the pavement and the top surface of utility structures, such as manhole covers and valve boxes located in the traveled way, shall meet the pavement surface tolerances.
- B. Tolerance: The surface of the finished pavement shall be within 0.02 foot of the specified line, grade, and cross section.
- C. Texture: The completed surface of all courses of the mixture shall closely parallel that specified for the top surface of the finished pavement and shall be smooth, uniform on texture and conform to the specified crown and grade.
- D. Job control testing shall be performed with a 10 foot straightedge furnished and operated by the Contractor. The Engineer may observe this testing, or the Engineer may require additional testing to be performed under the Engineer's supervision. Operations to eliminate the unacceptable pavement shall be corrected by the Contractor using a method or methods listed below and approved by the Engineer.
- E. Roughness: When tests show the pavement is not within the above tolerances, the Contractor shall take immediate action to correct equipment or procedures in the paving operations to eliminate the unacceptable pavement roughness.
- F. Method of Correction: Any surface irregularities exceeding the above tolerances shall be corrected by the Contractor using a method or methods listed below and approved by the Engineer.

3.13 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 1. Base rock compaction testing.
 2. Asphaltic concrete pavement compaction testing.
 3. Asphaltic concrete pavement gradation testing.
- C. Field Inspections: Notify Engineer prior to paving operations.

3.14 CORRECTIVE ACTION

- A. Corrective Measures: The Engineer shall require one or more of the following corrective measure be performed on the deficient areas:
 1. Remove and replace the surface course.
 2. Place an overlay of a thickness approved by the Engineer.
 3. Grind the pavement surface utilizing diamond blades up to a maximum depth of 0.3 inch and apply an emulsion fog coat as directed by the Engineer.

- B. Additional Corrective Work: After completion of the corrective work, if the Engineer finds it is still not satisfactory, the Contractor shall perform additional corrective work on areas still not meeting the above tolerances.
- C. Expense: All corrective work, including furnishing of materials, shall be performed at the Contractor's expense and no adjustment in contract time will be made for corrective action work.
- D. Localized Surface Irregularities: Where surface irregularities are localized or where the Engineer determines corrective work would not be in the Owner's best interests, the Engineer may deduct from payment due the Contractor amounts equivalent to the Engineer's estimate of work costs had the corrective work been done.

3.15 STRUCTURE ADJUSTMENT

- A. Prior to placement of wearing course, locate and adjust to finished pavement grade all catch basins and other structures and appurtenances within the pavement area.

3.16 WHEEL STOPS

- A. Refer to Section 32 1713, Parking Bumpers.

3.17 PAVEMENT STRIPING

- A. Refer to Section 32 1723.13, Painted Pavement Markings.

3.18 CLEANING

- A. Trim and remove excess asphalt concrete accumulations from abutting structures such as curbs, manholes, catch basins, and other structure.
- B. Including work of other sections, clean, repair and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by work of this section. Remove excess spilled material and debris from project site upon work completion or sooner, if directed.
- C. Upon completion of the work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.19 PROTECTION

- A. In addition to other required provisions for traffic, the following shall apply to pavement construction: No traffic or equipment shall come in contact with the compacted mixture until it has cooled and set sufficiently to prevent marking; edges shall be protected from being broken down; and edge drop-off(s) one inch or more in height shall be marked with approved reflectorized and/or flashing warning devices visible by day and night to the traveling public, and placed at spacings as specified by the Engineer.
- B. Protect all work installed under this section.
- C. Replace at no additional cost to Owner, any damaged work of this section.

END OF SECTION

**SECTION 32 1313
CONCRETE PAVING**

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. On-site private vehicular pavement improvements.

1.03 RELATED SECTIONS

- A. Section 03 1000 - Concrete Forming and Accessories
- B. Section 03 2000 - Concrete Reinforcing
- C. Section 03 3000 - Cast-In-Place Concrete
- D. Section 31 2000 - Earth Moving

1.04 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.05 DESIGN AND ENGINEERING

- A. Formwork design and engineering, as well as construction, are the sole responsibility of the Contractor.

1.06 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Quality Control:
 - 1. Submit joint layout drawings for Engineer's review and acceptance.
- C. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.07 WEATHER PRECAUTIONS

- A. Provide cold weather and/or hot weather protection as recommended in ACI 306 and ACI 305.
- B. Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow. Protect concrete from rain water, maintain concrete water ratio and protect concrete surface.
- C. All concrete shall be adequately protected after pouring to prevent damage from freezing, by the use of suitable cover. Frozen and damaged concrete must be removed and replaced at the Contractor's expense. Do not place concrete on frozen earth.

1.08 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installers Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.
- C. Product/Material Qualifications:
 - 1. Design data: Compaction testing shall be in accordance with Section 01 4000, QUALITY REQUIREMENTS.
 - 2. Test reports: Provide job mix test reports.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.

1. Protect from damage by the elements and construction procedures.

1.10 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before intended concrete placement.
- B. Place no concrete until formwork and reinforcement have been inspected.

1.11 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 CRUSHED ROCK PAVEMENT BASE

- A. Imported, clean, 3/4"-0 Crushed Rock Pavement Base as specified in Section 31 2000, EARTH MOVING.

2.02 CAST-IN-PLACE CONCRETE

- A. Concrete shall be ready-mixed conforming to Section 03 3000, CAST-IN-PLACE CONCRETE, and shall have a minimum compressive strength of 4,000 psi at 28 days.

2.03 JOINT FILLER

- A. Concrete Pavement Joint Sealant:
 1. Joint sealant shall be hot poured rubber meeting the requirements of AASHTO M213.

2.04 JOINT SEALANT

- A. Joint Sealant for Vehicular Pavements.
 1. Joint sealant shall hot poured asphaltic material complying with ASTM D6690, Type IV. Sealant type shall be approved by the manufacturer for use in the local climate, and shall be approved for use where in parking lot areas and areas with high levels of foot traffic. Crafcro Roadsaver 222, Special Asphalt Products SA 102.

2.05 EXPANSION JOINT FILLER

- A. Expansion Joint Filler shall be asphalt-impregnated Cane Fiber per ASTM D1751 (latest revision); 3/8" thickness unless otherwise indicated. Depth as required to extend through full slab depth and to position filler top below top of slab, to allow backer rod and sealant installation, per sealant manufacturer recommendations.

2.06 FORMS

- A. Conform to Section 03 1000, CONCRETE FORMING AND ACCESSORIES.

2.07 REINFORCEMENT

- A. Conform to Section 03 2000, CONCRETE REINFORCING.
- B. Provide where shown on drawings.

2.08 CURING COMPOUND

- A. Curing compound for all other concrete shall conform to AASHTO M171, White Polyethylene Film for curing concrete or AASHTO M148, Liquid Membrane-Forming Compounds for Curing Concrete.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting work of this section verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.
- B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 EXCAVATION

- A. All excavation shall be in accordance with Section 31 2000, EARTH MOVING.

3.03 CRUSHED ROCK PAVEMENT BASE

- A. After the subgrade is compacted and at the proper grade, spread required thickness of 3/4-inch minus crushed rock. Compact by rolling or other approved method. Surface of the compacted base shall be at the proper level to receive the concrete. Manholes, catch basins, inlets, and other such structures shall be completed, adjusted, cured, and otherwise prepared, as applicable, and made clean and ready to have concrete placed in contact with them.

3.04 FORMWORK

- A. Conform to the requirements of Section 03 1000, CONCRETE FORMING AND ACCESSORIES. Construct forms to the shape, lines, grades, and dimensions called for on the Drawings. Stake wood or steel forms securely in place, true to line and grade. Brace forms to prevent change of shape or movement in any direction resulting from the weight of the concrete during placement.
- B. Allowable Tolerances: Tops of forms shall not depart from grade line more than 1/8-inch when checked with 10-foot straightedge. Alignment of straight sections shall not vary more than 1/8-inch in 10 feet.

3.05 REINFORCEMENT

- A. Reinforcement shall conform to the requirements of Section 03 2000, CONCRETE REINFORCING. Provision shall be made for placing dowels, tie bars, and other devices called for by the Contract Documents, during placement of the pavement. Reinforcement shall be placed on supporting devices, or "chairs," and maintained in position while the pavement is being placed.

3.06 FINISHING

- A. After the pavement has been struck off and consolidated, it shall be scraped with a straightedge equipped with a handle to permit operation from the edge of the pavement. Any excess water shall be removed from the surface of the pavement. Irregularities shall be corrected by adding or removing concrete. All disturbed places shall be again straightedged.
- B. After the concrete has been given a preliminary finish, the surface of the pavement shall be checked by the contractor with a straightedge device. Each successive check with the straightedge device shall lap the previous check path by at least half the length of the straightedge. Surface deviations exceeding 0.01 foot shall be corrected. Upon completion of the surface floating, but before any required edge tooling or joint tooling, and before initial set of the surface pavement, the pavement shall be given a textured finish perpendicular to match the existing. The textured finish shall be accomplished by a steel tine tool that will mark the finished pavement to a depth of 1/8 inch plus or minus 1/16 of an inch. Match finish of existing pavement where new pavement is adjacent. The surface of the pavement shall not vary from a true surface, when tested with a 12 foot testing straightedge, more than 1/8 inch in 12 feet.
- C. Finish shall be a light broom finish for slip resistant surface. Broom pattern to be parallel to slope.

3.07 JOINTS

- A. General:
 - 1. Review jointing plan with Architect. Architect may make minor changes to joint layout after or during review of Contractor-provided jointing plan.
 - 2. Construction joints, expansion joints, transverse contraction joints, and all longitudinal contraction joints shall be placed as indicated in the drawings.
 - 3. Joints shall be aligned with adjacent utility structures, as shown on the Drawings. Field verify dimensions of utility structures prior to placement of concrete. Coordinate with affected trades. Submit RFI to engineer if discrepancy between utility structures and joints

is apparent prior to concrete pour. Misalignment of joints will be corrected by removal and replacement of concrete panels and/or utility structures at the Contractor's expense.

- B. Contraction Joints:
 - 1. Longitudinal contraction joints shall consist of planes of weakness created by forming or sawing grooves in the surface of the pavement. Curb, gutter, and pedestrian pavement joints shall be formed. Vehicular pavement joints shall be sawn unless otherwise approved by the Engineer.
 - 2. Joint spacing, detailing, and layout shall conform to the Drawings and the approved contractor-provided jointing plan.
- C. Construction Joints: Construction joints shall be placed whenever the placing of concrete is suspended for more than 45 minutes. All construction joints shall be at the location of a contraction joint. A tied butt joint, as detailed on the Drawings, shall be used at all construction joints.
- D. Expansion Joints / Isolation Joints: Isolation / Expansion joints shall be placed at the interface between paving and vertical site elements, building walls, or utility structures, as shown on the Drawings.

3.08 SEALING JOINTS

- A. Seal joints for pavements as follows:
 - 1. Joint sealant is required at expansion joints, as shown on the drawings.
 - 2. Tool sealant reservoir for pavement joints per the details shown on the construction drawings, and to conform to the sealant manufacturer recommended dimensions.
 - 3. Clean reservoir, prepare joints, install backer rod and sealant all in strict accordance with the recommendations in the joint sealant manufacturer's installation or application instructions.
 - 4. Apply masonry sand to all sealed joints within pedestrian pavement areas while sealant is still tacky.
- B. Joints to be sealed shall be filled with joint-sealing material before the pavement is opened to traffic and as soon after completion of the curing period as is feasible.
- C. Each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound, and joint faces shall be clean and surface-dry when seal is applied.

3.09 PAVEMENT EDGING

- A. Before final finishing is completed and before final concrete set has occurred, finish concrete edges with edging tool shaped with 1/4 inch radius.
 - 1. Take particular care to maintain surface on both sides of joint in same plane.
 - 2. Do not use kneeling planks on concrete surface.

3.10 CURING

- A. Minimum Curing Period: 7 days.
- B. Uniformly apply compound in accordance with manufacturer's instructions, after final Concrete finishing is complete, and after all free water has disappeared from pavement surface.
- C. Apply to concrete edges immediately after formwork removal.
- D. Do not use membrane compound method if pavement will be exposed to de-icing chemicals within 30 days following curing period completion.
- E. Where asphalt topping is to be placed on concrete, asphalt shall not be placed until the minimum curing period has elapsed, or the concrete has reached at least 75% of the specified 28-day compressive strength.

3.11 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:

1. Observance and approval of subgrade and base rock compaction.
 2. Concrete cylinder strength tests. Concrete flexural strength tests.
- C. Field Inspections: Notify Engineer prior to work of this section.
- D. Special Inspections for Code Compliance: Obtain building inspector approvals.

3.12 DEFECTIVE WORK

- A. Remove and replace any surfaces which show excessive cracks, pavements that do not drain properly, and other defective concrete.
- B. Minimum Surface Evenness: 1/8 inch per 10 ft.

3.13 CLEANING

- A. Including work of other trades, clean, repair and touch-up, or replace when directed products which have been soiled, discolored, or damaged by work of this section.
- B. Upon completion of the work of this section, promptly remove from the working area all scraps, debris, and surplus material.

3.14 PROTECTING COMPLETED WORK

- A. Protect all work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

SECTION 32 1600
CONCRETE CURBS AND GUTTERS

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. On-site private curb and gutter improvements.

1.03 RELATED SECTIONS

- A. Section 03 1000 - Concrete Forming and Accessories
- B. Section 03 2000 - Concrete Reinforcing
- C. Section 03 3000 - Cast-In-Place Concrete
- D. Section 31 2000 - Earth Moving

1.04 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.05 DESIGN AND ENGINEERING

- A. Formwork design and engineering, as well as construction, are the sole responsibility of the Contractor.

1.06 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Quality Control:
 - 1. Submit joint layout drawings for Engineer's review and acceptance.
- C. Field Quality Control Submittals:
 - 1. Before starting work and in accordance with Section 01 3300, prepare mockups for Engineer's review and acceptance of concrete walk surface texture.
 - a. Minimum Panels Size: 4 ft. square.
 - b. Re-prepare, if directed, until accepted.
 - c. Accepted mockup represents minimum quality standard. Work of lesser quality will be subject to rejection and replacement.
 - 2. Accepted mockup, in like new condition, may be used in contract work.
- D. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.07 WEATHER PRECAUTIONS

- A. Provide cold weather and/or hot weather protection as recommended in ACI 306 and ACI 305.
- B. Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow. Protect concrete from rain water, maintain concrete water ratio and protect concrete surface.
- C. All concrete shall be adequately protected after pouring to prevent damage from freezing, by the use of suitable cover. Frozen and damaged concrete must be removed and replaced at the Contractor's expense. Do not place concrete on frozen earth.

1.08 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.

- B. Installers Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.
- C. Product/Material Qualifications:
 - 1. Design data: Compaction testing shall be in accordance with Section 01 4000, QUALITY REQUIREMENTS.
 - 2. Test reports: Provide job mix test reports.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.10 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before intended concrete placement.
- B. Place no concrete until formwork and reinforcement have been inspected.

1.11 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 CRUSHED ROCK PAVEMENT BASE

- A. Imported, clean, 3/4"-0 Crushed Rock Pavement Base as specified in Section 31 2000, EARTH MOVING.

2.02 CAST-IN-PLACE CONCRETE

- A. Concrete shall be ready-mixed conforming to Section 03 3000, CAST-IN-PLACE CONCRETE, and shall have a minimum compressive strength of 3,000 psi at 28 days.

2.03 FORMS

- A. Conform to Section 03 1000, CONCRETE FORMING AND ACCESSORIES.

2.04 REINFORCEMENT

- A. Conform to Section 03 2000, CONCRETE REINFORCING.
- B. Provide where shown on drawings.

2.05 CURING COMPOUND

- A. Curing compound for all other concrete shall conform to AASHTO M171, White Polyethylene Film for curing concrete or AASHTO M148, Liquid Membrane-Forming Compounds for Curing Concrete.

2.06 TACTILE WARNINGS

- A. Shall be truncated dome warning surface.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting work of this section verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.
- B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 EXCAVATION

- A. All excavation shall be in accordance with Section 31 2000, EARTH MOVING.

3.03 CRUSHED ROCK BASE

- A. After the subgrade is compacted and at the proper grade, spread required thickness of 3/4-inch minus crushed rock. Compact by rolling or other approved method. Surface of the compacted base shall be at the proper level to receive the concrete. Manholes, catch basins, inlets, and other such structures shall be completed, adjusted, cured, and otherwise prepared, as applicable, and made clean and ready to have concrete placed in contact with them.

3.04 FORMWORK

- A. Conform to the requirements of Section 03 1000, CONCRETE FORMING AND ACCESSORIES. Construct forms to the shape, lines, grades, and dimensions called for on the Drawings. Stake wood or steel forms securely in place, true to line and grade. Brace forms to prevent change of shape or movement in any direction resulting from the weight of the concrete during placement.
- B. Allowable Tolerances: Tops of forms shall not depart from grade line more than 1/8-inch when checked with 10-foot straightedge. Alignment of straight sections shall not vary more than 1/8-inch in 10 feet.

3.05 REINFORCEMENT

- A. Reinforcement shall conform to the requirements of Section 03 2000, CONCRETE REINFORCING. Provision shall be made for placing dowels, tie bars, and other devices called for by the Contract Documents, during placement of the pavement. Reinforcement shall be placed on supporting devices, or "chairs," and maintained in position while the pavement is being placed.

3.06 FINISHING

- A. After the pavement has been struck off and consolidated, it shall be scraped with a straightedge equipped with a handle to permit operation from the edge of the pavement. Any excess water shall be removed from the surface of the pavement. Irregularities shall be corrected by adding or removing concrete. All disturbed places shall be again straightedged.
- B. After the concrete has been given a preliminary finish, the surface of the pavement shall be checked by the contractor with a straightedge device. Each successive check with the straightedge device shall lap the previous check path by at least half the length of the straightedge. Surface deviations exceeding 0.01 foot shall be corrected. Upon completion of the surface floating, but before any required edge tooling or joint tooling, and before initial set of the surface pavement, the pavement shall be given a textured finish perpendicular to match the existing. The textured finish shall be accomplished by a steel tine tool that will mark the finished pavement to a depth of 1/8 inch plus or minus 1/16 of an inch. Match finish of existing pavement where new pavement is adjacent. The surface of the pavement shall not vary from a true surface, when tested with a 12 foot testing straightedge, more than 1/8 inch in 12 feet.
- C. Finish shall be a light broom finish for slip resistant surface. Broom pattern to be parallel to slope.
- D. Accessible Ramps: Steel trowel finish. Apply tactile warning finish.

3.07 JOINTS

- A. Construction joints, expansion joints and transverse contraction joints shall be placed as indicated in the drawings.
- B. Contraction Joints:
 - 1. Maximum joint spacing shall be 12 feet or as shown on drawings.
- C. Construction Joints: Construction joints shall be placed whenever the placing of concrete is suspended for more than 45 minutes.

3.08 WALK EDGING

- A. Before final finishing is completed and before final concrete set has occurred, finish concrete edges with edging tool shaped with 1/4 inch radius.

1. Take particular care to maintain surface on both sides of joint in same plane.
2. Do not use kneeling planks on concrete surface.

3.09 CURING

- A. Minimum Curing Period: 3 days.
- B. Uniformly apply compound in accordance with manufacturer's instructions, after final Concrete finishing is complete, and after all free water has disappeared from pavement surface.
- C. Apply to concrete edges immediately after formwork removal.
- D. Do not use membrane compound method if pavement will be exposed to de-icing chemicals within 30 days following curing period completion.

3.10 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 1. Observance and approval of subgrade and base rock compaction.
 2. Concrete cylinder strength tests. Concrete flexural strength tests.
 3. Slump and air tests.
- C. Field Inspections: Notify Engineer prior to work of this section.
- D. Special Inspections for Code Compliance: Obtain building inspector approvals.

3.11 DEFECTIVE WORK

- A. Remove and replace any surfaces which show excessive cracks, pavements that do not drain properly, and other defective concrete.
- B. Minimum Surface Evenness: 1/8 inch per 10 ft.

3.12 CLEANING

- A. Including work of other trades, clean, repair and touch-up, or replace when directed products which have been soiled, discolored, or damaged by work of this section.
- B. Upon completion of the work of this section, promptly remove from the working area all scraps, debris, and surplus material.

3.13 PROTECTING COMPLETED WORK

- A. Protect all work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

**SECTION 32 1610
CONCRETE SIDEWALKS**

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. On-site exterior concrete sidewalks.
- B. Concrete curbs not specified elsewhere.
- C. Concrete mowstrips.
- D. Sand finish for concrete slabs exterior and interior.
- E. Glass and exposed aggregate finish.
- F. Sand blast finish of concrete.
- G. Cast metal letters exterior and interior.
- H. Custom concrete stamp.

1.02 RELATED SECTIONS

- A. Section 03 1000 - Concrete Forming and Accessories
- B. Section 03 3200 - Concrete Reinforcing
- C. Section 03 3000 - Cast-In-Place Concrete
- D. Section 07 9005 - Joint Sealer
- E. Section 31 2323 - Fill

1.03 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the City of Eugene right-of-way shall conform to the 2008 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and current City of Eugene Amendments.

1.04 DESIGN AND ENGINEERING

- A. Formwork design and engineering, as well as construction, are the sole responsibility of the Contractor.

1.05 SUBMITTALS

- A. Comply with Section 01 3300 - Submittal Procedures, unless otherwise indicated.
- B. Quality Control: Submit joint layout drawings for review and acceptance.
- C. Samples: Submit for approval samples of the products to be exposed at the dry creek bed: colored glass aggregate (one pound each color), (two) small accent stones and (four) extra small accent stones. Submit two 12-inch square panels representative of each special finish type identified, for approval prior to installation. Special finishes include the following types: sand finish. Submit one sample of the Cast Metal Letters including the letters of the word "River".
- D. Concrete Mix Design: Submit mix design to Architect for approval. Include mix for each type of concrete.
- E. Provide image of Custom Concrete Stamp.
- F. Closeout Requirements: Comply with Section 01 7700 - Closeout Procedures.
 - 1. Provide record documents.

1.06 MOCK UP

- A. Before starting work and in accordance with Section 01 3300, prepare mockups for Architect's review and acceptance of concrete walk surface texture.
- B. Minimum Panels Size: 4 ft. square.
 - 1. Re-prepare, if directed, until accepted.

2. Accepted mockup represents minimum quality standard. Work of lesser quality will be subject to rejection and replacement.
- C. Dry Creek Mock-up: Prepare on-site for approval.
- D. Sand blast finishes: Prepare on-site for approval.
- E. Accepted mockup, in like new condition, may be used in contract work.

1.07 WEATHER PRECAUTIONS

- A. Provide cold weather and/or hot weather protection as recommended in ACI 306 and ACI 305.
- B. Unless adequate protection is provided, concrete shall not be placed during rain, sleet, or snow.
 1. Protect concrete from rain water, maintain concrete water ratio and protect concrete surface.
- B. All concrete shall be adequately protected after pouring to prevent damage from freezing, by the use of suitable cover. Frozen and damaged concrete must be removed and replaced at the Contractor's expense. Do not place concrete on frozen earth.

1.08 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installers Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.
- C. Product/Material Qualifications:
 1. Design data: Compaction testing shall be in accordance with Section 01 4000 - Quality Requirements.
 2. Test reports: Provide job mix test reports.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.
 1. Protect from damage by the elements and construction procedures.

1.10 ADVANCE NOTICES

- A. Notify Architect at least 48 hours before intended concrete placement.
- B. Place no concrete until formwork and reinforcement have been inspected.

1.11 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 CRUSHED ROCK PAVEMENT BASE - SELECT FILL

- A. Imported, clean, 3/4"-0 Crushed Rock Pavement Base, Select Fill, as specified in Section 31 2000 - Earth Moving.

2.02 CAST-IN-PLACE CONCRETE

- A. Concrete shall be ready-mixed conforming to Section 03 3000 - Cast-In-Place Concrete.
 1. Sidewalks and mowstrips: 2,500 psi at 28 days and a minimum flexural strength of 600 psi at 28 days.
 2. Curbs: 3,000 psi at 28 days and a minimum flexural strength of 600 psi at 28 days.
 3. At exposed aggregate concrete, use 1-1/2 inch to 3/4 inch round rock to concrete mix.

2.03 FORMS

- A. Conform to Section 03 1000 - Concrete Forming and Accessories.

2.04 REINFORCING

- A. Conform to Section 03 2000 - Concrete Reinforcing

2.05 CURING COMPOUND

- A. Curing compound for all other concrete shall conform to AASHTO M171, White Polyethylene Film for curing concrete or AASHTO M148, Liquid Membrane-Forming Compounds for Curing Concrete.

2.06 SPECIAL CONCRETE FINISHES

- A. Cast Metal Letters
 - 1. Type: Aluminum letters for casting into concrete slabs. Provide with bolts and stabilizer plate to hold letters in place while finishing concrete. Letters custom cut from plate.
 - 2. Letter thickness: 1/2 inch minimum.
 - 3. Finish: Brushed Aluminum No 4 finish.
 - 4. Size and Font: As indicated on drawings. See Information Graphics (IG) drawings.
 - 5. Manufacturer:
 - a. J&G Diversified Products - www.cut-metal-letters.com.
 - b. Sign Letter Source, www.signlettersource.com
 - c. Substitutions: Follow procedures in section 01 6000 - Product Requirements
 - 6. Extent of Work: Interior and exterior concrete slabs as indicated. See Information Graphics (IG) drawings.
- B. Custom Concrete Stamp
 - 1. Type: Custom fabricated stamp able to imprint wet concrete slab surface and make impression of footprints. Image depth to be approximately 3/8 inch below top of adjacent concrete.
 - 2. Digital image of footprints to be provided by Architect. See Information Graphics (IG) drawings.
 - 3. Design and fabrication of stamp: Contractor's choice. Provide design of stamp for approval of Architect as specified under submittals.
 - 4. Extent of Work: Footprints at Sundial as shown on Information Graphics (IG) drawings.
- C. Sand Blasted Concrete or Etched Concrete
 - 1. Description: Sandblast cured concrete slab surface to impart designs as indicated on Information Graphics (IG) drawings.
 - 2. Materials: Provide custom cut stencils able to mask concrete surface and impart clean sharp edges to sandblasted design. Provide other sandblasting materials and equipment as needed to achieve desired results.
 - 3. Digital image of designs to be provided by Architect. See Information Graphics (IG) drawings.
 - 4. Depth of images: Two contrasting depths of sandblasting are desired. The lighter depth should be adequate to contrast with the surrounding exterior concrete slab finishes. The second deeper sandblast should contrast with the first. All sandblasted areas to be of adequate depth to remain distinct after prolonged surface wear.
 - 5. Extent of Work: Provide where etched surface is indicated at Sundial on Digital image of footprints to be provided by Architect. See Information Graphics (IG) drawings.

2.07 ACCESSORIES

- A. Joint Sealant and Backer rod: See Section 07 9005
- B. Expansion Joint Filler: Asphalt-impregnated Cane Fiber per ASTM D1751; 3/8" thickness unless otherwise indicated. Depth as required to extend through full slab depth and to position filler top 1/2 inch below top of slab, or as shown on the Drawings.
- C. Accent Stones
 - 1. See Planting Specifications for approved Products.
- D. Colored Glass Aggregate at Dry Creek Type DC.
 - 1. Description: recycled colored glass with no sharp edges; size: 1/2" to 1"; color: Turquoise. Intent is to "seed" this product into the surface amongst exposed aggregate, achieving

- approximately 50% of the exposed surface consisting of colored glass. For bidding purposes, assume up to 1.5 pound of product per square foot will be installed.
2. Approved product: Recycled Glass Aggregate by Heritage Glass Inc or approved.
- E. Impermeable Liner at Dry Creek Bed
1. Description: Flexible two-layer laminated water barrier composed of 56 mil polymeric waterproofing and four-mil polyethylene carrier film.
 2. Approved product: MEL-ROL Sealtight by WR Meadows, Inc. or approved.
- F. Waterstop at Dry Creek Bed edge
1. Description: Flexible PVC water containment barrier designed for concrete joints.
 2. Approved product: Shape #702, 4" ribbed with center bulb, by Greenstreak Group, Inc or approved.
- G. Sealer at Exterior Sand Finish
1. Description: Emulsion penetrating water repellent for concrete surfaces.
 2. Approved product: Siloxane 6 by Mascoseal or approved.
- H. Sealer at Interior Sand Finish
1. Sealer and hardener as specified in Section 03 3511 - Concrete Floor Finishes.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting work of this section verify that existing grades and field conditions agree with drawings. Notify Engineer of deviations.
- B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit.
 1. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 EXCAVATION

- A. All excavation shall be in accordance with Section 31 2316 - Excavation.

3.03 CRUSHED ROCK BASE - SELECT FILL

- A. After the subgrade is compacted and at the proper grade, spread required thickness of 3/4-inch minus crushed rock. Compact by rolling or other approved method. Surface of the compacted base shall be at the proper level to receive the concrete. Manholes, catch basins, inlets, and other such structures shall be completed, adjusted, cured, and otherwise prepared, as applicable, and made clean and ready to have concrete placed in contact with them.
- B. Depth: Rock base to be extend from sound subgrade to the bottom of concrete or 8 inches minimum unless otherwise noted.

3.04 FORMWORK

- A. Conform to the requirements of Section 03 1000, CONCRETE FORMING AND ACCESSORIES.
 1. Construct forms to the shape, lines, grades, and dimensions called for on the Drawings. Stake wood or steel forms securely in place, true to line and grade. Brace forms to prevent change of shape or movement in any direction resulting from the weight of the concrete during placement.
- B. Allowable Tolerances: Tops of forms shall not depart from grade line more than 1/8-inch when checked with 10-foot straightedge. Alignment of straight sections shall not vary more than 1/8-inch in 10 feet

3.05 FINISHING

- A. After the pavement has been struck off and consolidated, it shall be scraped with a straightedge equipped with a handle to permit operation from the edge of the pavement. Any excess water

shall be removed from the surface of the pavement. Irregularities shall be corrected by adding or removing concrete. All disturbed places shall be again straight edged.

- B. After the concrete has been given a preliminary finish, the surface of the pavement shall be checked
 - 1. By the contractor with a straightedge device. Each successive check with the straightedge device shall lap the previous check path by at least half the length of the straightedge. Surface deviations exceeding 0.01 foot shall be corrected. Upon completion of the surface floating, but before any required edge tooling or joint tooling, and before initial set of the surface pavement.
 - 2. The pavement shall be given a textured finish perpendicular to match the existing. The textured finish shall be accomplished by a steel tine tool that will mark the finished pavement to a depth of 1/8 inch plus or minus 1/16 of an inch. Match finish of existing pavement where new pavement is adjacent. The surface of the pavement shall not vary from a true surface, when tested with a 12 foot testing straightedge, more than 1/8 inch in 12 feet.
- C. Finish shall be a light broom finish for slip resistant surface unless noted otherwise. Broom pattern to be parallel to slope.
- D. Accessible Ramps: Steel trowel finish. Apply tactile warning finish.
- E. Special Finish: As indicated below and on drawings.

3.06 SPECIAL SIDEWALK FINISHES

- A. Sand Finish Type SFC
 - 1. Provide at areas designated on the drawings, and at Concrete Accent Bands at the East Courtyard, West Courtyard, and North Plaza.
 - 2. Achieve finish equivalent to Top-Cast SE 05.
 - 3. Apply Sealer at recommended rate and according to Manufacturer's instructions.
- B. Exposed Aggregate at Dry Creek Type DC
 - 1. Provide at areas designated on the drawings.
 - 2. At Dry Creek, enhance standard concrete aggregate with Colored Glass Aggregate, "seeded" at the top surface.
 - 3. At all areas, wash to expose standard mix 3/4" aggregate to medium depth. Intent is to replicate the appearance of a rocky creek bed.
 - 4. Apply Sealer at recommended rate and according to Manufacturer's instructions.
- C. Colored Glass Aggregate at Dry Creek Type DC
 - 1. Seed" this product into the surface amongst exposed aggregate, achieving approximately 50% of the exposed surface consisting of colored glass. For bidding purposes, assume up to 1.5 pound of product per square foot will be installed.
- D. Cast Metal Letters
 - 1. Provide at the locations indicated on the drawings.
 - 2. Secure letters in place to remain in alignment during pouring and finishing of concrete.
 - 3. Set letter surface approximately 1/8 inch below surface of adjacent concrete.
 - 4. Polish letters after completion.
- E. Custom Concrete Stamp
 - 1. After finishing concrete, use stamp to create impression of about 3/8 inch depth with clean sharp edges.
- F. Sand Blasted Concrete or Etched
 - 1. Protect surrounding areas.
 - 2. conduct sandblasting after concrete has achieved 28 day strength.
 - 3. Mask areas surrounding image to create sharp edges.
 - 4. Blast in 2 distinct depths to create images indicated.

3.07 JOINTS

- A. Construction joints, expansion joints, transverse contraction joints, and all longitudinal contraction joints shall be placed as indicated in the drawings. Where not specifically described on the Drawings, comply with the following:
- B. Contraction Joints:
 - 1. Longitudinal contraction joints shall consist of planes of weakness created by forming grooves in the surface of the pavement.
 - 2. Maximum joint spacing, as below, and as shown on drawings for other work.
 - a. Sidewalks up to 8 ft wide: Joint spacing to match width of sidewalk.
 - b. Sidewalks over 8 ft wide: Joint spacing to be half of sidewalk width up to 8 ft on center,
- C. Construction Joints: Construction joints shall be placed whenever the placing of concrete is suspended for more than 45 minutes. A butt joint with dowels or a thickened-edge joint shall be used if the joint occurs at the location of a contraction joint.

3.08 SEALING JOINTS

- A. Joints to be sealed shall be filled with joint-sealing material before the pavement is opened to traffic and as soon after completion of the curing period as is feasible.
- B. Each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound, and joint faces shall be clean and surface-dry when seal is applied.

3.09 WALK EDGING

- A. Before final finishing is completed and before final concrete set has occurred, finish concrete edges with edging tool shaped with 1/4 inch radius.
 - 1. Take particular care to maintain surface on both sides of joint in same plane.
 - 2. Do not use kneeling planks on concrete surface.

3.10 CURING

- A. Minimum Curing Period: 3 days.
- B. Uniformly apply compound in accordance with manufacturer's instructions, after final Concrete finishing is complete, and after all free water has disappeared from pavement surface.
- C. Apply to concrete edges immediately after formwork removal.
- D. Do not use membrane compound method if pavement will be exposed to de-icing chemicals within 30 days following curing period completion.

3.11 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 - Quality Requirements for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 - 1. Observance and approval of subgrade and base rock compaction.
 - 2. Concrete cylinder strength tests. Concrete flexural strength tests.
 - 3. Slump and air tests.
- C. Field Inspections: Notify Architect prior to work of this section.
- D. Special Inspections for Code Compliance: Obtain building inspector approvals.

3.12 DEFECTIVE WORK

- A. Remove and replace any surfaces which show excessive cracks, pavements that do not drain properly, and other defective concrete.
- B. Minimum Surface Evenness: 1/8 inch per 10 ft.

3.13 CLEANING

- A. Including work of other trades, clean, repair and touch-up, or replace when directed products which have been soiled, discolored, or damaged by work of this section.

- B. Upon completion of the work of this section, promptly remove from the working area all scraps, debris, and surplus material.
- C. Completely remove sand blasting media and masking.

3.14 PROTECTING COMPLETED WORK

- A. Protect all work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

**SECTION 32 1713
PARKING BUMPERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Recycled plastic parking bumpers.

1.02 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturer and Brand:
 - 1. Global industrial, a Systemax Company: www.globalindustrial.com
 - 2. Traffic Safety Store: www.trafficsafetystore.com
 - 3. Earthwise Plastics: www.earthwiseplastics.com
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Recycled Plastic Parking Bumpers
 - 1. Length: 6 feet minimum.
 - 2. Profile: 8 inches wide by 4 inches tall, canted sides, flat top.
 - 3. Ends: Sloped to discourage tripping
 - 4. Material: Fade resistant, HDPE or LDPE solid recycled plastic with integrally molded color. 100 percent post consumer recycled plastic resin.
 - 5. Installation: Suitable for installation on asphalt or concrete pavements.
 - 6. Will not deteriorate due to petroleum products.
 - 7. Features: Resistant to scuffing or discoloration by vehicle tires.
 - 8. Color: Blue at accessible parking spaces, elsewhere yellow.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.
- C. Fasten units in place with 3 dowels per unit.

END OF SECTION

SECTION 32 1723.13
PAINTED PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Parking lot markings, including parking bays, crosswalks, arrows, handicapped symbols, and curb markings.
- B. Roadway lane markings and crosswalk markings.
- C. Playground markings in hard surface play area.

1.02 RELATED REQUIREMENTS

- A. Section 32 1216 - Asphalt Paving.
- B. Section 32 1313 - Concrete Paving.

1.03 REFERENCE STANDARDS

- A. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.
- B. FHWA MUTCD - Manual on Uniform Traffic Control Devices for Streets and Highways; U.S. Department of Transportation, Federal Highway Administration; <http://mutcd.fhwa.dot.gov>; current edition.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Line and Zone Marking Paint: MPI No. 97 Latex Traffic Marking Paint; color(s) as indicated.
 - 1. Parking Lots: White.
 - 2. International Symbol of Accessibility: Blue.
 - 3. Curb Markings - Yellow
 - 4. Hard Play Area: White
- B. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Clean surfaces thoroughly prior to installation.
 - 1. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods.
- C. Where oil or grease are present, scrub affected areas with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinse thoroughly after each application; after cleaning, seal oil-soaked areas with cut shellac to prevent bleeding through the new paint.
- D. Establish survey control points to determine locations and dimensions of markings; provide templates to control paint application by type and color at necessary intervals.
- E. Temporary Pavement Markings: When required or directed by Architect, apply temporary markings of the color(s), width(s) and length(s) as indicated or directed.
 - 1. After temporary marking has served its purpose, remove temporary marking by carefully controlled sandblasting, approved grinding equipment, or other approved method so that surface to which the marking was applied will not be damaged.
 - 2. At Contractor's option, temporary marking tape may be used in lieu of temporary painted marking; remove unsatisfactory tape and replace with painted markings at no additional cost to Owner.

3.03 INSTALLATION

- A. Begin pavement marking as soon as practicable after surface has been cleaned and dried.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
- C. Apply in accordance with manufacturer's instructions using an experienced technician that is thoroughly familiar with equipment, materials, and marking layouts.
- D. Comply with FHWA MUTCD manual (<http://mutcd.fhwa.dot.gov>) for details not shown.
- E. Apply markings in locations determined by measurement from survey control points; preserve control points until after markings have been accepted.
- F. Apply uniformly painted markings of color(s), lengths, and widths as indicated on the drawings true, sharp edges and ends.
 - 1. Apply paint in one coat only.
 - 2. Wet Film Thickness: 0.015 inch, minimum.
 - 3. Width Tolerance: Plus or minus 1/8 inch.
- G. Roadway Traffic Lanes: Use suitable mobile mechanical equipment that provides constant agitation of paint and travels at controlled speeds.
 - 1. Conduct operations in such a manner that necessary traffic can move without hindrance.
 - 2. Place warning signs at the beginning of the wet line, and at points well in advance of the marking equipment for alerting approaching traffic from both directions. Place small flags or other similarly effective small objects near freshly applied markings at frequent intervals to reduce crossing by traffic.
 - 3. If paint does not dry within expected time, discontinue paint operations until cause of slow drying is determined and corrected.
 - 4. Skip Markings: Synchronize one or more paint "guns" to automatically begin and cut off paint flow; make length of intervals as indicated.
 - 5. Use hand application by pneumatic spray for application of paint in areas where a mobile paint applicator cannot be used.
- H. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
 - 1. Mark the International Handicapped Symbol at indicated parking spaces.

2. Hand application by pneumatic spray is acceptable.
- I. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.

3.04 DRYING, PROTECTION, AND REPLACEMENT

- A. Protect newly painted markings so that paint is not picked up by tires, smeared, or tracked.
- B. Provide barricades, warning signs, and flags as necessary to prevent traffic crossing newly painted markings.
- C. Allow paint to dry at least the minimum time specified by the applicable paint standard and not less than that recommended by the manufacturer.
- D. Remove and replace markings that are applied at less than minimum material rates; deviate from true alignment; exceed length and width tolerances; or show light spots, smears, or other deficiencies or irregularities.
- E. Remove markings in manner to avoid damage to the surface to which the marking was applied, using carefully controlled sand blasting, approved grinding equipment, or other approved method.
- F. Replace removed markings at no additional cost to Owner.

END OF SECTION

SECTION 32 3113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fence framework, fabric, and accessories.
- B. Excavation for post bases; concrete foundation for posts.
- C. Baseball backstop construction.

1.02 RELATED REQUIREMENTS

- A. Section 32 3119 - Decorative Metal Fences and Gates

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a.
- D. ASTM A491 - Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric; 2011.
- E. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.
- F. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2014.
- G. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2013.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures for submittal procedures.
- B. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.
- D. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

1.05 QUALITY ASSURANCE

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Chain Link Fences and Gates:
 - 1. Master-Halco, Inc.: www.masterhalco.com.
 - 2. Merchants Metals: www.merchantsmetals.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Posts, Rails, and Frames: ASTM F1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 30 ksi.
- B. Wire Fabric: ASTM A 392 zinc coated steel chain link fabric.
- C. Concrete: Type specified in Section 03 3000.

2.03 COMPONENTS

- A. Line Posts: 2.38 inch diameter.
- B. Corner and Terminal Posts: 2.88 inch.

- C. Gate Posts: 3.5 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Bottom Rail: Match Top Rail.
- F. Gate Frame: 1.66 inch diameter for welded fabrication.
- G. Fabric: 2 inch diamond mesh interwoven wire, 9 gage thick, knuckle and tied back, top and bottom so there are no protruding edges.
- H. Fabric Height: As shown on the Drawings.
- I. Tension Wire: 6 gage thick steel, single strand.
- J. Tie Wire: 11 ga galvanized steel.

2.04 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.
- B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

2.05 FINISHES

- A. See schedule end of this section.
- B. Components (Other than Fabric): Galvanized in accordance with ASTM A123/A123M, at 1.7 oz/sq ft.
- C. Components and Fabric: Vinyl coated over coating of 1.8 oz/sq ft galvanizing.
- D. Hardware: Hot-dip galvanized to weight required by ASTM A153/A153M.
- E. Accessories: Same finish as framing.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F 567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
- D. Line Post Footing Depth Below Finish Grade: ASTM F 567.
- E. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: ASTM F 567.
- F. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.
- G. Provide top rail through line post tops and splice with 6 inch long rail sleeves.
- H. Install center brace rail on corner gate leaves.
- I. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- J. Position bottom of fabric 2 inches above finished grade.
- K. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.
- L. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.
- M. Install bottom tension wire stretched taut between terminal posts.
- N. Install gate with fabric to match fence. Install hardware.
- O. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.

3.02 BALL STOP NETTING SLEEVES

- A. Install per manufacturer's requirements.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From True Position: 1 inch.
- C. Components shall not infringe adjacent property lines.

END OF SECTION

SECTION 32 3119
DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative steel fences and gates, located as indicated on drawings.
- B. Vehicle sliding cantilever gate with power operator and controls.
- C. Vehicle swing gates manually operated.
- D. Person swing gates.
- E. Provisions for gate hardware, exit signs, and security devices.

1.02 RELATED REQUIREMENTS

- A. Section 03 3300 - Cast-in-Place Concrete, concrete at fencing and gate operator.
- B. Section 05 5000 - Metal Fabrications, bollards
- C. Section 08 7100 and 08 07111 - Door Hardware and Door Hardware Schedule, preparation for door hardware.
- D. Section 09 9600 - High Performance Coating, finishing of Decorative Metal Fences and Gates.
- E. Division 28 - Electronic Safety and Security, access control devices and wiring.
- F. Division 26 - Electrical, power to exit devices and exit lights.
- G. Section 32 1610 - Sidewalks, concrete paving and mow strips at fences.
- H. Section 32 2000 - Earth Moving, fills at fence posts.

1.03 REFERENCE STANDARDS

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2015.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2013.
- G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2012.
- H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2013.
- I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- J. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2010.
- K. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2012.
- L. ASTM B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric); 2012.
- M. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012e1.
- N. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012e1.

- O. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.
- P. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.
- Q. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; American Welding Society; 2012.
- R. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- S. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; American Welding Society; 2008.
- T. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc.; 2011.
- U. SSPC-Paint 15 - Steel Joist Shop Primer; Society for Protective Coatings; 1999 (Ed. 2004).
- V. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); Society for Protective Coatings; 2002 (Ed. 2004).
- W. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).
- X. ASTM B117 - Practice for Operating Salt Spray (Fog) Apparatus; 2011.
- Y. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
- Z. ASTM D714 - Test Method for Evaluating Degree of Blistering in Paint; 2002 (Reapproved 2009).
- AA. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings; 2013.
- AB. ASTM D1654 - Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008.
- AC. ASTM D2244 - Test Method for Calculations of Color Differences from Instrumentally Measured Color Coordinates; 2011.
- AD. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2010).
- AE. ASTM D3359 - Standard Test Method for Measuring Adhesion by Tape Test; 2009e2.

1.04 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design Decorative Metal Fencing and Gates, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Oregon, using performance requirements and design criteria indicated.

1.05 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
 - 2. Foundation details, concrete design mix and reinforcing schedule for anti-ram barrier system.
- D. Calculations: Provide structural calculations bearing the stamp of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- E. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

- F. Delegated-Design Submittal: For Decorative Metal Fencing and Gates indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Submit submittals as "Deferred Submittals" in accordance with Section 01 30 00 - Administrative Requirements. Transmit a copy of each submittal indicating agency approval to the Architect for record.
- G. Installer's Qualification Statement.
- H. Manufacturer's Warranty.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.
- C. Design connections and size members not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- D. Perform Work in accordance with Oregon Structural Specialty Code.
- E. Design gates for loads and deflection normal to conditions of use.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Decorative Metal Fences:
 - 1. Basis of Design: Ameristar Perimeter Security, Montage Commercial, Genesis style, USA: www.ameristarfence.com.
 - 2. Other Manufacturers must fully match specification: Alumi-Guard, Inc: www.alumi-guard.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FENCES

- A. Fences: Complete fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
 - 1. Capable of resisting vertical load, horizontal load and infill performance requirements for fence categories defined in ASTM F2408.
- B. Electro-Deposition Coating: Multi-stage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 - 1. Total Coating Thickness: 2 mils, minimum.
 - 2. Color: As selected by Architect from manufacturer's standard range.
 - 3. Coating Performance: Comply with general requirements of ASTM F2408.
 - a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
 - b. Corrosion Resistance: ASTM B117, D 714 and D 1654; 1/8 inch coating loss or medium No.8 blisters after 1,500 hours.
 - c. Impact Resistance: ASTM D2794; 60 inch pounds.
 - d. Weathering Resistance: ASTM D523, D822/D822M and D2244; less than 60 percent loss of gloss.
- C. Steel Tubing and Hollow Steel Sections: ASTM A 500, Grade B cold-formed structural tubing.

- D. Plates: ASTM A 283.
- E. Pipe: ASTM A 53/A 53M, Grade B Schedule 40, hot-dip galvanized finish.
- F. Bolts and Nuts: Carbon steel, ASTM A307, Grade A galvanized to ASTM A 153/A, Class C.
- G. Anchor Bolts, Headed Anchor Rods: ASTM F 1554 Grade 36.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.
- J. Perforated aluminum sheet:
 - 1. Thickness: 16 gauge.
 - 2. Perforations: 1/4 inch round holes on 3/8 inch staggered centers
 - 3. Material: Finish to match fencing.
 - 4. Edge: 2 inch unperforated border at panel edges.
 - 5. Manufacturer and brand: McNichols Round Hole Perforated Products;
www.mcnichols.com
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
 - 7. Extent of Work: Provide at inside face of sliding cantilever gate to reduce visibility into utility courtyard, mechanically fasten. Provide at personnel gate.

2.03 WELDED STEEL FENCE

- A. Provide fence meeting requirements for Industrial class as defined by ASTM F2408.
- B. Fence Posts:
 - 1. Size: 6 inch by 6 inch minimum.
 - 2. Material: Tubular steel.
 - 3. Finish: Match fencing.
- C. Fence Panels: Fusion welded; 4 feet high at school garden fence. 6 feet high elsewhere.
 - 1. Panel Style: Three rail.
- D. Posts: Steel tube.
 - 1. Size: 2-1/2 inches square by 12 gage, 0.109 inch, with manufacturer's standard cap.
 - 2. Post Cap: Flush plate.
- E. Rails: Manufacturer's standard, double-wall steel channel 1-3/4 inch square by 12 gage, 0.1094 inch with pre-punched picket holes.
 - 1. Picket Retaining Rods: 0.125 inch galvanized steel.
 - 2. Picket-to-Rail Intersection Seals: PVC grommets.
- F. Pickets: Steel tube.
 - 1. Spacing: 3-3/4 inch clear.
 - 2. Size: 1 inch square by 18 gage, 0.0478 inch.
 - 3. Style: Square top pickets extend above top rail.
 - 4. Finial: None, square top..
- G. Flexibility: Capable of following variable slope of up to 1:2.

2.04 STEEL GATES

- A. Personnel Gates
 - 1. Manufacturer and Brand: Match Fencing
 - 2. Material and finish: Steel to match fencing.
 - 3. Height: 7 feet
 - 4. Frames: Tubular steel. Increase size as needed to accommodate gate hardware and design criteria.
 - 5. Gate Posts: Sizes and shapes as shown on drawings.
 - 6. Provide Adjustable Mounting Plate with openings, supports, and fastenings for gate hardware specified in Section 08 7100 Door Hardware.
 - 7. Operation: Panic device from inside courtyard. Latch set from exterior. Card reader required to release latch from exterior.

8. Do not provide openings in gate panel within 12 inches of panic device. Provide perforated metal mesh on interior face of gate to prevent "reaching through" to open gate.
 9. Provide steel shapes and fasteners for mounting to masonry walls where indicated.
 10. Provide stop and latching strike at jamb post.
 11. Provide cane bolt to hold gate in open position.
 12. Provide ability to route wiring within gate post from below grade to gate exit sign, electronic hardware, and security wiring.
- B. Vehicular Gates, Sliding Cantilever Gates
1. Manufacturer and Type: Transport II by Ameristar, Genesis style to match fence.
 - a. Material: Aluminum
 - b. Finish: Match fencing
 - c. Height: 7 feet
 - d. Width of Opening: As shown on drawings.
 - e. Provide mounting posts for gate support and operation. Materials and finish to match fence.
 - f. Provide with site obscuring round perforated aluminum sheet facing on interior face.
 - g. Operation: Power operation as indicated.
 - h. Provide steel shapes and fasteners for mounting to masonry walls where indicated.
 - i. Provide stop at jamb post.
 - j. Power Gates: Provide with operator as described in work of this section.

2.05 CANTILEVER GATE OPERATOR

- A. Manufacturer & Brand:
1. Basis of Design: Liftmaster 1/2 HP Sliding Gate Operator
 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Type: Heavy duty sliding gate operator, controls, and accessories.
- C. Power requirements: 24 Volts DC, low voltage control circuit.
- D. Available horse power: 1/2 HP for use in Class I through IV application.
- E. Maximum gate weight: 800 LBS.
- F. Maximum cycles per hour: 45 CPH.
- G. Maximum gate width: 14 feet.
- H. Gate speed: 13 seconds from open to close.
- I. Code: UL 325 Listed, comply with ASTM 2200
- J. Accessories and Features:
1. Safety edges both by contact sensor and by photo cell.
 2. Magnetic gate lock.
 3. Control boards.
 4. Loop detectors able to detect vehicle presence at entry, exit, and mid point of passing through gate. Preformed loops to be placed at time of concrete pour. 3 loops located as recommended by Manufacturer.
 5. Ground mounted control pedestal able to operate gate using card reader or by entering numeric combination on keypad.
 6. Desired operation: Entry from exterior only by security card or correct entry of numeric combination. After vehicle clears gate, gate closes automatically. Exit from interior accomplished using 2 modes. First mode: gate opens automatically upon detection of vehicle presence. Second mode: gate is opened using push button with keyed lockout.
 7. Motor Operator Enclosure: Secure with access controlled by key or special tool.
 8. Concrete base for control pedestal and motor operator: Size and reinforcing as recommended by Gate Operator manufacturer. Material as specified in Section 03 3000 Poured in Place Concrete.
- K. Provide means of securing gate in closed position.

2.06 STEEL FINISHES

- A. Prepare and finish as specified in Section 09 9600 - High Performance Coatings.
- B. Provide painted images on fence and vehicle gate panels as indicated on drawings. Architect to provide digital files of images for painting. Apply image to exterior face of gate only.

2.07 ACCESSOIRES

- A. Fire Department Lock Box: As specified in Section 10 4400 - Fire Protection Specialties.

2.08 FABRICATION

- A. Steel connections; Fully welded.
- B. Cap open ends of tube steel.
- C. Ease edges.
- D. Attachment of steel face to frames: Tack weld. Do not cause welds to distort smoothness of steel panels.
- E. Provide custom cut openings in face panels at steel personnel gates. Architect to provide digital file of images to be cut in steel.
- F. Provide custom painted images on vehicular gates and fence panels. See Finishing.
- G. Provisions for Hardware: Provide openings, reinforcements, and penetrations allowing installation of hardware. Hardware mounting heights and locations to comply with Section 08 7100. Comply with Accessibility requirements of the Oregon Structural Specialty Code requirements for gates and hardware.
- H. Provisions for wiring: Provide open pathways for security and line voltage wiring to exit hardware, security devices, exit lights.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in accordance with approved shop drawings.
- C. Set fence panels level. Do not allow an open space greater than 4 inches between the bottom of a gate or fence to finished grade.
- D. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
 - 1. Base type and quantity of gate hinges on the application; weight, height, and number of gate cycles.

3.04 ERECTION TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum distance from property line: 6 inches.
- D. Set gates level to hold in any position.

3.05 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

3.06 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

SECTION 32 8000

IRRIGATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Installation of Backflow Prevention Assembly and related appurtenances.
- B. Installation of Central Control system, control wires, shrub and lawn zones.

1.02 RELATED REQUIREMENTS

- A. Section 01 5639 - TEMPORARY TREE AND PLANT PROTECTION
- B. Section 01 6000 - Product Requirements
- C. Section 01 7900 - Demonstration and Training
- D. Division 26 - Electrical
- E. Division 31 - Earthwork
- F. Section 32 9000 - Planting

1.03 REFERENCE STANDARDS

- A. ASTM D1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- B. ASTM D1785: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- C. ASTM D2464 - Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- D. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- E. ASTM D 2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2004 (Reapproved 2009).

1.04 PROTECTION

- A. Protect existing improvements and growth in areas to remain undisturbed until completion of project. Leave area in similar condition as found.
- B. Protect utilities and maintain in continuous operation or in operational condition during work. Repair damage to known utilities at Contractor's expense.
- C. Use means necessary to protect materials of this Section before, during, and after installation and to protect installed Work and materials of other trades. In the event of damage immediately make repairs and replacements as directed by Owner's Representative.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with other trades affecting and affected by Work of this Section.
- B. Preinstallation Meeting: Convene one week (minimum) prior to commencing work of this Section to coordinate utility marking procedures, to review proposed irrigation wire path, coordinate irrigation wire path with relevant controller, review expectations for decoder address documentation, review splice and wire branch expectations.

1.06 SUBMITTALS

- A. See Section 01 6000 - Product Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's printed data covering products and installation instructions.

- C. Quality Assurance Data: Submit license information and project references including name and location of previous projects, date of installation, square footage of areas with irrigation work, description of irrigation system, and Owner's contact information.
- D. Record Documents: Record actual locations of installed irrigation components on a clean set of plans. Use white out and red ink to legibly re-draft as-built information.
 - 1. Produce and keep current throughout the project.
 - 2. Indicate two dimensions for valves, stub outs, and main line T's, L's, ends, elbow's, and change in direction.
 - 3. Indicate wire run and color of wire.
 - 4. Indicate relevant decoder address for each valve.
 - 5. Submit to Owner's Representative for approval.
- E. Operation and Maintenance Data:
 - 1. Provide written instructions at System Demonstration for operation and maintenance of system and controls, seasonal activation and shutdown, and manufacturer's parts catalog.
 - 2. Submit chart showing actual precipitation rates for each zone.
 - 3. Prepare a program for the irrigation controller for Spring/Summer; Summer; Summer/Fall using historical weather data and averages. Include start times, watering duration, day of week, repeat cycle mode, program mode, precipitation rates in inches per hour, and application quantities. Coordinate operation and programming with Owner's Representative.
- F. Maintenance Materials: Provide the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Valve Keys for Manual Valves: One.
 - 3. Extra Valve Box Keys: One.
 - 4. Wrenches: One for each type head core and for removing and installing each type head.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing Work of this Section who has successfully completed a minimum of 5 comparable scale projects and have the following licenses:
 - 1. For Irrigation Work:
 - a. Valid Oregon Landscape Contractors license.
 - b. Valid Oregon Landscape Business license.
 - 2. For Plumbing Work:
 - a. Valid Oregon Plumbing license.
 - b. Valid Oregon Landscape Contractor license.
 - 3. Successfully completed at least 5 comparable scale projects.
 - a. Submit names, addresses, dates, owners and locations of previous projects if requested by Owner's Representative.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in original unopened packaging with legible manufacturer's identification.
- B. Comply with manufacturer's recommendations for storage and protection.
 - 1. Store in a cool, dry place out of direct sunlight.

2. Protect from damage by the elements and construction procedures.
3. Store plastic pipe on firm, level supports.
4. Store plastic pipe cement in cool location.

1.09 ENVIRONMENTAL CONDITIONS

- A. Temperature of mating surfaces of plastic pipe and fittings to be between 40 degrees fahrenheit and 100 degrees fahrenheit. Perform no PVC Solvent welding in rainy weather except under cover.

1.10 REVIEWS

- A. Request the following reviews by the Owner's Representative two days (min.) in advance:
 1. Irrigation Head Layout Review
 2. Pressure Test and Mainline Installation
 3. System Review
 4. System Demonstration to Owner
- B. Coordinate Reviews to coincide with regular progress meetings where possible.

1.11 MAINTENANCE

- A. During period between system installation and Final Acceptance provide maintenance to assure proper operation of the irrigation system.

1.12 WARRANTY

- A. Warranty period shall be one year following Final Completion or one full operating season following Final Completion, whichever is longer.
- B. Contractor guarantees materials furnished under this Contract will be as specified and the Work will be free of defects in compliance with the Contract Documents.
- C. Irrigation system must be in proper working condition at the end of the warranty period. At no additional cost to the Owner replace Work of this Section as necessary to restore system to proper working condition following the Contract Documents.
- D. Visit and inspect Work at least once a month during warranty period and notify Owner's Representative in writing of any observed conditions requiring attention. Failure to provide such notification renders deficiencies the Contractor's responsibility to rectify.
- E. Contractor is not responsible for loss or damage to Work of this Section caused by unusually extreme weather, vandalism, or lack of Owner's maintenance during warranty period.

PART 2 PRODUCTS

2.01 IRRIGATION SYSTEM MATERIALS

- A. Use only new materials of brands and types shown on Drawings or specified herein.
- B. Similar materials must be products of one manufacturer unless otherwise approved.
- C. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PIPE MATERIALS

- A. Mainline, Lateral Line, and Irrigation Sleeve Pipe: Schedule 40 PVC Pipe, Type 1, normal impact: IPS, NSF approved conforming to ASTM D1784, ASTM D1785.
- B. Risers: One piece schedule 80 gray PVC Pipe, Type 1, threaded at both ends conforming to ASTM D1784 and ASTM D2464. No snap-risers.
- C. Fittings: Type and style of connection to match pipe.
- D. Fittings: Polyvinyl chloride type 1, white schedule 40 and gray schedule 80; ASTM D1784, ASTM D2466, or ASTM D2464, as applicable.

- E. Swing Joint Assembly Pipe and Fittings: Double swing joint risers as detailed. Swing-Pipe, snap, and "Funny pipe" risers not acceptable.
- F. Flex Riser Assembly: 18 inch minimum, 3 feet maximum Swing-Pipe with transfer barb 90 degree ells at both ends and a marlex ell below the irrigation head.
- G. Electrical Conduit and Fittings:
 - 1. Underground: Plastic, Class 3, Federal Specification W-C-1094.
 - 2. Above Ground: Aluminum, Federal Specification WW-G-540.
- H. PVC Solvent Cement: NSF approved solvent for Class 1245-B&C PVC through 4 inches conforming to ASTM D 2564 for PVC pipe and fittings. Ensure that manufacturer's expiration date is not exceeded.
 - 1. IPS Corporation Weld-on #704 or #711.
- I. PVC Cleaner and Primer:
 - 1. IPS Corporation Weld-on P-70 or as recommended by PVC Pipe manufacturer.

2.03 VALVES

- A. Isolation Valves - 3 inch and under: Threaded gate valve with resilient wedge sized to match mainline with brass wheel handle.
 - 1. Kennedy C-509, or approved.
- B. Control Valve Assembly:
 - 1. Automatic Control Valve: Globe type, 200 psi rated, threaded connections with cross type operating handle designed to receive operating key. Size according to Valve Schedule on Drawing.
 - a. Approved Products:
 - 1) Rain Bird PEB-PRS-D Series.
 - 2) Tucor RKL-050 Line Decoder for 2-wire system
 - 2. Shut Off Valve: USA manufactured gate valve. 135 psi cold water rated constructed of brass or bronze on 2 inch and under valves with bronze wheel handle.
 - a. Nibco T-113
- C. Quick Coupling Valves:
 - 1. Rain Bird 44 RC.
- D. Master Valve: 24V AC, normally open and flanged at both ends.
 - 1. Size: 2 inch.
 - 2. By Superior Manufacture.
 - 3. Tucor RKL-050 Line Decoder for 2-wire system.
- E. Flow Sensor: PVC tee type sensor.
 - 1. Model FSI-T20_001 by Creative Sensor Technology.
 - 2. Tucor SD-100 Sensor Decoder for 2-wire system.
- F. Manual Drain Valve: Globe or angle brass manual valve with non-floating seat disk that allows positive drainage.
 - 1. Manufactured by Champion.

2.04 VALVE BOXES

- A. Valve box of suitable size with tee top type lid .
 - 1. Black box and lid in plant bed areas.

2. Black box and green lid in lawn areas.
 3. Green box and lid.
 4. Black box and brown lid at plant bed areas.
- B. Install valves in the following valve boxes:
1. Control Valve Assembly: (2) Rain Bird VB-STD, bolted together, T-Lid.
 2. Quick Coupling Valves: Carson 910-10, T-Lid.
 3. Manual Drain Valves: Carson 910-10.
 4. Isolation Valves: Carson 910-10.
 5. Other Valves: Sized as applicable by Carson.

2.05 IRRIGATION HEADS

- A. Makes and models shown on Drawings, or approved.

2.06 WIRE

- A. Zone Control Wire: Install according to manufacturer's wire schedule for valve specifications. 14 gauge minimum, type AVG-UF, bearing U.S. approval.
- B. Zone Control Wire (2-Wire): Tucor Control Cable, 16 AWG, multiple colors
- C. Surge Protection
1. Tucor SP-100 Surge Protector, resistance to ground 50 ohm max.
- D. Wire Connections: Direct bury splice Kit.
1. DBR/Y by 3M.
- E. Utility Locate Wire: 14 gauge minimum, type AVG-UF, bearing U.S. approval, blue in color.
- F. Tucor SP-100 surge protector with ground rods.

2.07 IRRIGATION CONTROLLER ASSEMBLY

- A. One (1) commercial Series ESP-24SAT-LW Maxicom irrigation controller by Rain Bird.
- B. One (1) commercial Series ESP-40SAT-LW Maxicom irrigation controller by Rain Bird.
- C. Ethernet Communication
1. RBDS-SEMETS by Rain Bird per controller.
- D. 2-Wire Interface with Maxicom Controller
1. One (1) Tucor TDI per controller.

2.08 BACKFILL MATERIALS

- A. Pea Gravel: 3/4 x 1/2 inch washed round rock.
- B. Sand: Clean, fill sand free of clay, rocks, organic matter, or other deleterious material.
- C. Topsoil or Loam: See Section 31 20 00 - Earth Moving.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that required utilities and sleeves are available, in proper location, and ready for use. Verify location, type, size, psi, and GPM of existing water lines, meters, and sleeves.
- B. Verify that surfaces and structures to receive Work are accurately sized and located, sound, secure, true, complete, and otherwise properly prepared.
- C. Verify electrical service and conduit for Irrigation Controller is properly sized and located.

3.02 PREPARATION

- A. System layout is diagrammatic. Route piping to avoid plants, ground cover, and structures. If field measurements differ slightly from Drawings modify work for accurate fit. If measurements differ substantially notify Owner's Representative prior to installation.
- B. Review layout requirements with other affected work. Coordinate locations of sleeves under paving to accommodate system and piping to minimize conflict with other work.
- C. Coordinate connections to existing irrigation system, including system shut down, new connections, system re-start, and scheduling of new irrigation zone run times with Owner's Representative.
- D. Irrigation Head Layout Review: Install flags at locations of irrigation heads and components shown on Drawings. Obtain Owner's Representative's approval and make adjustments to locations as directed. Coordinate marking of pipe trenches and location of valves prior to executing Work.

3.03 CUTTING OF PAVEMENT AND REPAIR

- A. Do no cutting of pavement for installation of Work without Owner Representative's approval.

3.04 TRENCHING

- A. Excavate trenches with uniform bottom and remove rocks and sharp objects to provide firm, even, clean base for pipe. Width of trench to be 1.5 times the outside diameter of the pipe.
- B. Trench Depth:
 - 1. Minimum Cover Over Installed Mainline Piping: 24 inches.
 - 2. Minimum Cover Over Installed Lateral Line Piping: 18 inches.
 - 3. Minimum Cover Over Installed Sleeves in Roadway: 24 inches.
 - 4. Minimum Cover Over Installed Sleeves at other paving: 6 inches from bottom of paving.
- C. More than one pipe is permitted in the same trench provided that:
 - 1. Two pipes may be stacked vertically if 4 inches of Sand separates them.
 - 2. Three or more pipes must be laid 4 inches apart horizontally.
- D. Where excavation is performed to excess levels backfill with Sand to proper levels.
- E. Keep trenches dry and frost free. Provide and operate pumping equipment to keep excavations free from standing water.
- F. Protect existing vegetation to remain. Cut no roots over two inches in diameter without approval of Owner's Representative. Make cuts clean, straight, at right angles to roots. Paint cuts over 1-1/2 inches diameter with approved tree paint. Repair or replace damaged plant material.

3.05 SLEEVE INSTALLATION

- A. Sleeves may be jacked or pulled but cover requirements must be maintained. Jacking of PVC pipe is not permitted in rocky or bar run fills where there is potential for damage to pipes.
- B. Extend sleeves 12 inches beyond pavement edge or curb.
- C. Install level and perpendicular to sidewalks and pavement unless shown otherwise on drawings.
- D. Provide markers where sleeve ends are concealed.

3.06 PIPE BEDDING

- A. Mainline: Provide uniform bearing surface of Sand, 4 inches minimum depth, free of rocks and sharp objects under entire length of pipe.
- B. Lateral Line: Provide uniform bearing surface of clean topsoil, loam, or Sand. If rock or other deleterious materials are encountered bed pipe with 4 inches of Sand on all sides.

3.07 PIPE INSTALLATION

- A. Irrigation lines may be jacked or pulled but cover requirements must be maintained. Jacking of PVC pipe is not permitted in rocky or bar run fill or where there is potential damage to pipes.
- B. Install pipe in accordance with manufacturer's instructions and with the following minimum clearances around pipe:
 - 1. 2 inch diameter and smaller: 2 inches
 - 2. 2-1/2 inch diameter and larger: 4 inches
 - 3. Between irrigation and other utilities: 1 foot
- C. Threaded Plastic Pipe Installation:
 - 1. Do not use solvent cement on joints.
 - 2. Wrap threaded joints with teflon tape. Minimum 4 wraps of tape.
- D. Cemented Plastic Pipe Installation:
 - 1. Cut ends square using approved pipe cutter and bevel cuts with deburring tool.
 - 2. Clean pipe of scale, sand, dirt, etc. prior to assembling.
 - 3. Avoid using an excess amount of primer and cement when making joints; particularly on the inside of female pipe ends and fittings.
 - 4. Wipe off excess cement continuously as it appears on the surface of the pipe after making joints.
 - 5. Allow fifteen minutes of cure time on joints before moving or handling. Assemble pipe before lowering into trench.
 - 6. Snake lines to allow for contraction.
 - 7. Transition pipe sizes at fittings and not bell end of pipes.
 - 8. Install thrust blocks at 90 degree corners and tees.

3.08 THRUST BLOCK INSTALLATION

- A. Install 2500psi thrust block at pipe corners, tees, ells, and stub outs.
 - 1. Pipe 2 - 3 inches in diameter: 1 cubic foot.

3.09 VALVE INSTALLATION

- A. Install plumb and square, as detailed, and according to manufacturer's specifications.
- B. Manual Drain Valves:
 - 1. Install at mainline low points and at outlet of control valves where laterals run uphill.
 - 2. Record locations on as-built drawings.
- C. Install 1 valve in each valve box assembly.
- D. Valve Sump: Install a minimum of 2 cubic feet of Pea Gravel below each valve. Allow for 4 inches clearance between bottom of valve and valve sump.

3.10 VALVE BOX INSTALLATION

- A. Install plumb and square with adjacent construction with one valve in each valve box assembly.
- B. At Control Valve Assemblies bolt two valve boxes together as detailed.
- C. Permanently label valve type and zone number on inside of valve box lid.
- D. Set top of valve boxes flush with lawn or mulch at plant beds unless otherwise noted.
- E. Provide 12 square inches (min.) of support on each side of valve box as detailed.

3.11 CONTROL WIRE INSTALLATION

- A. Install wires below irrigation mainline with multiple wires bundled together at 5 foot maximum intervals in a continuous run. Notify Owner's Representative for approval prior if splices are required and locate in valve box.
- B. All splices will use 3M DBR/Y gel filled splices.
- C. Use different colored wire for each branch of 2-Wire path.
- D. Use coded and labeled wires for each valve. Provide a numbered tag at each end of a wire at valve, and at controller. The number at each end of wire to be the same.
- E. Provide 48 inches loop in wires at each valve where controls are connected and at 100 foot maximum intervals between. Coil wire around 1/2 inch rebar dowel inside of valve box.
- F. Make electrical joints waterproof using specified connectors. Enclose joints in valve boxes.
- G. Install wire in continuous runs with no splices unless approved.
- H. Install and ground surge protection every 500 LF and at end of wire run.
- I. Show wire routes and approved splice locations on As-Built drawings.
- J. Install wires above grade or independent of the mainline in conduit.

3.12 CONTROLLER ASSEMBLY INSTALLATION

- A. Controller cabinet to be fabricated and installed by Water Wise or technician factory trained and authorized by Tucor and Rain Bird. Contact Water Wise at (503) 381-6282 or rick@waterwisenorthwest.com.
- B. Ethernet communication devices (SEMET) to be coordinated and installed by Water Wise or Rain Bird authorized service provider. Contact Water Wise at (503) 381-6282 or rick@waterwisenorthwest.com.

3.13 MAINLINE PRESSURE TEST AND INSPECTION

- A. Field inspection and testing will be performed under provisions of Section 01 4000.
- B. Prior to backfilling and installing valves test irrigation mainline for leakage. Establish and maintain 100 psi pressure for 24 hours. Perform test a minimum of 24 hours after set-up of solvent weld. Notify Owner's Representative a minimum of 24 hours for review of pressure gauge at beginning and end of test period. Mainline will be accepted if pressure loss is less than 2 psi.
- C. Following the pressure test but prior to backfilling, notify Owner's Representative for review of pipe, fittings, joints, thrust blocks, bedding, control wire installation, valves, and other materials for installation and water tightness.
- D. After successful pressure test and mainline inspection begin backfilling and assembly of zones and system components.

3.14 BACKFILLING

- A. Remove debris, sharp rocks, and decayable matter from areas to be back filled before proceeding.
- B. Main Lines: Provide 6 inch Sand cover over piping then place Utility Locate Wire the entire length of pipes where control wires are not present. Backfill remainder of trench with Topsoil or Loam.
- C. Lateral Lines: Backfill trench with Topsoil or Loam. Protect piping from displacement.
- D. At Paved Areas: Backfill trench with Sand under paved areas.
- E. Compact backfill in 6 inch lifts to match density of surrounding material. Install backfill to match adjacent elevations.

3.15 FLUSHING

- A. Mainline: Open valves and thoroughly flush piping system under full water head after piping, risers, and valves are installed. Maintain flushing for three minutes. Close valves and cap risers immediately after flushing.
- B. Second Flushing: Flush a second time after installation of lateral lines and sprinklers prior to nozzle installation. Flush under full water head for three minutes. Install nozzles after flushing.
- C. Drip Line Flushing: Remove flush cap and flush each zone under full water head after all connections have been made. Maintain flushing for three minutes and immediately replace flush cap.

3.16 SPRINKLER HEAD INSTALLATION

- A. Install plumb with top of Topsoil/Loam or Mulch as detailed and at locations shown on drawings. Allow a maximum of 3 inches clearance between sprinkler head and adjacent lawn or planting edge.
- B. Install 1 cubic foot Pea Gravel sump on all low irrigation heads where drainage occurs at zone shutdown.

3.17 SYSTEM REVIEW

- A. Prepare and start system in accordance with manufacturer's instructions. Prior to notifying Owner's Representative for review of the system review zones and make adjustments to ensure full and even coverage.
- B. Notify Owner's Representative for review of system operation to determine if water afforded to all areas is complete, adequate, and uniform.
- C. Final acceptance with operation of system by Maxicom Central Control to be coordinated by Water Wise or Rain Bird authorized service provider. Contact Water Wise at (503) 381-6282 or rick@waterwisenorthwest.com.
- D. Adjust system for full water coverage as directed.

3.18 SYSTEM DEMONSTRATION TO OWNER

- A. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance data as basis for demonstration.

3.19 RAINWATER CISTERN INSTALLATION

- A. Install per manufacturer's instruction and as shown on drawings and details.

3.20 CLEANING

- A. Remove excess excavation, backfill materials, and other left over materials from the site. Clean improvements soiled by Work of this Section.

END OF SECTION

SECTION 32 9000
PLANTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Soil Material placement.
- B. Infield Material placement.
- C. Boulders and drain rock placement.
- D. New trees, plants, and ground cover.
- E. Mulch and Fertilizer.
- F. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 01 5639 - Temporary Tree and Plant Protection.
- B. Section 01 6000 - Product Requirements.
- C. Section 01 7000 - Execution and Closeout Requirements.
- D. Section 31 2000 - Earth Moving.
- E. Section 32 80 00 - Irrigation.

1.03 DEFINITIONS

- A. Weeds: Any plant life not specified or scheduled. Includes seeds and roots.
- B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.04 REFERENCE STANDARDS

- A. Quality definitions, grading tolerances, root system condition, caliper height, branching, budding: ANSI/ANLA Z60.1 - American Standard for Nursery Stock, latest edition.
- B. ANSI A300 Part 1 - American National Standard for Tree Care Operations -- Tree, Shrub and Other Woody Plant Maintenance -- Standard Practices; 2001.
- C. Nomenclature conforms to "Standardized Plant Names," 1942 Edition, published by J. Horace McFarland Co., or "New Sunset Western Garden Book," listed in these references are those used most commonly in the nursery trade.
- D. Standard references may be obtained from publishers

1.05 PROTECTION

- A. Protect existing improvements and growth in areas to remain undisturbed until completion of project. Leave in similar condition as found.
- B. Maintain benchmarks, monuments, and other reference points. Replace if disturbed or destroyed.
- C. Contact local utility companies for verification of the location of underground utilities within the project area prior to starting excavation. Protect utilities and maintain in continuous operation or in operational condition during work. Repair damage to known utilities or related facilities in an approved manner at Contractor's expense.
- D. Protect drainage inlets and underground drain lines from infiltration or clogging by soils and mulch during construction until Final Completion.
- E. Protect materials of this Section before, during, and after installation. Protect installed work and materials of other trades. In the event of damage immediately make repairs or replacements as directed by Landscape Architect.

1.06 SUBMITTALS

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

- B. Maintenance Data: Include written instructions covering yearly recommended maintenance and care of plantings including fertilization, pest and disease control, weed control, mulching, and pruning.
- C. Quality Assurance Data: Submit license information and project references including name and location of previous projects, date of installation, square footage of areas with planting work, and Owner's contact information.
- D. Submit list of plant life sources within 14 calendar days of Agreement Date.
 - 1. Submit confirmation from supplier(s) that specified plant materials, meeting the specifications, have been secured.
 - 2. Include plant name, quantity, size, condition, and name of supplier.
 - 3. Submit certification letter from the sod supplier(s) stating the sod has been secured or contracted for delivery. Include the quantity, grass mix, and description.
- E. Product Data: Submit manufacturer's printed data for products and a list of suppliers.
- F. Sample: Submit a 2 quart sample of Soil Material with supplier's name and specific location of source. Approval of Soil Material by Landscape Architect is required prior to delivery to the site.
- G. Invoices: Within 2 days of delivery submit invoices, load tickets, and truck measures for Organic Material and Mulch.

1.07 QUALITY ASSURANCE

- A. Valid Oregon Landscape Contractor's license.
- B. Valid Oregon Landscape Business license.
- C. Herbicide applicators must have valid State of Oregon Herbicide Applicator's license.
- D. Installer Qualifications: Company specializing in installing and planting the plants with 5 projects of comparable scale successfully completed.
 - 1. Submit names, addresses, and dates of previous projects, owners.

1.08 COORDINATION

- A. Coordinate with other trades affecting and affected by Work of this Section.
- B. Pre-Installation Conference: Attend conference to coordinate Work of this Section and other related Sections.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- B. Protect and maintain plant life until planted.
- C. Deliver plant life materials immediately prior to placement. Keep plants moist.
- D. Deliver products in original unopened packaging with legible manufacturer's identification.
- E. Seed containers shall show manufacturer's guaranteed analysis of seed mixture, percentage of purity, year of production, date and location of packaging, name and trademark, and conformance with governing regulations.
- F. Plants may be rejected if:
 - 1. Ball of earth surrounding roots has been dried out, cracked, or broken.
 - 2. Burlap, staves, wire baskets, or ropes required in connection with transplanting have been displaced.
 - 3. Grower or nursery identification labels have been displaced prior to acceptance.

1.10 ENVIRONMENTAL CONDITIONS

- A. Do not install plant life and seed when ambient temperatures is below 32 degrees F or above 90 degrees F.
- B. Do not install plant life when wind velocity exceeds 30 mph.

- C. Do not install plant life when soil becomes saturated.
- D. Install plant materials and seed during periods which are normal for such work as determined by the following:
 - 1. Biological season
 - 2. Specified environmental conditions
 - 3. Accepted practice
 - 4. After all major construction work has been completed
- E. Planting Seasons:
 - 1. Trees: Bare root trees may be planted only between January 15th and March 15th unless otherwise approved.
 - 2. Seeding: Permitted between April 15 and October 15 unless otherwise approved.
 - 3. Other: Permitted during any period, except when prohibited by other portions of this Section.

1.11 REVIEWS

- A. Request the following reviews by the Landscape Architect 2 days in advance:
 - 1. Subgrade preparation
 - 2. Soil Material placement
 - 3. Organic Material placement
 - 4. Finish grading
 - 5. Accent Stone mock-up
 - 6. Accent Stone placement review
 - 7. Plant materials
 - 8. Plant material layout
 - 9. Planting mock-up
 - 10. Completion
- B. See Part 3 - Execution for review requirements.
- C. Coordinate all reviews to coincide with regular progress meetings where possible.

1.12 RECORD DOCUMENTS

- A. See Section 01 7800 - Closeout Submittals
- B. Produce, keep current, and submit legible record documents on a clean set of plans and details supplied by the Landscape Architect. Use white-out and red ink to legibly re-draft actual locations of installed work.

1.13 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide one year warranty following Final Completion or one full growing season following Final Completion, whichever is later.
- C. Replacements: Plants of same size and species as specified, planted in the next growing season, with a new warranty commencing on date of replacement.
- D. Inspection: Visit work at least once a month during warranty period. Notify Landscape Architect and Owner in writing of any observed conditions requiring attention. Failure to provide such notification renders any deficiencies the Contractor's responsibility to rectify.
- E. At the end of the warranty period, as directed by Landscape Architect and at no additional cost to the Owner:
 - 1. Replace work not surviving, in poor condition, or not exhibiting satisfactory growth.
 - 2. Lawns must be healthy, dense, uniform, well sodded, and reasonably weed free as judged by the Landscape Architect
 - 3. Reset plant materials and stones which have settled or become un-set
 - 4. Replace plant materials which appear to be a different species or variety than specified.

5. Provide noxious weed eradication from imported Soil Material, if required and as specified herein.
 6. Complete warranty work within 30 days of warranty review.
- F. Contractor is not responsible for plant loss or damage to work during warranty period which is caused by unusually extreme weather, vandalism, or Owner's lack of maintenance.

PART 2 PRODUCTS

2.01 PLANTS

- A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.
- B. General:
1. Sizes, grades, and conditions are listed on Plant List. Quantities are shown for Contractor's convenience. Contractor is responsible for providing plants drawn on drawings.
 2. Cold storage stock unacceptable.
 3. Free of disease, decay, injury, insects, or indication of strawberry root weevil.
 4. Full foliated when in leaf.
 5. Furnish balled and burlapped (B&B) stock with solid, properly wrapped and secured, natural ball. Stock 2 inch caliper and up to be transported and handled with root ball in wire basket.
 6. Furnish container stock with sufficient roots to insure healthy growth but not root bound. When plant is removed from container soil must hold together and roots must be visible but not encircling.
 7. Free from Weeds.
 8. Field grown trees and shrubs must have been transplanted or root pruned at least once no more than two years prior to this Contract.
 9. Container stock may be substituted for Balled and Burlapped (B&B) stock at any time.
- C. Trees shall have:
1. Single, straight, uniformly tapering trunks which are perpendicular to the ground, unless specified as multi-stemmed or otherwise on Plant List. Trees with co-dominant, damaged, crooked, or topped leaders will be rejected.
 2. Healthy and vigorous overall condition.
 3. Full and even branch distribution; structural scaffold branches at least 4 inches apart where they attach to the main trunk.
 4. Well developed root systems. Trees with more than 2 inches of root ball soil covering root flare will be rejected.
 5. Grafts near ground level.
 6. Minimum/maximum branching heights above the ground unless specified otherwise on Plant List:
 - a. 2 inch caliper tree: 5' - 7'
 - b. 1.5 inch caliper tree: 4' - 6'
 7. Conifers shall also have full, even branching to ground level and intact single leader.
 8. Trees shall be free of:
 - a. Major structural defects including, but not limited to, branches with narrow angle of attachment (less than 40 degrees to the trunk), bark with major branch unions, and trees with co-dominant leaders.
 - b. Poor pruning practices including, but not limited to, stubbed branches and topped leader.
 - c. Damage to the trunk, branches, and root system including, but not limited to, bark abrasions, sun scald, and disfiguring knots.
 9. Trees shall be freshly dug during the most recent favorable harvest season.

2.02 RAISED GARDEN BEDS

- A. Recycled Plastic Raised Garden Beds by eartheasy.com
1. Size: 4 ft width x 8 ft length x 16.5 in height.

2.03 SOIL MATERIALS

- A. Planting Soil: On-site soil, natural, fertile, friable, with at least 10% humus; free of rock, clay, subsoil, clods, lumps, plants, roots, sticks, weeds, seeds, and other deleterious material, as approved.
 - 1. At Plant Beds:
 - a. Excavated from site. Stock piled off site.
 - b. Primary Planting Soil by Rexius Forest By-Products, Eugene, Oregon.
 - c. Frugal Planting Soil by Lane Forest Products, Eugene, Oregon.
 - 2. At Lawns, Eco Lawns, Meadow, and Wet Prairie:
 - a. Excavated from site. Stock piled off site.
 - b. Imported, natural, fertile, friable, sandy loam with at least 10% humus; free of rock, clay, subsoil, clods, plants, roots, sticks, weeds, seeds, and other deleterious material including any evidence of horsetail.
 - 3. At Vegetable Gardens:
 - a. Imported, all-organic, friable soil blend free of rock, clay, subsoil, plants, roots, sticks weeds, seeds, and other deleterious material, including evidence of horsetail.
 - b. Pro-Organic Mix by Everwood Farm, Brooks, Oregon.
 - c. Flower-n-Garden Planting Soil by Rexius Forest By-Products, Eugene, Oregon.
 - d. Nature's Best Soil by Lane Forest Products, Eugene, Oregon.
- B. Infield Soil
 - 1. 60% Drainage Sand
 - a. Imported, clean, meeting the requirements of ODOT Standard Specifications (current edition) 02630.
 - b. Approved product: Fazio Columbia River Sand
 - c. Sieve Analysis (or approved equal)

US Standard Sieve Mesh	Diameter of Seve (mm)	Allowable Range % Retained on Individual Sieve	Allowable Range % Passing on Individual Sieve
#4	4.75 mm	0%	100%
#10	2 mm	<5%	90-100%
#30	0.6 mm	>20%	30-75%
#60	0.25 mm	<40%	15-30%
#100	0.15 mm	<15%	0-20%
#200	0.05 mm	<5%	0-5%

- 2. 20% Silt
- 3. 20% Clay
- C. Infield Topdressing
 - 1. Ballfield Pumice - South Chemult
 - a. Supplier: Rexius Forest By-Products (541) 342-1835

2.04 SOIL AMENDMENT MATERIALS

- A. Lawn Installation Fertilizer: Uniform composition, dry, and free flowing of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:
 - 1. Nitrogen: 16 percent. (source of Nitrogen to be methyl-urea based)
 - 2. Phosphoric Acid: 16 percent.
 - 3. Soluble Potash: 16 percent.
 - 4. Do not use within 50 feet of water.
- B. Lawn Maintenance Fertilizer: Uniform composition, dry, and free flowing of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:
 - 1. Nitrogen: 25 percent. (30% Nitrogen from slow release)
 - 2. Phosphoric Acid: 5 percent.

3. Soluble Potash: 10 percent.
 4. Do not use within 50 feet of water.
- C. Plant Bed Maintenance Fertilizer: Uniform composition, dry, and free flowing of proportion necessary to eliminate any deficiencies of topsoil, to the following proportions:.
1. Nitrogen: 16 percent. (Source of Nitrogen to be methyl-urea based)
 2. Phosphoric Acid: 16 percent.
 3. Soluble Potash: 16 percent.
 4. Do not use within 50 feet of water.
- D. Planting Tablets:
1. Product: Sierra Chemical "Agriform" with 20-10-5 chemical analysis.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Micorrhizal Fungi:
1. MycroApply® All Purpose Granular by Micorrhizal Applications Inc, Grants Pass, Oregon (541-476-3985).
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Water: Clean, fresh, and free of substances or matter that could inhibit vigorous growth of plants.
- G. Organic Material: 100% organic materials following guidelines and tested to meet the US Composting Council's seal of testing assurance.
1. Products: Garden Compost by Rexius Forest Byproducts, Eugene, Oregon.
- H. Top Dressing: Turf Start by Rexius Forest Byproducts, Eugene, Oregon, or approved.

2.05 ACCENT STONES

- A. Clean, hard, durable rounded river stones, with no broken fragments, in a range of natural colors. Provide accent stones from a single source in the Willamette Valley. Provide color photo indicating sample of eight accent stones of assorted colors, indicating source of material. Provide accent stones in the following four 4 distinct sizes:

	<u>Length</u>	<u>Width</u>	<u>Height</u>
Large	36-42 inches	24-30 inches	18-24 inches
Medium	24-30 inches	18-24 inches	12-18 inches
Small	10-14 inches	10-14 inches	10-14 inches
Extra Small	6-8 inches	4-6 inches	5-6 inches

- B. Approved Suppliers:
1. Oakridge Quarry, Berry St. Oakridge, Oregon.

2.06 GRASS SEED

- A. Certified Oregon Blue Tag Free of Weed seed with dealer's statement analysis guarantee.
- B. Current or latest season's crop labeled in conformance with State and US Department of Agriculture laws and regulations:
1. Purity: 98% by weight
 2. Germination: 90%
- C. Products:
1. Lawn Seed:
 - a. Futura 3000 by Pickseed, Tangent, Oregon
 2. Eco Lawn Seed:
 - a. Pro-Time 705 PDX Ecology Mix by Hobbs and Hopkins, Portland, Oregon.
 3. Meadow Seed:
 - a. Pro-Time 460 Low Profile Wildflower Mix by Hobbs and Hopkins, Portland, Oregon.

2.07 MULCH MATERIALS

- A. Mulching Material at Plant Beds: Hemlock species wood shavings, free of growth or weeds, "sliver free".
 - 1. Products: Hemlock Bark by Rexius Forest Byproducts, Eugene, Oregon.
- B. Mulching Material at Play Area and Vegetable Garden (walking surface only): Random-sized engineered wood fibers, in manufacturer's fiber size, approximately 10 times longer than wide; containing no bark, leaves, twigs, or foreign or toxic materials according to ASTM F 2075; graded according to manufacturer's standard specification for material consistency for playground surfaces and for accessibility according to ASTM F 1951 .
 - 1. Products:
 - a. Fiberex by Rexius Forest By-Products, Eugene Oregon.
 - b. Fibar by Fibar Group LLC, Armonk NY.
- C. Mulch Material at Tree Grates: Gravel

2.08 ACCESSORIES

- A. Wrapping Materials: Burlap.
- B. Stakes: 2 x 2 inch x 8 feet wood stakes, capable of at least 2 years ground burial, stained charcoal or black.
- C. Tree Ties: Chain lock tree ties, 1 inch wide, or approved.

2.09 SOURCE QUALITY CONTROL

- A. Provide analysis of Soil Material; comply with requirements of Section 01 4000.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to installation of Work of this Section, carefully inspect the work of others and verify that such work is complete to the point where this installation may properly commence.
- B. Verify that materials and surfaces to receive work specified herein are accurately sized, shaped, and located; sound, secure, true, complete, and otherwise properly prepared.
- C. Verify subgrades produce positive drainage and allow for placement of Soil Material, Ammendments, and Mulch to specified depths.
- D. Do not install Work of this Section until all unsatisfactory conditions have been corrected. Beginning Work of this Section signifies acceptance of existing conditions.

3.02 TOLERANCES

- A. Perform earthwork true to lines and grades, and to prevent ponding of water, with maximum variation in elevations of +/- 1/2 inch at subgrades and +/- 1/4 inch at finish grades.
- B. Compacted thickness of materials within 1/4 inch of specified thickness.

3.03 PLACING SOIL MATERIAL

- A. Soil Placement Schedule:
 - 1. At Plant Beds: 18 inches minimum depth.
 - 2. At Vegetable Gardens: 18 inches minimum.
 - 3. At Lawns: 9 inches minimum depth.
 - 4. At Eco Lawn Fire Lane and Reinforced Lawn: As detailed.
 - 5. At Wet Prairie: 9 inches minimum depth.
 - 6. At Grassy Swales: 9 inches minimum depth.
 - 7. Place additional Soil Material as required to establish finish grades shown on drawings and to fill in depressions, blend grades, and produce positive drainage.
- B. Place Soil Material during dry weather and on dry unfrozen subgrade. Suspend Soil Material placement if subgrade or Soil Material become saturated.

- C. Phase Soil Material placement so that equipment does not travel over Soil Material already installed.
- D. Place Soil Material in a relatively dry state to depths specified at locations shown on Drawings:
 - 1. Remove stones, roots, grass, weeds, debris, and foreign material while spreading.
 - 2. Manually spread around existing trees, paving, and other structures to prevent damage.
 - 3. Establish levels, profiles, slopes, contours, and uniform gradients between given grade points as shown on Drawings.
 - 4. Eliminate uneven or low spots at lawns and plant beds.
 - 5. Fine grade Soil Material within specified tolerances.
- E. Notify Landscape Architect for Soil Material Placement Review prior to proceeding with Work.

3.04 INFIELD SOIL PLACEMENT

- A. See Drawings to identify areas with Skinned Infield for Infield Soil Placement.
- B. At areas designated for Infield Soil Placement: Verify debris, sticks, roots, clods, stones, and foreign material have been removed. Eliminate uneven areas or low spots in subsoil.
- C. Subgrade Preparation Review: Owner's Representative will review subgrades for adequate preparation. Make adjustments as directed before proceeding.
- D. Scarify subgrade to a depth of 6" prior to placing Infield Soil. Do not allow the subgrade to become compacted after scarifying.
- E. Infield Soil Placement Schedule:
 - 1. Place 6" Infield Soil.
 - 2. Set final grades to allow for final grades of Infield Topdress.
- F. Phase Infield Soil placement so that equipemnt does not travel over Soil already installed.
- G. Suspend Infield Soil placement if subgrade or Infield Soil become saturated.
- H. Place Infield Soil in a relatively dry state, to depths specified and at locations shown on Drawings:
 - 1. Remove stones, roots, grass, weeds, debris, and foreign material while spreading.
 - 2. Manually spread around existing paving, and other structures to prevent damage.
 - 3. Establish levels, profiles, slopes, contours, and uniform gradients between given grade points, as shown on Drawings.
 - 4. Eliminate uneven or low spots.
 - 5. Fine grade Infield Soil within specified tolerances eliminating rough or low areas.
- I. Infield Soil Placement Review: Owner's Representative will review Infield Soil placement and rough grading. Make adjustments as directed before proceeding.

3.05 INFIELD TOPDRESS

- A. See Drawings to identify areas within Skinned Infield.
- B. At areas designated Skinned Infield work: verify that debris, sticks, roots, clods, stones, and other foreign material have been removed. Eliminate uneven areas or low spots in Infield Soil.
- C. Infield Topdress Placement Schedule:
 - 1. At Skinned Infield areas: Place 1-1/2" Topfield Dressing.
 - 2. Establish levels, profiles, slopes, contours, and uniform gradients between given grade points, as shown on Drawings.
 - 3. Eliminate uneven or low spots.
 - 4. Fine grade within specified tolerances eliminating rough or low spots.
- D. Infield Topdress Placement Review: Owner's Representative will review Infield Soil placement.

3.06 INITIAL WEED CONTROL

- A. Inspect plant beds, lawns, meadows, eco lawn, wet prairie, and grassy swale for the presence of weeds. If weeds are present manually remove.

3.07 SOIL PREPARATION AND FINISH GRADING

- A. Remove debris, sticks, roots, clods, stones, and soils contaminated by petroleum products at plant beds and lawns. Rake smooth, eliminate uneven areas or low spots in Soil Material, and set grades for positive drainage.
- B. At plant beds:
 - 1. Manually remove weeds as described in Initial Weed Control.
 - 2. Spread 3 inches Organic Material over entire plant bed. Organic Material must be incorporated immediately into plant beds, no stock piling is permitted.
 - 3. Notify Landscape Architect for Organic Material Placement Review prior to proceeding with tilling and planting.
 - 4. Thoroughly rototill Organic Material into the top 6 inches of Soil Material, except within 10 feet of existing trees and Tree Protection zones where plants will be pocket planted.
 - 5. Rake smooth and reset finish grades eliminating uneven or low spots in plant beds and setting grades for positive drainage. Ensure grades at edges of plant beds allow for placement of Mulch Material to specified depths and as detailed.
- C. At trees:
 - 1. Thoroughly mix 5 parts Soil Material and 1 part Organic Material for backfilling trees.
- D. At lawns, eco lawns, meadow, grassy swales, and wet prairie:
 - 1. Manually remove weeds as described in Initial Weed Control.
 - 2. Spread Lawn Installation Fertilizer at the rate of 15 lbs per 1000 square feet. If a Terraseeding method is used for lawn installation do not apply Lawn Installation Fertilizer.
 - 3. Rototill to a minimum depth of 4 inches, except within 10 feet of existing trees and Tree Protection zones.
 - 4. Set finish grades to ensure that finish grade of lawn will be flush with surrounding surfaces.
 - 5. Establish a friable, fine textured seed bed free of bumps and depressions immediately before seeding.
 - 6. Firm seed bed with a lawn roller making passes in 2 directions.
- E. At eco lawn fire lane:
 - 1. Manually remove weeds as described in Initial Weed Control.
 - 2. Establish a friable, fine textured seed bed free of bumps and depressions immediately before seeding.
 - 3. Spread Lawn Installation Fertilizer at the rate of 15 lbs per 1000 square feet. If a Terraseeding method is used for eco lawn installation do not apply Lawn Installation Fertilizer.
- F. At lawn repair areas:
 - 1. Manually remove weeds as described in Initial Weed Control.
 - 2. Place additional Soil Material as necessary to fill in depressions and blend grades with surrounding lawns, plant beds, and paving.
 - 3. Set finish grades to ensure that finish grade of lawn will be flush with surrounding surfaces.
 - 4. Establish a friable, fine textured seed bed free of bumps and depressions immediately before seeding.
 - 5. Firm seed bed with a lawn roller making passes in 2 directions.
 - 6. Spread Lawn Installation Fertilizer at the rate of 15 lbs per 1000 square feet. If a Terraseeding method is used for lawn installation do not apply Lawn Installation Fertilizer.
- G. Notify Landscape Architect for Finish Grading Review prior to proceeding with Work.

3.08 ACCENT STONE PLACEMENT

- A. Install Accent Stones where shown on Plans. Make minor adjustments to accommodate irrigation, planting, and other site elements.
- B. Notify Landscape Architect at least 2 days prior to commencement of Accent Stone Placement.
- C. Accent Stone mock-up and stone layout review:

1. Landscape Architect will provide on-site aesthetic direction for Stone placement to establish design intent. Acceptable mock-up represents expected quality level of the remaining stone installation and may remain as part of Work.
 2. Stake locations of Stones, using irrigation flags of contrasting colors for each Stone size.
- D. Install Accent Stones in the following sequence:
1. Large
 2. Medium
 3. Small
 4. Extra Small
- E. Nest Accent Stones into Soil Material or Concrete as detailed. In general, Stones should be installed based on the following, in order of importance:
1. Horizontal rather than vertical
 2. Wider at the ground than at the top so the Stone appears to grow out of the soil.
 3. Flatter surface on top, positioned for seating opportunity.
- F. Notify Landscape Architect for Accent Stone Placement Review.

3.09 SECOND WEED CONTROL

- A. After completion of Soil Preparation and finish grading commence irrigation of all plant beds, lawns, and erosion control grass areas. If weeds are present manually remove.

3.10 INSTALLATION OF PLANT MATERIAL

- A. Plant Material Review: Notify Landscape Architect prior to the delivery of all trees and plant materials to the site but prior to installing plants. Landscape Architect will review quality of plant materials and reject plant materials not in compliance the the Plant List and Specifications. This review is preliminary. Final approval of plants materials will not be given until Completion Review.
- B. Plant Material Layout Review: Layout plant material (in containers or B&B) at plantbeds for review prior to installation. Notify Landscape Architect for review of plant material layout prior to commencement of planting. The plant material layout review may occur concurrently with the planting mock-up review. Adjust plant materials as directed.
- C. Planting Mock-Up Review: Notify Landscape Architect prior to commencement of planting. Install an initial 500 square feet sample of typical plantings for review. Adjust planting procedure as directed.
- D. Tree Planting:
1. Soak container grown, B&B, and BR plants before planting.
 2. Remove extra soil on top of root ball to expose flare of first buttress root. Root flare must be visible at top of root ball.
 3. Dig individual planting holes circular with vertical sides as shown on Planting Detail.
 4. Save and thoroughly loosen soil removed from planting hole and use as backfill around tree. Backfill trees with specified mixture if additional Soil Material is needed.
 5. Sprinkle micorrhizal fungi to surface of planting holes at rate of 2-4 ounces per inch of stem caliper.
 6. Lift trees by wire basket only. Do not lift trees by trunk or use trunk as a lever to position or move tree.
 7. Set B&B trees in the hole with the north marker facing north unless otherwise approved.
 8. Set root crown as shown on Planting Detail not less than 3 inches above surrounding finish grade.
 9. Cut and completely remove twine and other fasteners from root ball. Remove burlap from top half of root ball. Remove all burlap if not biodegradable. Neatly cut off broken or frayed roots.
 10. Remove top half of wire basket after planting.
 11. Stake trees as shown on Planting Detail.
- E. All other Plants:

1. Soak container grown, B&B, and BR plants before planting.
 2. Dig individual planting holes with circular and with vertical sides 1-1/2 inch shallower than depth of root ball.
 3. Dig holes for pocket-planted shrubs 3 times the diameter of the rootball.
 4. Sprinkle micorrhizal fungi to surface of planting holes at the following rates:
 - a. #SP4 container - 1 tablespoon
 - b. #1 container - 2 tablespoons
 - c. #3 container - 3 tablespoons
 - d. #5 container - 5 tablespoons
 5. Install Planting Tablet at shrubs and ground covers at manufacturer's recommended high rate.
 6. Cut circling roots with a sharp knife.
 7. Set root crowns 1-1/2 inch above surrounding grade and as detailed.
- F. Plants set too deeply will be rejected. Reset plants that have settled.
- G. Set Plants plumb and for best appearance.
- H. Carefully tamp soil under and around root balls and bare roots to prevent settlement.
- I. Backfill pocket-planted plants with equal parts Soil Material and Organic Material.
- J. Flood hole when half backfilled and tamp soil between bare roots.
- K. Complete backfilling and tamp soil between bare roots.
- L. Thoroughly water each plant and entire bed immediately after planting.
- M. Remove all tags, labels, strings, etc. from plants.
- N. Prune Plant Material to remove dead, broken, or damaged branches.
- O. Rake plant beds smooth, resetting finish grades for positive drainage and eliminating uneven or low spots.
- P. Bulb Planting:
1. Dig individual holes to the depth, size, and spacing scheduled on the Plant List.
 2. Place one teaspoon of Installation Fertilizer and work into soil. Place bulb and backfill soil.
 3. Cover entire area shown on Drawing as Mulch Area with Perennial Bulbs with 3 inches Organic Material as a mulch.

3.11 MULCH INSTALLATION

- A. Install 3 inch minimum depth Mulch within 24 hours after planting at plant beds and trees as shown on drawings and details.
- B. Remove excess Mulch from foliage of plant materials and from bark of trees. Mulch must not be placed within 3 inches of tree trunks. Remove mulch from adjacent surfaces and produce edges shown on Details.

3.12 LAWN, ECO LAWN, MEADOW, GRASSY SWALES, AND WET PRAIRIE INSTALLATION

- A. Install lawns, eco lawn, meadow, grassy swales, and wet prairie using one of the following methods
 1. Hand seeding:
 - a. Apply seed evenly at rate of 6 lbs at lawns per 1000 square feet and 16 lbs per acre at eco lawn, meadow, and wet prairie.
 - b. Apply Lawn Installation Fertilizer at a rate of 15 lbs per 1000 square feet.
 - c. Rake lightly to a depth of 1/16 inch.
 - d. Roll seeded area with half full lawn roller.
 - e. Apply approved mulch as necessary to keep areas moist during germination.
 2. Hydroseeding:
 - a. Mix components at the following rates and apply uniformly and completely:
 - 1) Seed: 8 lbs per 1000 square feet at lawns and 16 lbs per acre at eco lawn, meadow, and wet prairie

- 2) Lawn Installation Fertilizer: 15 lbs per 1000 square feet
- 3) Sufficient hydromulch to keep areas moist during germination and protect seed from wind erosion.
- b. Ensure all equipment, including hoses, is clean and contains only the specified seed.
3. Terraseeding:
 - a. Apply a 1 inch layer of Top Dressing injected with the following:
 - 1) Seed: 8 lbs per 1000 square feet a lawns or per manufacturer's specifications and 16 lbs per acre at eco lawn, meadow, and wet prairie.
 - 2) Lawn Installation Fertilizer: 15 lbs per 1000 square feet.
 - b. Do not install Top Dressing within mulch circles at trees.
- B. Apply water with fine spray immediately after each area is sown.

3.13 TREE PRUNING

- A. Perform pruning of trees as recommended in ANSI A300.
- B. Prune newly planted trees as required to remove dead, broken, and split branches.

3.14 MAINTENANCE

- A. At Plant Beds during period between installation and Final Completion:
 1. Water, fertilize, weed, reset unstable or disturbed plants, and perform other maintenance necessary to assure healthy growth.
 2. Install Plant Bed Maintenance Fertilizer at a rate of 6 lbs per 1000 square feet 45-60 days after installation. Adjust timing for seasonal requirements of plant materials.
 3. Thoroughly water immediately after applying Plant Bed Maintenance Fertilizer.
 4. Repair and regrade erosion damage .
 5. Provide continued weed control and removal until any weed problem is fully eradicated.
- B. At lawns during period between installation and Final Completion:
 1. Water, weed, mow, reseed, top dress, and fertilize as necessary to establish a healthy, dense, uniform, weed free stand of grass; maintain at 2 inches high. This includes unirrigated lawns, unless otherwise noted on drawings.
 2. Conduct first mowing after grass is firmly rooted and secure. Mow grass when it exceeds 2 inches in height, cutting no more than 1/3 of the grass height at a time. Remove all clippings.
 3. Maintain surfaces and supply additional Soil Material and Seed where necessary.
 4. After first mowing apply Lawn Maintenance Fertilizer at a rate of 8 lbs per 1000 square feet. Thoroughly water after application.
 5. Manually remove weeds.
- C. At eco lawn, meadows, grassy swales, and wet prairie between installation and final completion:
 1. Water, weed, mow, reseed, top dress, and fertilize as necessary to establish a healthy, dense, uniform, weed free stand of grass.
 2. Maintain surfaces and supply additional Soil Material and Seed where necessary.
 3. Manually remove weeds.

3.15 CLEANING

- A. Remove excess materials from site. Protect drain inlets and underground piping as necessary and clean improvements soiled by Work of this Section.

3.16 COMPLETION REVIEW

- A. Notify Architect for Completion Review when Work of this Section is complete.

END OF SECTION

**SECTION 33 1000
WATER UTILITIES**

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. Private on-site water distribution system improvements, including domestic system and fire distribution system.

1.03 WORK INCLUDED BUT SPECIFIED IN OTHER SECTIONS

- A. Section 31 2333 - Trenching and Backfill
- B. Section 32 8000 - Irrigation

1.04 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.05 REFERENCED SPECIFICATIONS

- A. ASTM Standards (current edition)
- B. AWWA Standards (current edition)
- C. NFPA Standards (current edition)

1.06 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, and fabrication information.
 - 1. Submit for: Pipe materials and fittings, valves, valve boxes, fire hydrants, fire department connection, backflow preventers, backflow preventer vaults and enclosures, irrigation well vault, valve position indicator, and sump pump.
 - 2. Contractor shall provide the Architect with 6 sets of shop drawings complying with Eugene Fire Department private water system review checklist. After Architect's review, submit three copies of shop drawings to Fire Department for review and approval. Shop drawings shall incorporate all information required by the private water system review checklist including, but not limited to, the following: pipe sizes, materials, locations, depth of bury; fire hydrant types and locations; fire department connection types and locations; indicate pipe restraint type (thrust blocking or mechanical joint restraint), size, and locations.
- C. Field Quality Control submittals as specified in Part 3 of this Section:
 - 1. Field Tests
 - 2. Special Inspections for Code Compliance
- D. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.07 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original, unopened packaging with legible manufacturer's identification.

- B. Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.09 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section.

1.10 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 DOMESTIC WATER AND FIRE PROTECTION WATER PIPE AND FITTINGS (4 INCH AND LARGER) (UNLESS OTHERWISE NOTED)

- A. Polyvinyl Chloride Plastic Pipe:
 - 1. Pipe: PVC, AWWA C900 (4" to 12"), .AWWA C905 (14" to 16"), DR 18.
 - 2. Fittings: Gray or Ductile iron, mechanical joint, conforming to AWWA C110 or AWWA C153, with exterior asphaltic seal coat and cement mortar lining per AWWA C104 or Fusion Bonded Epoxy in accordance with AWWA C116.
 - 3. Joints:
 - a. Unless otherwise specified: Gasket, push-on joints unless otherwise specified, conforming to ASTM D3139.
 - b. Mechanical Joints: AWWA C110, with gasket joints per AWWA C111 and corrosion resistant bolts.

2.02 DOMESTIC WATER, RAINWATER SUPPLY, AND IRRIGATION MAKEUP WATER PIPE AND FITTINGS (3 INCH AND SMALLER) (UNLESS OTHERWISE NOTED)

- A. Polyvinyl Chloride Plastic Pipe:
 - 1. Pipe: PVC Schedule 40, ASTM D1784.
 - 2. Fittings: PVC, ASTM D1784 and D2466.
 - 3. Joints: Solvent-cemented, in accordance with ASTM D2564.

2.03 IRRIGATION BLOWOFF WATER AND DOMESTIC WATER PIPE AND FITTINGS (1½ INCH AND SMALLER)

- A. Steel Pipe:
 - 1. Pipe: Schedule 40 black steel, ASTM A 53, Grade B.
 - 2. Fittings: Malleable iron, class 150, ANSI B 16.3.
 - 3. Joints: Screwed.

2.04 GATE VALVES FOR DOMESTIC AND FIRE PROTECTION SYSTEMS

- A. Shall be iron body, class 125, flexible wedge disc, non-rising stem, stuffing box repackable under pressure, UL listed and FM approved, fire protection system only, rated working pressure of 150 psi minimum and conforming to AWWA C515-01. Crane, Kennedy, or Grinnell. Similar to Kennedy Model 7561 or Kennedy Model 7572.

2.05 CHECK VALVES (3 INCH AND LARGER)

- A. Type shall be swing with renewable composition seat and iron disc. Body shall be iron or bronze with bronze trim and bolted bonnet. Class 125, rated working pressure 125 psig steam minimum; 200 psig WOG. UL listed, FM approved. Manufacturer: Crane, Grinnell, Nibco, Powell, or Hammond.

2.06 VALVE BOXES

- A. Cast iron conforming to ASTM A48 (latest revision), rated for H20 traffic loading, with a rust protective coating; cover marking "water"; bury depth as required on drawings. Olympic Foundry, Inc. VB910.

2.07 YARD HYDRANT

- A. Automatic draining, frost-proof / pollution-proof yard hydrant with ASSE 1052 double check backflow preventer, diverter spout, and 1-inch N.P.T. female inlet. Hydrant to have hose connection outlet and working pressures of 20 psi minimum, 100 psi maximum. Hydrant shall

meet ADA requirements for height and 5 lbs maximum operating force. Woodford Model S4H or approved equal.

2.08 FIRE DEPARTMENT CONNECTION

- A. Shall be double clapper, 2-way, 90 degree Siamese inlet; rough brass; two 2-1/2 inch inlets, one 6 inch outlet; brass caps with chains, National Standard Threads threads conforming to local fire department; UL listed, FM approved, and conforming to City standards. Designated "AUTO SPRINKLER". Contractor to verify manufacturer with Fire Marshal.

2.09 BACKFLOW PREVENTERS

- A. Fire Protection System:
 - 1. Double check detector backflow preventer, 6 inch, maximum working pressure of 175 psi, with OS&Y valves, UL listed and FM approved. Febco, Ames, Watts or approved (meeting EWEB requirements). Provide with watertight plugs or caps on test cocks. Provide without detector meter.
 - 2. Chain and Lock: Chain valves in open position with galvanized chain and padlock.
- B. Domestic Water System:
 - 1. Reduced pressure backflow preventer, 3 inch, maximum working pressure of 175 psi, with OS&Y valves, UL listed. Febco, Ames, Watts, or approved meeting EWEB requirements.

2.10 BACKFLOW PREVENTER VAULT (BELOW GRADE)

- A. Vault:
 - 1. Vault: Precast reinforced concrete vault per ASTM C-875, rated for H20 traffic loading, size appropriate to selected backflow preventer and conforming with details, joints and openings grouted watertight, Utility Vault, Hanson, or approved.
 - 2. Ladder: Provide galvanized ladder meeting OSHA requirements and capable of extending 42 inches above top of vault. Ladder to be permanently mounted when vault depth exceeds 4 feet.
 - 3. Access Hatch: Galvanized hinged access hatch, 3' ± by 6' ± minimum opening size, traffic rated for H20 loading, locking latches, spring assisted doors. Access hatch shall factory-applied non-skid coating on all metal surfaces exposed to traffic.
- B. Permanent Dewatering System - Sump Pump:
 - 1. Sump Pump:
 - a. Type: Submersible.
 - b. Motor: Oil filled, built-in auto reset overloads.
 - c. Bearings: Permanently lubricated.
 - d. Impeller: Bronze no-clog.
 - e. Seal: Mechanical
 - f. Controls: Built-in, internal control system. Set "on" level at 7 to 10 inches above sump floor and one high water alarm float.
 - g. Cord: 3-wire with 3-prong grounded plug, 10-foot long.
 - h. Power / Power Supply: 1/3 HP, 120 volt, 1-phase.
 - i. Capacity: 20 gpm at 22 ft total head
 - j. Manufacturer: Hydromatic, Paco, Little Giant, or approved.
 - k. Refer to Electrical for power, receptacle, and connections.
 - 2. Discharge Piping:
 - a. Routing: Route piping from sump pump discharge through vault, holding tight to sides of vault. Extend piping through vault side through a weep hole to be drilled through the nearest curb on site as detailed on drawings.
 - b. Pipe: 2" diameter PVC Schedule 40 per ASTM D1784 with solvent cement joints.
 - c. Check Valve / Union: Thermoplastic industrial ball check type manufactured per ASTM F 1970, Spears True Union 2000 or approved. Locate valve 12-18 inches above pump discharge elevation or as recommended by pump manufacturer.
- C. Temporary Dewatering System:
 - 1. Provide temporary dewatering of vault until permanent dewatering system is installed.

- D. Vault High Water Alarm:
1. Float Switch: Corrosion resistant, high impact float switch with normally closed contacts, SJE Signal Master or approved. Set float switch at 18 inches above vault floor. Provide waterproof junction box mounted within vault and provide additional float switch wiring as needed to reach alarm panel located inside building.
 2. Alarm Configuration: Install alarm panel at Custodial Room (Room A116), as shown on Electrical Drawings and connect float switch to alarm panel.
 3. Alarm Panel:
 - a. Volts: 120 VAC.
 - b. Enclosure: 6.4x5.3x5 inch, NEMA 4X, UV stabilized thermoplastic.
 - c. Alarm Horn: 88 decibels at 10-feet.
 - d. Alarm Beacon: UL Listed, Type 4x.
 - e. Auxiliary Alarm Contacts: 120 VAC, 5 amps max, 50/60 Hz with transformer and auxiliary dry contacts, beacon and alarm horn, NEMA 4X enclosure, SJE-Rhombus Tank Alert 4x or approved.
 - f. Manufacturer: SJE Rhombus or approved.
 4. Wiring and Connections: Electrical contractor to provide power and connections. All electrical work shall comply with Division 26, and shall be performed by a licensed Electrician.
 5. Signs: Provide engraved plastic signs conforming to Section 26 0553. Location and text of sign as follows.
 - a. Backflow Preventer Vault: Mount sign on inside of vault wall above float switch at a location visible from the access hatch. Sign text:
HIGH WATER ALARM FLOAT SWITCH TIED TO ALARM PANEL IN CUSTODIAL ROOM A116.
 - b. Alarm Panel: Mount sign below panel in a visible location. Sign text:
HIGH WATER ALARM (PUMP FAILURE): FIRE SERVICE BACKFLOW PREVENTER VAULT NEAR MAIN WATER SERVICE CONNECTION EAST OF HOWARD ELEMENTARY SCHOOL BUS DRIVEWAY.

2.11 IRRIGATION WELL VAULT (BELOW GRADE)

- A. Vault: Precast reinforced concrete vault per ASTM C-875, rated for H20 traffic loading, 8'Lx6'Wx6'H minimum size, joints and openings grouted watertight, Utility Vault, Hanson, or approved.
- B. Ladder: Provide galvanized ladder meeting OSHA requirements and capable of extending 42 inches above top of vault. Ladder to be permanently mounted when vault depth exceeds 4 feet.
- C. Access Hatch: Galvanized hinged access hatch, 3' ± by 6' ± minimum opening size, traffic rated for H20 loading, locking latches, spring assisted doors. Access hatch shall factory-applied non-skid coating on all metal surfaces exposed to traffic.

2.12 BACKFLOW PREVENTER ENCLOSURE (ABOVE GRADE)

- A. Reinforced aluminum enclosure, insulated. Minimum 18 ga. Construction, structural unicellular insulation minimum R value of 8, lockable, with thermostatically controlled heat source mounted on the interior wall for protection to -30°F. No bare wood or "particle board" allowed in assembly.
- B. Provide with drain openings for reduced pressure backflow preventer (RP) device sized to accommodate maximum device discharge.
- C. Enclosure shall be certified to meet ASSE 1060 "Performance Requirements for Outdoor Enclosures." Provide modular design series, size to accommodate selected backflow device and meeting City clearance requirements.
- D. Color to be selected by Architect from manufacturer's standard color list. Hot Box of Jacksonville, FL (800) 736-0238, or approved.

2.13 BALL DRIP

- A. Ball drip shall have brass body, inlet and outlet threads, and have automatic operation.

2.14 MECHANICAL JOINT RESTRAINT RESTRAINED JOINTS

- A. Mechanical Joints: At MJ Fittings: Ductile iron mechanical joint follower gland with restraining wedges secured to pipe by torque-limiting twist-off nuts. EBBA iron sales "Mega Lug" Series 2000 PV or Romac "Romagrip". At Push-on Joints: Clamp-ring and fire-bolt assembly with ductile iron ring and corrosion resistant bolts. Uni-flange series 1350.

2.15 CONCRETE

- A. Concrete shall be ready-mixed conforming to Section 03 3000, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1½ inches.

2.16 OTHER MATERIALS

- A. Recommended by Manufacturer and subject to Engineer's review and acceptance. Provide all materials required to complete and make water system operational.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to installation, carefully inspect trench, excavations and base to verify that all such work is complete to the point where this installation may properly commence.
- B. Do not install work of this Section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 TRENCHING AND BACKFILL

- A. Trenching and backfill shall conform to the requirements of Section 31 2333, TRENCHING AND BACKFILL.

3.03 PIPE INSTALLATION

- A. Installation shall be in accordance with the manufacturer's recommendations. All pipe ends and interiors shall be thoroughly cleaned of all foreign matter and shall be kept clean during installation. When work is not in progress, all open ends of pipe and fittings shall be securely closed so that no trench water, earth, animal life or other substance may enter.
- B. Cutting of pipe to be done in a neat and workmanlike manner by method which will not damage pipe and as recommended by manufacturer.
- C. Install piping within 0.02 feet of indicated grade and location.

3.04 THRUST BLOCKS AND MECHANICAL JOINT RESTRAINT

- A. Install at all changes of directions and fittings as shown on the drawings.
- B. Install mechanical joint restraint at fittings and pipe joints where indicated on drawings.

3.05 VALVES, FITTINGS AND CAPS

- A. Shall be set and joined to the pipe as shown on the drawings. All pipe shall be supported to prevent stress on valves. All dead ends shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure.

3.06 VALVE BOXES

- A. Shall be provided for every valve. Box shall be centered along axis of the operating nut of the valve and shall be set so as not to transmit shock or stress to the valve or valve operator. Keep box free of debris.
- B. Set rim flush with adjacent finished surfaces unless otherwise noted.

3.07 YARD HYDRANT

- A. Conform to Manufacture's installation recommendations
- B. Set plumb and square with adjacent construction.

3.08 FIRE DEPARTMENT CONNECTION

- A. Conform to referenced specifications AWWA Manual M17 and AWWA C600.
- B. Set fire department connection plumb and square with adjacent construction.

3.09 DOUBLE CHECK BACKFLOW PREVENTER AND VAULT

- A. Install on compacted gravel base, level, plumb, square with adjacent construction, with rim flush with adjacent surfaces in accordance with manufacturers recommendations. Chain gate valves in open position with galvanized chain and padlock. Comply with EWEB installation requirements.
- B. EWEB to provide and install detector meter on backflow preventer and remote reader in vault at property line. Coordinate vault requirements with EWEB. Coordinate work and schedule with EWEB.
- C. Construct drain line from vault through adjacent curb as a weephole as indicated on drawings. Locate drain so that drain extends level from vault to daylight.
- D. Manufactured pipe supports to be installed and adjusted appropriately to support backflow preventer at the required elevations.

3.10 IRRIGATION WELL VAULT (BELOW GRADE)

- A. Installation:
 - 1. Install on compacted gravel base, level, plumb, square with adjacent construction, with rim flush with adjacent surfaces in accordance with manufacturers recommendations.
 - 2. Construct filter drain line from vault to adjacent area drain as indicated on drawings.

3.11 REDUCED PRESSURE BACKFLOW PREVENTER AND VAULT

- A. Install on compacted gravel base, level, plumb, square with adjacent construction, with base flush with adjacent surfaces in accordance with manufacturer's recommendations.
- B. Manufactured pipe supports to be installed and adjusted appropriately to support backflow preventer at the required elevations.

3.12 WORK BY UTILITY COMPANY

- A. Initiate service, coordinate, and schedule water service, connection, meter installation, detector meter, remote reader, fire hydrant relocations, and new fire hydrant installation by EWEB.
- B. Owner to pay EWEB costs directly.

3.13 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 - 1. Hydrostatic tests as described below.
 - 2. Disinfection Tests.
- C. Field Inspections: Notify Engineer prior to work of this section.
- D. Special Inspections for Code Compliance:
 - 1. Test hydrostatically. All testing, acceptance, and documentation shall comply with Oregon State Plumbing Specialty Code (current edition) and NFPA and AWWA specifications as applicable.
 - 2. Prior to testing partially backfill or provide other means of restraint to prevent any movement during the test.

3. Observance: Plumbing inspector to observe domestic, mainline irrigation, and fire line testing. Fire Department to observe fire line testing. Contractor shall notify plumbing inspector and Fire Department at least 48 hours prior to testing.
4. Obtain plumbing inspector and fire marshal approvals and submit to Engineer.

3.14 FLUSHING AND DISINFECTION

- A. Flushing:
 1. Contractor shall flush and clean all parts of all completed system. All pipe and structures shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.
- B. Disinfection:
 1. Disinfect all domestic water supply piping and appurtenances in accordance with AWWA C651 and Oregon State Health Department requirements.
 2. Provide written certification from a firm specializing in disinfection that the disinfection has been successfully completed.
 3. Dispose of test water in accordance with all governing rules and regulations.

3.15 CLEANING

- A. Upon completion of the work of this section promptly remove from the working area all scraps, debris and surplus material.

3.16 PROTECTION

- A. Protect all Work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

SECTION 33 3000
SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. On-site private sanitary sewer system improvements.

1.03 WORK INCLUDED BUT SPECIFIED IN OTHER SECTIONS

- A. Section 31 2333 - Trenching and Backfill
- B. Section 33 3913 - Sanitary Utility Sewerage Manholes, Frames, and Covers

1.04 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.05 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, fabrication, and installation information.
 - 1. Submit for: Pipe, fittings, grease interceptor, and cleanout covers.
- C. Field Quality Control submittals as specified in Part 3 of this Section:
 - 1. Field Tests
 - 2. Special Inspections for Code Compliance
- D. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original, unopened packaging with legible manufacturer's identification.
- B. Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.08 ADVANCE NOTICE

- A. Notify Engineer at least 48 hours before starting work of this section.

1.09 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPE AND FITTINGS (6 INCH AND SMALLER)

- A. Shall be Polyvinyl chloride plastic pipe with rubber gasket joints. Manufacturing Standard: ASTM D-3034 (latest revision) SDR 35 for pipe sizes 6"-15" and ASTM F679 (latest revision) for pipe sizes 18"-24".
- B. Provide with manufactured fittings unless otherwise noted on drawings.

2.02 CLEANOUTS

- A. Shall be constructed from solid wall pipe and fittings specified above with locking traffic grade frame and cover. Frame and cover shall be H20 rated cast iron valve box as detailed on drawings with "sewer" marking. Olympic Foundry 910. Provide slip resistant covers in pavement areas.

2.03 GREASE INTERCEPTOR

- A. Reinforced, precast concrete grease interceptor, two chambers, 1500 gallon, conforming to ACI-318-89 Building Code, ASTM C857 (latest revision), IAPMO Listed, and rated for H20 traffic loading. Tank shall be sealed water tight. Provide top section and precast concrete riser rings with 24" diameter access opening with cast iron manhole frames and covers mounted flush with the vault top. Conform to construction drawings. Oldcastle Precast 5106-GA-1500, or approved equal.

2.04 CONCRETE

- A. Concrete shall be ready-mixed conforming to Section 03 3000, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.05 OTHER MATERIALS

- A. Recommended by Manufacturer and subject to Engineer's review and acceptance. Provide all materials required to complete and make drainage system operational.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting work of this section, carefully inspect trench, excavations, and pipe bedding to verify that all such work is complete to the point where this installation may properly commence.
- B. Do not install work of this section until unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 TRENCHING AND BACKFILL

- A. Trenching and backfill shall conform to the requirements of Section 31 2333, TRENCHING AND BACKFILL.

3.03 PIPE INSTALLATION

- A. Installation shall be in accordance with the manufacturer's recommendation. All pipe ends and interiors shall be thoroughly cleaned of all foreign matter and shall be kept clean during installation. When work is not in progress, all open ends of pipe and fittings shall be securely closed so that no water, earth, animal life, or other substance may enter.
- B. Cutting pipe shall be done in a neat and workmanlike manner by method which will not damage pipe and as recommended by manufacturer.
- C. Install piping within 0.02 foot of indicated grade and location.
- D. Trim pipe ends flush with manhole interior walls.

3.04 CLEANOUTS

- A. Construct on compacted 4" minimum depth 3/4" - 0 crushed rock base level, plumb, and square with adjacent surfaces. Set rim flush with adjacent finished surfaces unless otherwise noted.

3.05 GREASE INTERCEPTOR

- A. Install in accordance with manufacturer's recommendations as detailed on drawings. Utilize manufacturer's approved installation device to assure proper joints, drawn tightly together by device.

- B. Install per manufacturer's recommendations and construction drawings.

3.06 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 - 1. Hydrostatic or air test as described below.
 - 2. TV Inspections and Reports:
 - a. Provide for all sanitary sewer pipe 6 inch diameter and larger.
 - 3. Deflection Test:
 - a. Conduct deflection tests of flexible pipe. The testing shall be conducted by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the pipe initial inside diameter. Conduct testing on a manhole-to-manhole basis after flushing and cleaning.
 - b. The mandrel shall be pulled in front of the camera so the deflection testing is clearly recorded on the video tape unless approved by the Engineer.
 - c. A water depth gauge shall be provided, located on the TV camera side of the mandrel. The gauge shall be graduated with marks at 0.50" increments clearly visible during TV inspection. The gauge shall be capable of measuring depth of water in 0.50" increments from 0.50" to 2.5". The gauge shall be designed so it will remain plumb regardless of the rotation of the mandrel or camera.
 - d. Deflection testing shall be conducted and accepted prior to any paving being done.
- C. Field Inspections: Notify Engineer prior to work of this section.
- D. Special Inspections for Code Compliance:
 - 1. Provide hydrostatic test or air test per State of Oregon Plumbing Specialty Code.
 - 2. Obtain plumbing inspector approvals and submit to Engineer.

3.07 CLEANING

- A. Prior to final acceptance, Contractor shall flush and clean all elements of the completed system. All pipe and structures shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.
- B. Upon completion of work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.08 PROTECTION

- A. Protect all work installed under this section.
- B. Replace at no additional cost to Owner, any damaged work of this section.

END OF SECTION

SECTION 33 3913

SANITARY UTILITY SEWERAGE MANHOLES, FRAMES AND COVERS

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. Manholes for on-site private sanitary sewer system improvements.

1.03 WORK INCLUDED BUT SPECIFIED IN OTHER SECTIONS

- A. Section 31 2333 - Trenching and Backfill
- B. Section 33 3000 - Sanitary Sewerage Utilities

1.04 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.05 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, and fabrication information.
 - 1. Submit for manholes, frames, and covers.
- C. Field Quality Control submittals as specified in Part 3 of this Section:
 - 1. Field Tests
 - 2. Special Inspections for Code Compliance.
- D. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than five years of experience in the actual production of specified products.
- B. Installer's Qualifications: Firm with not less than five years of experience in installation of systems similar in complexity to those required for this Project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original, unopened packaging with legible manufacturer's identification.
- B. Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.08 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section.

1.09 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 MANHOLE BASES, RISERS, AND CONES

- A. Standard precast manhole sections shall conform to ASTM C478 (latest revision) and consist of circular sections in standard nominal diameters. No more than two lift holes shall be cast into each section. Holes shall be located so as to not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling in lieu of lift holes.

Standard precast cones shall be eccentric unless otherwise specified and shall conform to ASTM C478 (latest revision).

2.02 CONCRETE

- A. Concrete shall be ready-mixed conforming to Section 03 3000, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.03 MORTAR

- A. Cement mortar in precast manhole joint shall conform to ASTM C387 (latest revision) and consist of one part portland cement and two parts clean, well graded sand which will pass a 1/8" screen with water as necessary to obtain the consistency such that it will readily adhere to the precast concrete. Mortar shall be used within 30 minutes after it is prepared.

2.04 MANHOLE JOINT SEALANT

- A. Preformed plastic gaskets, such as Kent Seal, or approved.

2.05 PLASTIC PIPE SEALANT

- A. At PVC pipe penetrations: KOR-N-SEAL Boot or approved.

2.06 MANHOLE FRAMES AND COVERS

- A. Manhole frames shall have a 24" clear frame opening. Bearing and wedging surface shall be machined to ensure a tight fit of the cover and to prevent rocking.
- B. Covers, grates, and frames:
 - 1. Covers, Grates, and Frames (Unless Otherwise Noted): Shall be cast iron conforming to ASTM A48 (latest revision), Class 30. Covers shall be locking/water-tight non-locking. Cover shall be marked "sewer" or other appropriate marking to indicate sanitary sewer system.
 - 2. Decorative Covers, Grates, and Frames: Shall be cast iron, H-20 traffic rating. Iron Age Designs, Oblio 25" Manhole Cover, or approved.
 - 3. Provide slip resistant covers where indicated on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to starting work of this section, carefully inspect trench, excavations, and base to verify that all such work is complete to the point where this installation may properly commence.
- B. Do not install work of this section until unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall conform to the requirements of Section 31 2333, TRENCHING AND BACKFILL.

3.03 MANHOLE BASES (WITHOUT SUMP)

- A. Manhole bases shall be precast or cast-in-place concrete. Placement of cast-in-place concrete shall conform to Section 03 3000, CAST-IN-PLACE CONCRETE. If a precast manhole is used, the channels shall be poured and shaped after manhole is in place as indicated on drawings. Base sections shall be constructed to form a watertight structure.
- B. Where indicated on drawings, the invert shall be constructed to a section identical with that of the sewer pipe. Where the size of sewer pipe is changed at the manhole, the invert shall be constructed to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, the top shall be broken out to the spring line of the pipe for the full width of the manhole, and the exposed

SANITARY UTILITY SEWERAGE MANHOLES, FRAMES AND COVERS

edge of the pipe completely covered with mortar. During construction, the Contractor shall divert existing flows of water or sewage from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.

- C. Construct on 4" minimum depth, 3/4"-0 crushed rock base; level and plumb.

3.04 PIPE OPENINGS

- A. Openings to receive pipe shall be circular, tapered in toward the inside of the section and held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joints.
- B. For PVC pipe make manhole connections using KOR-N-SEAL Boot.
- C. For corrugated pipe, make manhole connections using cement binder.
- D. Trim pipe ends flush with manhole interior wall. Grout between pipe and manhole for a smooth transition.

3.05 JOINT SEALING

- A. Pipe gaskets shall be installed in conformance with the manufacturer's recommendations. All mortar joints shall be clean and wet before setting risers and tops in a full bed of Portland cement mortar. Joints shall be watertight, grouted inside and have a smooth finish. Outside joints shall be grouted before backfilling.

3.06 GRADE RINGS

- A. Grade rings shall be laid in mortar with the sides plumb and the top level. The joints shall be sealed with mortar. The extensions shall be watertight.

3.07 MANHOLE FRAMES AND COVERS

- A. Frames shall be set in a bed of mortar. Frames shall be set so the rim is flush with adjacent surfaces unless otherwise noted on drawings. Frames and covers shall be installed in such a manner as to prevent infiltration of surface or ground water between the frame and the concrete of the manhole section.

3.08 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 - 1. Hydrostatic or air test as described below.
- C. Field Inspections: Notify Engineer prior to backfilling.
- D. Special Inspections for Code Compliance:
 - 1. Obtain plumbing inspector approvals and submit to Engineer.
 - 2. Provide hydrostatic test or air test of sanitary sewer manholes per State of Oregon Plumbing Specialty Code (current edition).

3.09 CLEANING

- A. Prior to final acceptance, Contractor shall flush and clean all elements of the completed systems. All manholes shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.
- B. Upon completion of work of this section, promptly remove from the working area all scraps, debris, and surplus material.

3.10 PROTECTION

- A. Protect all work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

SECTION 33 4000
STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. On-site private storm drain system improvements.

1.03 RELATED SECTIONS

- A. Section 31 2333 - Trenching and Backfill
- B. Section 33 4913 - Storm Drainage Manholes, Frames, and Covers

1.04 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.05 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, fabrication, and installation information.
 - 1. Submit for: Pipe and fittings, catch basins, area drains, deck drains, cleanout covers, ADA catch basin grates, storm drain treatment structure, and rainwater cistern, and storm chamber.
- C. Field Quality Control submittals as specified in Part 3 of this Section:
 - 1. Field Tests
 - 2. Special Inspections for Code Compliance
- D. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installer's Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original, unopened packing with legible manufacturer's identification.
- B. Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.08 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section.

1.09 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 STORM DRAIN PIPE AND FITTINGS (UNLESS OTHERWISE NOTED)

- A. Either of the following pipe materials may be used.

1. PVC Solid Wall: Shall be Polyvinyl chloride plastic pipe with rubber gasket joints. Manufacturing Standard: ASTM D3034 (latest revision) SDR 35 for pipe sizes 4"-15" and ASTM F679 (latest revision) for pipe sizes 18"-36", T-1 wall thickness. Provide with manufactured fittings unless otherwise noted on drawings.
2. Polyethylene Pipe: Corrugated polyethylene meeting the requirements of AASHTO M252 Type S (pipe sizes 3" – 10") and AASHTO M294 Type S (pipe sizes 12" and larger). Joint shall be water tight according to the requirements of ASTM D3212 (latest revision). Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477 (latest revision) with the addition that the gaskets shall not have any visible cracking when tested according to ASTM D1149 (latest revision) after 72 hour exposure in 50 PPHM ozone at 104° F. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the gasket is free from debris. Joints shall remain watertight when subjected to a 1.5° axial misalignment. A joint lubricant supplied by the manufacturer shall be used on the gasket and bell during assembly. Fittings shall conform to AASHTO M252 or AASHTO M294. Fabricated fittings shall be welded to the interior and exterior at all junctions. Hancor or ADS.

2.02 PERFORATED PIPE AND FITTINGS

- A. Shall be smooth interior perforated corrugated polyethylene pipe with AASHTO Type 'S' designation meeting the requirements of AASHTO M252 (pipe sizes 4" – 10") and AASHTO M294 (pipe sizes 12" – 60"). Provide with manufactured fittings unless otherwise noted on drawings.
- B. Provide with machine-knitted polyester drain envelope, 100-135 burst strength. Equivalent opening size of 30 to 40.

2.03 STORM CHAMBER

- A. Chambers shall be open-bottomed and shall incorporate an overlapping corrugation joint system to allow chamber rows of almost any length to be created. StormTech SC-310 or approved.
 1. Chambers shall conform to the requirements of ASTM F 2922, "Standard Specification for Polyethylene (PE) Corrugated Wall Stormwater Collection Chambers."
 2. Chambers shall conform to the requirements of ASTM F2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers."

2.04 SINGLE CHAMBER CATCH BASINS

- A. Shall be prefabricated steel, 24 inches square by 36 (minimum) inches deep, 10 gauge minimum, asphalt paint inside and out, 6 inch minimum water seal with hinged lid on trap, outlet size as specified on drawings. Lynch or Gibson. Gibson catch basin.
- B. Grate (Unless Otherwise Noted): Cast iron or steel grate with bicycle bars.
 1. Decorative Cover: Cast iron grate, with a raw finish, ADA compliant, 24"x24"x2". Oblio ON24-21114 by Iron Age.
- C. Use any of the following pipe materials from the catch basin to lateral where cover is less than one foot as detailed on drawings: Ductile Iron pipe and fittings (cement-lined), Class 52, AWWA C151; PVC, AWWA C900, CL150; Schedule 40 PVC, ASTM D2665, F891, or D1785 (latest revision).

2.05 AREA DRAINS AND DECK DRAINS

- A. Deck Drain: Shall be prefabricated steel, 18 inches square by 24 (minimum) inches deep, 10 gauge minimum, asphalt paint inside and out, 6 inch minimum water seal with hinged lid on trap, outlet size as specified on drawings. Lynch or Gibson.
 1. Cast iron grate, with a raw finish, ADA compliant, 18"x24"x1.5" cut to 18"x18"x1.5" by the manufacture. Oblio OX18-26161 by Iron Age.
- B. Area Drain: Shall be prefabricated steel, 18 inch diameter by 24 (minimum) inches deep, 10 gauge minimum, asphalt paint inside and out, 6 inch minimum water seal with hinged lid on trap, outlet size as specified on drawings. Lynch or Gibson.
 1. Area Drain Grate (Unless Otherwise Noted): Cast iron or steel grate with bicycle bars.

2. Area Drain Decorative Cover: High quality 100% recycled grey iron meeting ASTM A48 class 35B or better, with a raw finish, ADA Compliant, 18" round by 3/8" thick. OT-T24 by Urban Accessories.
- C. Provide slip resistant covers in pavement areas.

2.06 FLEX-TRANSITION COUPLER

- A. Shall be Fernco, 1000 series. Use fittings manufactured for the specific pipe size and material types being connected.
- B. Provide slip resistant covers where indicated on drawings.

2.07 CLEANOUTS

- A. Shall be constructed from solid wall pipe and fittings specified above with traffic grade frame and cover. Frame and cover shall be H20 rated cast iron valve box with flange top as detailed on drawings with "storm" marking. Varicast VB910 Rich Valve Box.

2.08 ANTI-SEEPAGE COLLARS

- A. Construct anti-seepage collars from Impermeable Membrane Liner specified in Section 31 2333, TRENCHING AND BACKFILL.

2.09 STORM DRAIN TREATMENT STRUCTURE

- A. Shall be Contech CDS® stormwater treatment system. Refer to manufacturer's specifications for general requirements and product specifications. Configuration and depth as required by Construction Drawings.

2.10 SADDLE CONNECTION

- A. Shall be "CB" sewer saddle by Romac Industries, Inc.

2.11 COMPRESSION-FIT CONNECTOR

- A. Shall be three-piece service hub consisting of PVC hub, rubber sleeve, and stainless steel band. Shall be a gasketed bell and of same material type as lateral pipe. Inserta-Tee.

2.12 IN-LINE BACKWATER VALVE

- A. In-line valve, Duco cast iron body with bronze backwater valve. Jay R. Smith 7022S series with extension to finished grade, or approved.
- B. Backwater valve box shall be as follows:
 1. In pavement areas – one piece concrete box, minimum 12" by 20", with concrete cover and cast iron lid, traffic rated. Concrete box extensions as required to set cover and lid flush with adjacent, finished surface. Brooks #37 Meter Box.
 2. In landscaped areas – one piece, injection molded box, minimum 12" by 20" box cover with 1/4" minimum wall thickness, with coloring and UV stabilizers added. Solid plastic cover. Plastic box extensions as required to set cover flush with adjacent, finished surface. NDS Series Meter Box.

2.13 TERMINAL BACKWATER VALVE

- A. Terminal Valve, Duco cast iron body and bronze valve seat with hub inlet and open outlet for installation at the end of drainage line. Jay R. Smith 7070, Zurn Z1091 or approved equal.

2.14 WATER SEAL GASKET

- A. Shall be manufactured PVC to concrete adaptor, Romac LCT or Fernco CMA. Field fabricated water stops or improvised adapter not allowed.

2.15 RAINWATER CISTERN

- A. Shall be a single-wall or double-wall, fiberglass reinforced plastic (FRP) water storage tank designed for underground installation as shown on the drawings. The water tank shall be manufactured according to applicable American National Standards Institute (ANSI) and

American Water Works Association (AWWA) standards. The tank size, fittings, and accessories shall be as shown on the drawings. Xerxes Corporation or approved equal.

2.16 CONCRETE

- A. Concrete shall be ready-mixed conforming to Section 03 3000, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1½ inches.

2.17 OTHER MATERIALS

- A. Recommended by Manufacturer and subject to Engineer's review and acceptance. Provide all materials required to complete and make drainage system operational.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting work of this section, carefully inspect trench, excavations, and pipe bedding to verify that all such work is complete to the point where this installation may properly commence.
- B. Do not install work of this section until unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 TRENCHING AND BACKFILL

- A. Trenching and backfill shall conform to the requirements of Section 31 2333, TRENCHING AND BACKFILL.

3.03 PIPE INSTALLATION

- A. Installation shall be in accordance with the manufacturer's recommendation. All pipe ends and interiors shall be thoroughly cleaned of all foreign matter and shall be kept clean during installation. When work is not in progress, all open ends of pipe and fittings shall be securely closed so that no water, earth, animal life, or other substance may enter.
- B. Cutting pipe shall be done in a neat and workmanlike manner by method which will not damage pipe and as recommended by manufacturer.
- C. Install piping within 0.02 foot of indicated grade and location.
- D. Trim pipe ends flush with manhole and catch basin interior walls.

3.04 STORM CHAMBER INSTALLATION

- A. Install per manufacturer's recommendations and as detailed on drawings.

3.05 CATCH BASINS, AREA DRAINS, AND DECK DRAINS

- A. Construct on compacted 4" minimum depth, ¾" - 0 crushed rock base level, plumb, and square with adjacent construction. Set rim flush with adjacent finished surfaces unless otherwise noted.

3.06 WATER SEAL GASKET

- A. To be installed in accordance with manufacturer's recommendations. Adapters requiring the use of grout for installation shall be anchored and finished using non-shrink grout.

3.07 CLEANOUTS

- A. Construct on compacted 4" minimum depth ¾" - 0 crushed rock base level, plumb, and square with adjacent surfaces. Set rim flush with adjacent finished surfaces unless otherwise noted.

3.08 ANTI-SEEPAGE COLLARS

- A. Construct collars using Impermeable Membrane Liner material, providing watertight seal throughout membrane.

- B. Place as detailed on Drawings.

3.09 STORM DRAIN TREATMENT STRUCTURE

- A. Contech manhole to be constructed on compacted 4" minimum depth, 3/4"-0 crushed rock base level, plumb and square with adjacent construction. Set rims flush with adjacent finished surfaces unless otherwise noted. Install per manufacturer's recommendations.

3.10 BACKWATER VALVE

- A. Install per manufacturer's recommendations and as detailed on drawings.

3.11 RAINWATER CISTER

- A. Install per manufacturer's recommendations and as detailed on drawings.

3.12 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests:
 - 1. TV Inspections and Reports:
 - a. Provide for all storm drain pipe 10 inch diameter and larger.
 - 2. Deflection Test:
 - a. Conduct deflection tests of flexible pipe. The testing shall be conducted by pulling an approved mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the pipe initial inside diameter. Conduct testing on a manhole-to-manhole basis after flushing and cleaning.
 - b. The mandrel shall be pulled in front of the camera so the deflection testing is clearly recorded on the video tape unless approved by the Engineer.
 - c. A water depth gauge shall be provided, located on the TV camera side of the mandrel. The gauge shall be graduated with marks at 0.50" increments clearly visible during TV inspection. The gauge shall be capable of measuring depth of water in 0.50" increments from 0.50" to 2.5". The gauge shall be designed so it will remain plumb regardless of the rotation of the mandrel or camera.
 - d. Deflection testing shall be conducted and accepted prior to any paving being done.
- C. Field Inspections: Notify Engineer prior to work of this section.
- D. Special Inspections for Code Compliance: Obtain plumbing inspector approvals.

3.13 CLEANING

- A. Prior to final acceptance, Contractor shall flush and clean all elements of the completed system. All pipe and structures shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.
- B. Upon completion of work of this section promptly remove from the working area all scraps, debris, and surplus material.

3.14 PROTECTION

- A. Protect all work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

SECTION 33 4600
SUBDRAINAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building Perimeter Drainage Systems.

1.02 RELATED REQUIREMENTS

- A. 31 2000 - Earth Moving

1.03 REFERENCE STANDARDS

- A. ASTM C4 - Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile; 2004 (Reapproved 2009).
- B. ASTM C412 - Standard Specification for Concrete Drain Tile; 2011.
- C. ASTM C412M - Standard Specification for Concrete Drain Tile (Metric); 2011.
- D. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2011.

1.04 SUBMITTALS

- A. See Section 01 3300 - Submittal Procedures for submittal procedures.
- B. Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections, and _____.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Polyvinyl Chloride Pipe: ASTM D2729; plain end, 4 inch inside diameter; with required fittings.
- B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.

2.02 AGGREGATE AND BEDDING

- A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 31 2000.

2.03 ACCESSORIES

- A. Pipe Couplings: Solid plastic.
- B. Joint Covers: 10 mil thick polyethylene.
- C. Filter Fabric: Water pervious type, black polyolefin.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout Drawings.

3.02 PREPARATION

- A. Hand trim excavations to required elevations. Correct over-excavation with Granular Fill.
- B. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.

3.03 INSTALLATION

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
- B. Place drainage pipe on clean cut subsoil.
- C. Lay pipe to slope gradients noted on Drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- D. Loosely butt pipe ends. Place joint cover strip 12 inches wide, around pipe diameter centered over joint.

- E. Place pipe with perforations facing down. Mechanically join pipe ends.
- F. Install pipe couplings.
- G. Install filter aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches.
- H. Place filter fabric over levelled top surface of aggregate cover prior to subsequent backfilling operations.
- I. Place aggregate in maximum 4 inch lifts, consolidating each lift.
- J. Refer to Section 31 2000 for compaction requirements. Do not displace or damage pipe when compacting.
- K. Place impervious fill over drainage pipe aggregate cover and compact.
- L. Connect to storm sewer system with unperforated pipe, through installed sleeves.
- M. Coordinate the Work with connection to municipal sewer utility service, and trenching.

3.04 FIELD QUALITY CONTROL

- A. Section 01 4000 - Quality Requirements: Field inspection and testing.
- B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.05 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION

SECTION 33 4913
STORM DRAINAGE MANHOLES, FRAMES AND COVERS

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. Manholes for on-site private storm drain system improvements.

1.03 RELATED SECTIONS

- A. Section 31 2333 - Trenching and Backfill
- B. Section 33 4000 - Storm Drainage Utilities

1.04 WORK INCLUDED BUT SPECIFIED ELSEWHERE

- A. Products and construction within the Lane County right-of-way shall conform to the 2015 Oregon Standard Specifications for Construction published by ODOT and the Oregon Chapter of APWA and City of Eugene Amendment No. 1.

1.05 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction and fabrication information.
 - 1. Submit for manholes, frames, and covers.
- C. Field Quality Control submittals as specified in Part 3 of this Section:
 - 1. Field Tests
 - 2. Special Inspections for Code Compliance.
- D. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than five years of experience in the actual production of specified products.
- B. Installer's Qualifications: Firm with not less than five years of experience in installation of systems similar in complexity to those required for this Project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original, unopened packaging with legible manufacturer's identification.
- B. Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.08 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section.

1.09 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 MANHOLE BASES, RISERS, AND CONES

- A. Standard precast manhole sections shall conform to ASTM C478 (latest revision) and consist of circular sections in standard nominal diameters. No more than two lift holes shall be cast into each section. Holes shall be located so as to not damage reinforcing or expose it to corrosion. At the manufacturer's option, steel loops may be provided for handling in lieu of lift holes.

Standard precast cones shall be eccentric unless otherwise specified and shall conform to ASTM C478 (latest revision).

2.02 CONCRETE

- A. Concrete shall be ready-mixed conforming to Section 03 3000, CAST-IN-PLACE CONCRETE, and shall have a compressive strength of 3,000 psi at 28 days. Maximum size of aggregate shall be 1-1/2 inches.

2.03 MORTAR

- A. Cement mortar in precast manhole joint shall conform to ASTM C387 (latest revision) and consist of one part portland cement and two parts clean, well graded sand which will pass a 1/8" screen with water as necessary to obtain the consistency such that it will readily adhere to the precast concrete. Mortar shall be used within 30 minutes after it is prepared.

2.04 MANHOLE JOINT SEALANT

- A. Preformed plastic gaskets, such as Kent Seal, or approved.

2.05 PLASTIC PIPE SEALANT

- A. At PVC pipe penetrations: KOR-N-SEAL Boot or approved.

2.06 MANHOLE FRAMES AND COVERS

- A. Manhole frames shall have a 24" clear frame opening. Bearing and wedging surface shall be machined to ensure a tight fit of the cover and to prevent rocking.
- B. Covers, grates, and frames shall be cast iron conforming to ASTM A48 (latest revision), Class 30. Covers shall be locking/water-tight non-locking.
- C. Cover shall be marked "storm" or other appropriate marking to indicate storm drain system.
- D. Provide slip resistant covers where noted on drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to starting work of this section, carefully inspect trench, excavations, and base to verify that all such work is complete to the point where this installation may properly commence.
- B. Do not install work of this section until unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 EXCAVATION AND BACKFILL

- A. Excavation and backfill shall conform to the requirements of Section 31 2333, TRENCHING AND BACKFILL.

3.03 MANHOLE BASES (WITHOUT SUMP)

- A. Manhole bases shall be precast or cast-in-place concrete. Placement of cast-in-place concrete shall conform to Section 03 3000, CAST-IN-PLACE CONCRETE. If a precast manhole is used, the channels shall be poured and shaped after manhole is in place as indicated on drawings. Base sections shall be constructed to form a watertight structure.
- B. Where indicated on drawings, the invert shall be constructed to a section identical with that of the sewer pipe. Where the size of sewer pipe is changed at the manhole, the invert shall be constructed to form a smooth transition without abrupt breaks or unevenness of the invert surfaces. Where a full section of concrete sewer pipe is laid through the manhole, the top shall be broken out to the spring line of the pipe for the full width of the manhole, and the exposed edge of the pipe completely covered with mortar. During construction, the Contractor shall divert existing flows of water or sewage from new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.
- C. Construct on 4" minimum depth, 3/4"-0 crushed rock base; level and plumb.

3.04 MANHOLE BASES (WITH SUMP)

- A. Manhole bases shall be precast. Base sections shall be constructed to form a watertight structure.
- B. Construct on 4" minimum depth, 3/4"-0 crushed rock base; level and plumb.

3.05 PIPE OPENINGS

- A. Openings to receive pipe shall be circular, tapered in toward the inside of the section and held to the minimum size possible to accommodate the pipe to be inserted and to effectively seal the joints.
- B. For PVC pipe make manhole connections using KOR-N-SEAL Boot.
- C. For corrugated pipe, make manhole connections using cement binder.
- D. Trim pipe ends flush with manhole interior wall. Grout between pipe and manhole for a smooth transition.

3.06 JOINT SEALING

- A. Pipe gaskets shall be installed in conformance with the manufacturer's recommendations. All mortar joints shall be clean and wet before setting risers and tops in a full bed of Portland cement mortar. Joints shall be watertight, grouted inside and have a smooth finish. Outside joints shall be grouted before backfilling.

3.07 GRADE RINGS

- A. Grade rings shall be laid in mortar with the sides plumb and the top level. The joints shall be sealed with mortar. The extensions shall be watertight.

3.08 MANHOLE FRAMES AND COVERS

- A. Frames shall be set in a bed of mortar. Frames shall be set so the rim is flush with adjacent surfaces unless otherwise noted on drawings. Frames and covers shall be installed in such a manner as to prevent infiltration of surface or ground water between the frame and the concrete of the manhole section.

3.09 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Inspections: Notify Engineer prior to backfilling.
- C. Special Inspections for Code Compliance:
 - 1. Obtain plumbing inspector approvals and submit to Engineer.

3.10 CLEANING

- A. Prior to final acceptance, Contractor shall flush and clean all elements of the completed systems. All manholes shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the Engineer.
- B. Upon completion of work of this section, promptly remove from the working area all scraps, debris, and surplus material.

3.11 PROTECTION

- A. Protect all work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION

**SECTION 33 5100
NATURAL GAS DISTRIBUTION**

PART 1 GENERAL

1.01 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this specification and accompanying drawings.

1.02 SECTION INCLUDES

- A. Private on-site natural gas distribution system improvements.

1.03 WORK INCLUDED BUT SPECIFIED IN OTHER SECTIONS

- A. Section 31 2333 - Trenching and Backfill.

1.04 WORK PROVIDED BY OTHERS

- A. Natural gas distribution system, piping, meters and connections by Northwest Natural Gas Co.
- B. Conduit for private on-site natural gas system improvements.

1.05 SUBMITTALS

- A. Comply with Section 01 3300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction, and fabrication information.
 - 1. Submit for: Conduit.
- C. Closeout Requirements: Comply with Section 01 7700 and Section 01 7839.
 - 1. Provide record documents.

1.06 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Not less than 5 years experience in the actual production of specified products.
- B. Installers Qualifications: Firm with not less than 5 years experience in installation of systems similar in complexity to those required for this project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Protect from damage by the elements and construction procedures.

1.08 ADVANCE NOTICES

- A. Notify Engineer at least 48 hours before starting work of this section.

1.09 COORDINATION

- A. Coordinate with other trades affecting or affected by work of this section.

PART 2 PRODUCTS

2.01 CONDUIT

- A. Contractor has option of picking up conduit from Northwest Natural Gas' yard or requesting delivery by Northwest Natural Gas to the jobsite.

2.02 OTHER MATERIALS

- A. Recommended by manufacturer and subject to Engineer's review and acceptance. Provide all materials required to complete and make natural gas system operational.

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. Prior to starting of the work of this section carefully inspect trench, excavations, and pipe bedding to verify that all such work is complete to the point where this installation may properly commence.

- B. Do not start work of this section until all unsatisfactory conditions have been corrected. Commencing work implies acceptance of existing conditions.
- C. If field measurements differ slightly from drawing dimensions, modify work as required for accurate fit. If measurements differ substantially, notify Engineer prior to starting work of this section.

3.02 TRENCHING AND BACKFILL

- A. Trenching and backfill shall conform to the requirements of Section 31 2333, TRENCHING AND BACKFILL.

3.03 PIPE INSTALLATION

- A. By Northwest Natural. Contractor shall coordinate with Northwest Natural's commercial marketing personnel then contact Northwest Natural three (3) business days prior to the trench being opened. Northwest Natural will then have the service line installed within four (4) business days of the trench being opened.

3.04 CONDUIT INSTALLATION

- A. Installation shall be in accordance with the manufacturer's recommendation. All pipe ends and interiors shall be thoroughly cleaned of all foreign matter and shall be kept clean during installation. When work is not in progress, all open ends of pipe and fittings shall be securely closed so that no water, earth, animal life, or other substance may enter.
- B. Cutting pipe shall be done in a neat and workmanlike manner by method which will not damage pipe and as recommended by manufacturer.
- C. Install piping within 0.02 foot of indicated grade and location.
- D. Install and test in accordance with NFPA 54 and applicable local codes.
- E. In addition to tracer wire, provide metallic detection tape, marked "gas pipe below", buried 6 inches below grade, directly above plastic gas pipe.
- F. Connections between plastic and steel gas pipe shall be made underground with ASTM D-2513 (latest revision) Category 1 mechanical joint transition fittings, which provide a seal and resistance to pullout.
- G. Apply tape to both ends of conduit prior to backfilling.
- H. Mark both ends of pipe so that Northwest Natural Gas can locate the conduit when making the connection to the main and to the new gas meter.

3.05 FIELD QUALITY CONTROL

- A. Refer to Section 01 4000 for responsibilities for arranging, supervising, and payment of field quality control requirements.
- B. Field Tests: Hydrostatic or air test as described below.
- C. Field Inspections: Notify Engineer prior to work of this Section.
- D. Coordinate Special Inspections for Code Compliance with NW Natural:
 - 1. Test per NFPA 54 and as required by Oregon State Plumbing Specialty code.
 - 2. Notify Engineer 48 hours prior to testing and inspection procedures.
 - 3. Obtain plumbing inspector approvals.

3.06 CLEANING

- A. Prior to final acceptance, contractor shall flush and clean all elements of the completed system. All pipe structures shall be clean and free of all construction debris, rocks, gravel, mud, sand, silt, and other foreign material, and as directed by the general contractor.

- B. Upon completion of work of this section promptly remove from the working area all scraps, debris and surplus material.

3.07 PROTECTION

- A. Protect all work installed under this section.
- B. Replace, at no additional cost to Owner, any damaged work of this section.

END OF SECTION