



TECHNICAL SPECIFICATIONS

FOR

NEW AIRPORT RESERVOIR AND BOOSTER STATION

AUGUST 2021

VOLUME 1 OF 2

DIVISIONS 00 THROUGH 26

murraysmith



SECTION 000107

SEALS PAGE

See Table of Contents for author of each specification section, identified by author's initials as follows:

AUTHOR'S NAME = INITIALS

LAEL L. ALDERMAN = LLA

KRISTOFOR R. SNIDER = KRS

TRAVIS GREGORY McFERON = TGM

DAVID C. ROOT = DCR

MICHAEL E. WALLIS = MEW



**TECHNICAL SPECIFICATIONS
FOR
NEW AIRPORT RESERVOIR AND BOOSTER STATION
FOR
CITY OF PENDLETON**

TABLE OF CONTENTS

Section	Person Responsible	Title	
Division 01 - General Requirements			
01 10 00	LLA	Special Provisions	1-19
01 22 20	LLA	Measurement and Payment	1-12
01 33 00	LLA	Submittal Procedures	1-12
01 45 00	LLA	Quality Control	1-7
01 75 16	LLA	Testing, Training and System Start-Up	1-6
Division 02 - Existing Conditions			
02 30 00	LLA	Subsurface Investigations	1-2
02 41 00	LLA	Demolition	1-6
Division 03 - Concrete			
03 21 00	TGM	Reinforcing Steel	1-6
03 33 00	TGM	Concrete Work	1-34
03 60 00	TGM	Grouting	1-8
Division 04 - Masonry			
04 05 10	TGM	Masonry Mortar and Grout	1-11
04 22 00	TGM	Concrete Masonry Units	1-7
Division 05 - Metals			
05 50 00	TGM	Metal Fabrications	1-22
Division 06 - Wood and Plastics			
06 05 23	TGM	Wood, Plastic, and Composite Fasteners	1-2
06 10 00	TGM	Rough Carpentry	1-5
06 17 53	TGM	Shop-Fabricated Wood Trusses	1-6
Division 07 - Thermal and Moisture Protections			
07 21 00	KRS	Thermal Insulation	1-5
04 21 19	KRS	Foamed-In-Place Insulation	1-3
07 41 13	KRS	Metal Roof Panels	1-6
07 42 13	KRS	Metal Wall Panels	1-4
07 46 46	KRS	Fiber Cement Siding	1-5

07 60 00	KRS	Flashing and Sheet Metal	1-5
07 92 00	KRS	Sealants and Caulking	1-3
07 92 25	LLA	Sealants and Caulking for Steel Water Storage Reservoirs	1-3
Division 08 - Doors and Windows			
08 11 13	KRS	Hollow Metal Doors and Frames	1-9
08 33 23	KRS	Overhead Coiling Doors	1-7
08 71 00	KRS	Door Hardware	1-10
08 80 00	KRS	Glazing	1-11
08 91 19	KRS	Louvers	1-5
Division 09 - Finishes			
09 20 10	KRS	Gypsum Wallboard	1-6
09 90 00	LLA	Painting and Coating	1-18
09 97 14	LLA	Steel Water Storage Tank Painting	1-34
Division 10 - Specialties			
10 14 10	KRS	Identifying Devices	1-3
10 44 16	KRS	Fire Extinguishers	1-2
Division 11 - Equipment			
11 81 29	LLA	Facility Fall Protection	1-2
Division 12 through Division 20 NOT USED			
Division 21 - Fire Suppression			
21 22 00	KRS	Clean Agent Fire Suppression Systems	1-9
Division 22 - Plumbing			
22 13 16	KRS	Sanitary Drain and Vent Piping	1-2
Division 23 - HVAC			
23 09 13	KRS	Instrumentation and Control Devices for HVAC	1-5
23 31 13	KRS	Metal Ducts and Accessories	1-18
23 34 00	KRS	Fans	1-8
23 38 10	KRS	Heat Pump Split Unit	1-8
23 83 00	KRS	Heating Units	1-2
Division 26 - Electrical			
26 05 00	DCR	Common Work Results for Electrical	1-12
26 05 19	DCR	Low Voltage Electrical Power Conductors and Cables	1-5
26 05 26	DCR	Grounding	1-3
26 05 29	DCR	Hangers and Supports for Electrical Systems	1-4
26 05 33	DCR	Conduits, Raceways, Boxes, and Fittings	1-6

26 05 53	DCR	Identification for Electrical Systems	1-2
26 05 73	DCR	Power System Studies	1-16
26 05 83	DCR	Wiring Connections	1-8
26 20 00	DCR	Low-Voltage AC Induction Motors	1-9
26 22 13	DCR	Low Voltage Distribution Transformers	1-5
26 24 16	DCR	Panelboards	1-5
26 27 00	DCR	Service and Distribution	1-3
26 27 16	DCR	Cabinets and Enclosures	1-3
26 28 16	DCR	Disconnect Switches	1-2
26 28 16.13	DCR	Enclosed Circuit Breakers	1-5
26 28 16.16	DCR	Enclosed Switches	1-10
26 29 24	DCR	Active Front-End Low-Voltage AFD	1-11
26 32 13	DCR	Standby Power System	1-13
26 36 23	DCR	Automatic Transfer Switch	1-12
26 50 00	DCR	Lighting	1-11

Division 27 through Division 30
NOT USED

Division 31 - Earthwork

31 05 13	LLA	Soils for Earthwork	1-5
31 05 16	LLA	Aggregates for Earthwork	1-6
31 10 00	LLA	Site Clearing	1-7
31 22 13	LLA	Rough Grading	1-5
31 23 16	LLA	Excavation	1-9
31 23 17	LLA	Trenching	1-22
31 23 18	LLA	Rock Removal	1-4
31 23 18.20	LLA	Controlled Blasting for Rock Removal	1-30
31 23 19	LLA	Dewatering	1-4
31 23 23	LLA	Fill	1-8
31 23 24	LLA	Flowable Fill	1-6
31 37 00	LLA	Riprap	1-5

Division 32 - Exterior Improvements

32 11 23	LLA	Aggregate Base Courses	1-6
32 12 16	LLA	Asphalt Concrete Pavement	1-6
32 12 16.39	LLA	Asphalt Paving for Steel Tank Base	1-1
32 31 13	LLA	Chain Link Fencing & Gates	1-8

Division 33 - Utilities

33 01 30.13	LLA	Storm and Manhole Testing	1-7
33 05 13	LLA	Manholes	1-14
33 05 17	LLA	Precast Concrete Valve Vaults and Meter Boxes	1-8
33 11 10	LLA	Water Utility Distribution & Transmission Piping	1-24

33 11 50	LLA	Existing Pipe Abandonment	1-4
33 12 16	LLA	Water Utility Distribution & Transmission Valves	1-7
33 12 19	LLA	Fire Hydrants	1-5
33 13 00	LLA	Testing and Disinfecting of Water Utility Piping	1-10
33 13 13	LLA	Disinfection of Water Utility Storage Tanks	1-4
33 16 23	TGM	Ground-Level Steel Water Storage Tank	1-7
33 16 23.13	TGM	Ground-Level Steel Water Storage Tank Accessories	1-7
33 41 10	LLA	Storm Utility Drainage Piping	1-10

Division 34 through Division 39

NOT USED

Division 40 - Process Integration

40 05 13	KRS	Common Work Results for Process Piping	1-20
40 05 23	KRS	Common Work Results for Process Valves	1-16
40 05 23.15	LLA	Gate Valves	1-4
40 05 23.18	LLA	Butterfly Valves	1-4
40 05 23.24	LLA	Check Valves	1-6
40 05 23.72	LLA	Miscellaneous Valves	1-7
40 05 23.74	KRS	Pressure Relief and Surge Anticipator Valves	1-6
40 61 21	MEW	Process Control System Testing	1-12
40 62 63	MEW	Operator Interface Terminals (OIT)	1-2
40 66 56	MEW	Point-to-Point Radio Equipment	1-3
40 67 00	MEW	Process Control Panels and Hardware	1-19
40 71 13	MEW	Magnetic Flow Meters	1-5
40 72 13	MEW	Ultrasonic Level Meters	1-4
40 73 26	MEW	Gauge-Pressure Transmitters	1-3
40 75 21	MEW	Chlorine Analyzers	1-4
40 90 00	MEW	General Instrumentation and Controls	1-14
40 90 01	MEW	Airport Booster Process Narrative	1-4
40 94 43	MEW	Programmable Logic Controllers	1-7

Division 41 - Material Processing and Handling Equipment

41 22 00	KRS	Hoists and Cranes, General	1-4
41 22 13	KRS	Overhead Bridge Crane System	1-9

Division 43 – Process Gas & Liquid Handling

43 21 00	KRS	Liquid Pumps	1-7
43 21 13	KRS	End Suction Centrifugal Pumps	1-5
43 21 15	KRS	Vertical Split Case Pumps	1-5
43 21 50	KRS	Mechanical Diaphragm Metering Pump	1-5
43 40 01	KRS	Polyethylene Storage Tank	1-8

DRAWINGS

See Sheet G-1 for Drawing Index

SUPPLEMENTAL INFORMATION

- A. Geotechnical Engineering Evaluation, Proposed City of Pendleton Water and Sewer System Upgrades Project, Water Storage Reservoir, Pendleton, Oregon. (GeoEngineers, June 5, 2018)
- B. Addendum Report, City of Pendleton Water and Sewer System Upgrades, Pendleton, Oregon, File No. 8946-003-03. (GeoEngineers, April 2, 2021)
- C. Form: Explosives Near Gas Facilities, Cascade Natural Gas.

SECTION 01 10 00

SPECIAL PROVISIONS

PART 1 GENERAL

These Special Provisions supplements and amplifies certain sections of the General Conditions and Supplementary General Conditions. The General Conditions and Supplementary General Conditions shall apply except as modified herein. These Special Provisions and additional technical specifications may contain occasional requirements not pertinent to the project. However, these specifications shall apply in all particulars insofar as they are applicable to this project.

1.1 APPLICABLE STANDARD SPECIFICATIONS AND PLANS

City of Pendleton, Oregon, Public Works Standards and American Public Works Association (APWA) Standard Specifications and Drawings (including all revisions through the date of bid opening), apply except as may be modified herein. In the case of discrepancy, unless noted otherwise herein, the more restrictive provisions shall apply.

1.2 SCOPE OF WORK

The work to be performed under these specifications and drawings consists of furnishing all labor, materials and equipment necessary for the construction of a 2.0 million gallon aboveground welded steel reservoir; a 4,500 gallon per minute firm capacity potable water pump station; approximately 5,000 lineal feet (LF) of 24-inch diameter transmission main and 2,500 LF of 18-inch diameter transmission main; complete electrical, instrumentation, controls and telemetry systems; and associated mobilization, site work and appurtenances. The work also includes water connections into existing systems. The above general outline of principal features of the work does not in any way limit the responsibility of the CONTRACTOR(s) to perform all work and furnish all equipment, labor and materials required by the specifications and drawings. The drawings and specifications shall be considered and used together. Anything appearing as a requirement of either shall be accepted as applicable to both even though not so stated therein or shown.

No attempt has been made in these specifications or drawings to segregate work covered by any trade or subcontract under one specification. Such segregation and establishment of subcontract limits will be solely a matter of specific agreement between the CONTRACTOR and its subcontractors and shall not be based upon any inclusion, segregation, or arrangement in or of these specifications.

1.3 COORDINATION OF DRAWINGS AND SPECIFICATIONS

The drawings and specifications are intended to describe and provide for a complete work. Any requirement in one is as binding as if stated in all. The CONTRACTOR shall provide any work or materials clearly implied in the Contract Documents even if the Contract Documents

do not mention it specifically. If there is a conflict within the Contract Documents, it will be resolved by the following order of precedence:

- A. Permits for outside agencies required by law
- B. OWNER-CONTRACTOR Agreement
- C. Addenda to Contract Documents
- D. CONTRACTOR's Proposal
- E. City of Pendleton Special Provisions
- F. Contract Drawings
- G. Technical Specifications
- H. General Conditions of the Contract
- I. Standard Specifications for the City of Pendleton, Oregon
- J. APWA Standard Specifications
- K. APWA Standard Drawings
- L. AWWA/ANSI Standards

Dimensions shown on the drawings or that can be computed shall take precedence over scaled dimensions. Notes on drawings are part of the drawings and govern in the order described above. Notes on drawings shall take precedence over drawing details.

The intent of the drawings and specifications is to prescribe the details for the construction and completion of the work which the CONTRACTOR undertakes to perform according to the terms of the Contract. Where the drawings or specifications describe portions of the work in general terms, but details are incomplete or silent, it is understood that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Unless otherwise specified, the CONTRACTOR shall furnish all labor, materials, tools, equipment, and incidentals, and do all the work involved in executing the Contract in a manner satisfactory to the OWNER'S REPRESENTATIVE.

The contract drawings are designated by general title, sheet number and sheet title. When reference is made to the drawings, the "Sheet Number" of the drawing will be used. Each drawing bears the OWNER'S REPRESENTATIVE's File No. 17-2024.0204 and the general title:

CITY OF PENDLETON, OREGON
NEW AIRPORT RESERVOIR AND BOOSTER STATION

The specific titles of each sheet are contained G-1 of the Drawings.

1.4 CODE REQUIREMENTS

All work shall be done in strict compliance with the requirements of the most current publications of the follow:

- A. International Building Code
- B. Oregon Structural Specialty Code

- C. Uniform Mechanical Code
- D. Uniform Plumbing Code
- E. National Electric Code
- F. National Electric Safety Code
- G. Oregon State Department of Labor and Industries
- H. Umatilla County
- I. City of Pendleton

In case of disagreement between codes or these specifications, the more restrictive shall prevail.

1.5 NOT USED

1.6 COORDINATION WITH OTHER CONTRACTORS AND WITH OWNER

Certain work within this contract may require connection to and coordination with the work of other contractors and OWNER. The CONTRACTOR under these specifications shall cooperate fully with all other contractors and OWNER and carefully fit its own work to such other work as may be directed by the OWNER'S REPRESENTATIVE. The CONTRACTOR shall not commit or permit any act to be committed which will interfere with the performance of work by any other contractor or the OWNER.

1.7 ACCESS TO WORK

Access to the work shall be provided as may be required by the OWNER or its representatives, and all authorized representatives of the state and federal governments and any other agencies having jurisdiction over any phase of the work, for inspection of the progress of the work, the methods of construction or any other required purposes.

1.8 PERMITS AND LICENSES

Unless provided for otherwise in these Contract Documents, all permits, licenses and fees shall be obtained by the CONTRACTOR and all costs shall be borne by the CONTRACTOR. CONTRACTOR shall pay all plan check fees and other fees necessary to obtain permits and shall accommodate special inspections required thereof. CONTRACTOR shall be responsible for compliance with all permit provisions and shall accommodate all special inspections required thereof, all at no additional expense to the OWNER beyond prices as bid.

The following permits are to be obtained by the Owner:

- A. Department of Environmental Quality (DEQ), 1200-C
 - 1. To be transferred to Contractor prior to initiation of construction activities.

- B. Umatilla County, Building Permit.
 - 1. Airport Reservoir
 - 2. Airport Booster Pump Station
- C. Umatilla County, Department of Public Works, Installation of Utilities on County and Public Roads
- D. Umatilla County, Department of Public Works, Construction of Road Approaches onto County and Public Roads and Private Road Crossings of County and Public Roads

1.9 SITE INVESTIGATION AND PHYSICAL DATA

The CONTRACTOR acknowledges that it is satisfied as to the nature and location of the work and the general and local conditions, including but not limited to those bearing upon transportation, disposal, handling and storage of materials, availability of water, roads, groundwater, access to the sites, coordination with other contractors, and conflicts with pipelines, structures, and other contractors. Information and data furnished or referred to herein is furnished for information only. Any failure by the CONTRACTOR to become acquainted with the available information and existing conditions will not be a basis for relief from successfully performing the work and will not constitute justification for additional compensation.

The CONTRACTOR shall verify the locations and elevations of existing pipelines, structures, grades, and utilities, prior to construction. The OWNER assumes no responsibility for any conclusions or interpretations made by the CONTRACTOR on the basis of the information made available.

1.10 TEMPORARY UTILITIES FOR CONSTRUCTION PURPOSES

- A. The CONTRACTOR shall make all arrangements necessary to provide all temporary utilities for construction purposes and shall pay all costs associated those temporary utilities.
- B. Water for construction purposes (dust control, hydrostatic testing of water mains, etc.) will be furnished by the OWNER at no cost, unless otherwise noted.
 - 1. The CONTRACTOR shall furnish all valves, hoses, connections, backflow prevention devices, and other devices as necessary to obtain sufficient water for construction and for filling and testing of water lines as required.
 - 2. Backflow protection is required on all connections to potable water systems.

3. OWNER's Preferred Option:

a. Supply during non-winter months (April through October):

A 2-inch diameter water service connection to existing piping at the Gilliam Canyon Pump Station (1102 Old Airport Road) at approximate 50 psi pressure is available for CONTRACTOR use non-winter months (April through October).

City-owned property at Gilliam Canyon Pump Station is available for siting of temporary aboveground tankage for fill station use.

b. Supply during winter months (November through March):

Upon request, the OWNER will make available water for hauling at City Well Nos. 4 & 14, located in the City of Pendleton at 2024 Westgate Avenue and 5400 Reith Road, respectively. CONTRACTOR will be required to set up a water billing account with the City of Pendleton for water fill stations at these well locations.

4. OWNER's Second Option:

a. Use of fire hydrant south of project site at intersection of Old Airport Road and Westgate / Highway 30.

b. Final determination of use is allowed only by permission of City of Pendleton's Water Department Supervisor.

c. Submittal by the CONTRACTOR of City of Pendleton Water Department Fire Hydrant Permit with City approval is required. Deposit is required by the CONTRACTOR for temporary water meter assembly. All equipment must be returned before deposit is refunded.

1.11 FIELD SERVICE BY MANUFACTURER'S REPRESENTATIVE

The CONTRACTOR shall furnish the services of a manufacturer's or material supplier's representative for all major equipment and materials furnished by the CONTRACTOR or OWNER under this contract, to check, place in operation and test the installation, and train operating personnel. The manufacturer's representative shall be qualified and authorized to perform repairs and maintenance on the equipment. The above gives a general scope of the services desired from the manufacturer's representative. It will be the responsibility of the CONTRACTOR and the equipment manufacturer to determine detailed requirements. Costs for services of the manufacturer's representative shall be included in the proposal of the CONTRACTOR. The operator training mentioned above shall include sufficient time during the CONTRACTOR's operation and testing period to fully explain to the operating personnel the features of the equipment and maintenance thereof.

1.12 CONSTRUCTION WITHIN PUBLIC RIGHTS-OF-WAY

When the work contemplated is wholly or partly within the right-of-way of a public agency such as a city, county or state, the OWNER will obtain from these agencies any right-of-way and street opening permits and all other necessary permit(s) required for the work. The CONTRACTOR shall abide by all regulations and conditions stipulated in the permit(s). Such conditions and requirements are hereby made a part of these specifications, as fully and completely as though the same were fully set forth herein. The CONTRACTOR shall examine the permit(s) granted to the OWNER by any city, county, state, and federal agencies. Failure to do so will not relieve the CONTRACTOR from compliance with the requirements stated therein.

See subsection 1.8, PERMITS, for information on permits obtained by OWNER for project.

The CONTRACTOR shall obtain all construction permits and pay all fees or charges and furnish any bonds and insurance coverages as necessary to ensure that all requirements of the city, county, state or federal agencies will be observed, and the roadway and ditches are restored to their original condition or one equally satisfactory. A copy of all permits shall be kept on the work site for use of the OWNER'S REPRESENTATIVE.

1.13 CONSTRUCTION WITHIN PRIVATE EASEMENTS

When portions of the work contemplated are within easements held by the OWNER on private property, the CONTRACTOR shall ascertain for itself to what extent the width, status and special conditions attached to easements may have on its operations and all costs resulting therefrom shall be included and absorbed in the unit prices of the CONTRACTOR'S bid. CONTRACTOR shall coordinate with private property owners and businesses if required. Landscaping, surface restoration and fence restoration shall be completed within 24 hours following piping and conduit installation and other construction work. Temporary fencing shall be provided continuously until such private fencing is properly restored.

The CONTRACTOR'S attention is directed to Paragraph 6.20 of the General Conditions regarding safety and the protection of property. Certain portions of this project require working in close proximity to existing structures and property within private easements. It is the CONTRACTOR'S responsibility to conduct its operations and limit the size of equipment used in such a manner so as to prevent damage to existing property from excessive vibration or from other direct or indirect CONTRACTOR operations. The cost associated with repairing or replacing property that is damaged by the CONTRACTOR'S operations shall be the responsibility of the CONTRACTOR, in accordance with the General Conditions.

1.14 NOT USED

1.15 PRIVATE ROADS AND DRIVEWAYS

Bridges at entrances to business properties where vehicular traffic is necessary shall be provided and maintained. Bridges shall be adequate in width and strength for the service required. No private road or driveway may be closed without approval of the OWNER'S REPRESENTATIVE unless written authority has been given by the owner whose property has been affected. Driveways shall be left open and ready for use at the end of the work shift. All expenses involved in providing for construction, maintenance, and use of private roads or driveways, shall be borne by the CONTRACTOR and the amount thereof absorbed in the unit prices of the CONTRACTOR's bid.

1.16 TRAFFIC CONTROL AND PROTECTION

The CONTRACTOR shall maintain traffic control and protection in the work areas 24 hours per day. Traffic control shall conform to the standards set forth in the "Oregon Manual on Uniform Traffic Control Devices" issued by the Oregon Department of Transportation.

The CONTRACTOR shall conduct its operations to keep one lane of traffic open for public and private access at all times on City, County and Public streets, roads and highways. If required by the State, the CONTRACTOR shall conduct its operations so as to keep both directions of traffic open on State Highways. Permits obtained for the project may have more stringent requirements than noted in this section.

Prior to beginning construction, the CONTRACTOR shall submit a detailed street closure and traffic control plan to the OWNER'S REPRESENTATIVE for review and all local permitting jurisdictions for approval. As construction proceeds, the CONTRACTOR shall notify the OWNER'S REPRESENTATIVE as to the status of street closures and detours.

On streets where traffic is heavy, the OWNER'S REPRESENTATIVE or jurisdictional permitting agencies may require the construction of two-way bridges of adequate design. These bridges shall be provided with guard rails and shall be well lighted at all times. Detours as required by the OWNER'S REPRESENTATIVE shall be surfaced with gravel or crushed rock and maintained in good condition. Detours for pedestrians shall not exceed one block in length, and foot bridges over the trenches shall be provided with adequate handrails.

All work shall be carried on with due regard for safety to the public. Open trenches shall be provided with barricades of a type that can be seen at a reasonable distance, and at night they shall be distinctly indicated by adequately placed lights.

1.17 NOT USED

1.18 LIMITS OF THE WORK AND STORAGE OF SPOILS

The limits of the site which may be used for construction, storage, materials handling, parking of vehicles and other operations related to the project include the project site as shown on the drawings and adjacent public rights-of-way subject to permission of the public

owner of that right-of-way. The limits of work also include rights of access obtained by the CONTRACTOR, subject to all public laws and regulations and rights of access by utility companies and other holders of easement rights.

1.19 EXISTING WATER SYSTEM SHUTDOWN

If the project involves the need to shut down an existing water system, the CONTRACTOR shall coordinate the work to insure a minimum of shutdown time. The CONTRACTOR shall submit a written shutdown schedule to the OWNER for approval. The CONTRACTOR shall provide 72-hour notice preceding each shutdown.

1.20 NOT USED

1.21 TESTING AND OPERATION OF FACILITIES

It is the intent of the OWNER to have a complete and operable facility. All of the work under this contract will be fully tested and inspected in accordance with the specifications. Upon completion of the work, the CONTRACTOR shall operate the completed facilities as required to test the equipment under the direction of the OWNER'S REPRESENTATIVE. During this period of operation by the CONTRACTOR, the new facilities will be tested thoroughly to determine their acceptance.

1.22 NOT USED

1.23 SALVAGE AND DEBRIS

Unless otherwise indicated on the drawings or in the specifications, all castings, pipe, equipment, demolition debris, spoil or any other discarded material or equipment shall become the property of the CONTRACTOR and shall be disposed of in a manner compliant with applicable Federal State and local laws and regulations governing disposal of such waste products. No burning of debris or any other discarded material will be permitted.

1.24 SAFETY STANDARDS AND ACCIDENT PREVENTION

The CONTRACTOR shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. The required and/or implied duty of the OWNER'S REPRESENTATIVE to conduct construction review of the CONTRACTOR's performance does not, and is not intended to, include review of the adequacy of the CONTRACTOR's safety measures in, on, or near the construction site.

The CONTRACTOR shall comply with the safety standards provisions of applicable laws and building and construction codes. The CONTRACTOR shall exercise every precaution at all times for the prevention of accidents and protection of persons, including employees, and property. During the execution of the work the CONTRACTOR shall provide and maintain all guards, railing, lights, warnings, and other protective devices which are required by law or

which are reasonably necessary for the protection of persons and property from injury or damage.

1.25 PUBLIC SAFETY AND CONVENIENCE

General Rule: The CONTRACTOR shall ensure the safety of the public during its performance of the Work and shall minimize any public inconvenience in addition to any other requirement imposed by law. These duties include, but are not limited to, the matters listed below.

Access: The CONTRACTOR shall not unreasonably restrict access to public facilities, commercial property, fire hydrants, residential property, and other areas where the public can be expected to be present, such as sidewalks and streets without first obtaining approval of the OWNER. Driveways shall be closed only with the approval of the OWNER or after obtaining specific permission from the property owner or owners. In addition, the CONTRACTOR shall not obstruct or interfere with travel over any public street or sidewalk without approval of the OWNER.

Public Transit: The CONTRACTOR shall not interfere with the normal operation of any public transit vehicles unless otherwise authorized.

Work Site: The CONTRACTOR shall keep the Project site safe in compliance with applicable law. Safety includes, but is not limited to: 1) providing an approved type of secured and adequate barricades or fences that are easily visible from a reasonable distance around open excavations; 2) closing up or covering with steel plates all open excavations at the end of each Working Day in all street areas and in all other areas when it is reasonably required for public safety; 3) marking all open work and obstructions by lights at night; 4) installing and maintaining all necessary signs, lights, flares, barricades, railings, runways, stairs, bridges, and facilities; 5) observing any and all safety instructions received from the OWNER; and 6) following all laws and regulations concerning worker and public safety. In the event that the law requires greater safety obligations than that imposed by the OWNER, the CONTRACTOR shall comply with the law.

Emergency: Emergency vehicles, including but not limited to police, fire, and disaster units shall be provided access to the work site at all times.

Cleanliness: The CONTRACTOR shall, on a continuing basis, keep the surfaces of all public and private roadways, sidewalks, and other pathways free of dirt, mud, cold plane grindings, and other matters that the CONTRACTOR may place upon the road. The cost of performing such work shall be included in the CONTRACTOR's Bid and no additional payment will be made for performing this task.

Parking: The CONTRACTOR shall make any necessary contacts with all applicable governmental bodies to arrange for the removal of parked automobiles, vehicles and other obstructions if they would interfere with the performance of the CONTRACTOR'S work.

Accidents: The CONTRACTOR'S Project Manager or superintendent shall be in charge of accident prevention. CONTRACTOR shall take all actions necessary to prevent damage, injury and loss to persons and property as a result of accidents.

Project Health and Safety Plan: CONTRACTOR shall develop, publish, and implement an overall Project Health and Safety Program for the Project. This Program shall conform to all applicable codes. Contractor shall submit the written Safety Program to the OWNER'S REPRESENTATIVE within 30 days after the receipt of the written Notice to Proceed and prior to mobilizing to the project site. The Plan shall be assembled to address project specific health and safety issues to both the public and on-site personnel. The plan shall include the following items when they apply:

- Employee orientation
- Safety inspections
- Instruction and training
- Accident reporting
- Signs and barricades
- Fire prevention and protection
- Welding, cutting and burning
- Painting and surface treatment
- Electricity
- Machinery and mechanized equipment
- Excavations
- Sanitation
- Chlorine safety
- Hazardous materials
- Hazardous communications program
- Job hazard analysis
- First aid/medical facilities
- Personal protective equipment
- Confined space entry plan
- Shoring plan
- Fall protection plan
- Emergency Action Plan
- Housekeeping
- Safety training requirements and certification
- Pedestrian access around work site during construction and after hours

If the project requires other health and safety issues to be addressed, they too shall be included in the Project Health and Safety Plan. The Program shall subsequently be distributed to and implemented by the CONTRACTOR's personnel as well as its Subcontractors and Suppliers. CONTRACTOR shall fully implement and comply with the Safety Program and submit to the OWNER a letter signed by CONTRACTOR'S owner/president affirming such implementation and compliance within 15 days after on-site work has started. CONTRACTOR shall notify the OWNER when safety meeting will be held so that Owner's personnel may attend. A copy of the approved Health and Safety Plan must be maintained on-site at all times during the life of the Project.

The OWNER has no responsibility for Work site safety. Work site safety is the responsibility of the CONTRACTOR. The CONTRACTOR is required to have a competent person on site at all times during construction activities.

The CONTRACTOR shall provide signs on work zone fencing that provide information regarding access to businesses and stating that such businesses are open and in operation.

The CONTRACTOR shall furnish and install the signs and provide sign attachments for the various business names.

1.26 WARRANTY PERIOD

The CONTRACTOR shall warrant all furnished materials and equipment for a period of one year from date of final acceptance of the Work by the OWNER. This warranty shall mean prompt attention to the correction and/or complete replacement of the faulty material or equipment. The expiration of the one-year warranty period shall not affect any other claims or remedy available to the OWNER. There may be other warranty provisions in these contract documents in addition to those noted above.

1.27 UTILITY PROPERTIES AND SERVICE

In areas where the CONTRACTOR's operations are adjacent to or near a utility and such operations may cause damage which might result in significant expense, loss and inconvenience, the operations shall be suspended until all arrangements necessary for the protection thereof have been made by the CONTRACTOR.

The CONTRACTOR shall notify all utility offices which may be affected by the construction operation at least 48 hours in advance. Before exposing any utility, the utility having jurisdiction shall grant permission and may oversee the operation. Should service of any utility be interrupted due to the CONTRACTOR's operation, the proper authority shall be notified immediately. It is of the utmost importance that the CONTRACTOR cooperates with the said authority in restoring the service as promptly as possible. Any costs shall be borne by the CONTRACTOR.

Utilities which may be impacted include the following:

Cascade Natural Gas Corporation	Natural Gas
Pacific Power	Electrical
Century Link	Telephone
City of Pendleton	Water, Sanitary Sewer, Storm Drain
Various entities	Telecom / Fiber Optic

1.28 SANITARY FACILITIES

The CONTRACTOR shall provide and maintain sanitary facilities for its employees and its subcontractors' employees that will comply with the regulations of the local and State Departments of Health and as directed by the OWNER'S REPRESENTATIVE.

1.29 STREET CLEANUP

The CONTRACTOR shall clean daily all dirt, gravel, construction debris and other foreign material resulting from its operations from all streets and roads to the OWNER'S REPRESENTATIVE.

1.30 VEHICLE PARKING

The vehicles of the CONTRACTOR's and subcontractors' employees shall be parked in accordance with local parking ordinances and in designated as shown in the Drawings.

1.31 PROTECTION OF QUALITY OF WATER

The work to be performed involves connections to an existing potable water system. The CONTRACTOR shall take such precautions as are necessary or as may be required to prevent the contamination of the water. Such contamination may include but shall not be limited to deleterious chemicals such as fuel, cleaning agents, paint, demolition and construction debris, sandblasting residue, etc. In the event contamination does occur, the CONTRACTOR shall, at its own expense, perform such work as may be necessary to repair any damage or to clean the affected areas of the water mains to a condition satisfactory to the OWNER'S REPRESENTATIVE.

1.32 RECORD DRAWINGS

CONTRACTOR shall maintain at the site one set of specifications, full size drawings, shop drawings, equipment drawings and supplemental drawings which shall be corrected as the work progresses to show all changes made. Drawings shall be available for inspection by the OWNER'S REPRESENTATIVE. Upon completion of the contract and prior to final payment, specifications and drawings shall be turned over to the OWNER'S REPRESENTATIVE.

1.33 NOT USED

1.34 SURVEYS

Based upon the information provided by the Contract Documents, the CONTRACTOR shall develop and make all detail surveys necessary for layout and construction, including exact component location, working points, lines and elevations. Prior to construction, the field layout shall be approved by the OWNER's representative. The CONTRACTOR shall have the responsibility to carefully preserve bench marks, reference points and stakes, and in the case of destruction thereof by the CONTRACTOR or resulting from its negligence, the CONTRACTOR shall be charged with the expense and damage resulting therefore and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such bench marks, reference points and stakes.

1.35 WORK HOUR LIMITATIONS

All work shall be conducted between the hours of 7:00 a.m. and 6:00 p.m. on non-holiday weekdays only. No weekend work will be allowed. Requests for variations in work hours shall be made in writing for consideration by the OWNER'S REPRESENTATIVE. No work shall be conducted outside of the above-described days and hours without prior approval of the OWNER'S REPRESENTATIVE.

1.36 DUST PREVENTION

All unpaved streets, roads, detours, haul roads or other areas where dust may be generated shall receive an approved dust-preventive treatment or be routinely watered to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

Dust emissions from reservoir construction activities including sandblasting and painting shall be controlled to be within applicable environmental regulations. The CONTRACTOR shall be responsible for cleaning and repair of properties near the reservoir site which may become damaged by sandblasting or painting emissions.

1.37 EROSION AND SEDIMENTATION CONTROL

The OWNER has obtained a National Pollutant Discharge Elimination system (NPDES) 1200-C Permit for this project. The CONTRACTOR shall take the necessary steps and pay the required fees to transfer the Permit from the OWNER to the CONTRACTOR (DEQ Form 08-WQ-013). The CONTRACTOR shall be responsible for compliance with all 1200-C permit provisions.

Temporary construction site erosion control measures shall be designed and constructed in accordance with the 1200-C permit obtained by the OWNER and drawings provided within the Contract Documents.

Erosion control measures shall be maintained throughout the project site until approved permanent cover such as a healthy stand of grass, other permanent vegetation, or other ground covering is established. When approved permanent ground cover is established, all temporary erosion control measures shall be removed from the construction site. Erosion control measures shall be installed as approved, per the erosion control drawing(s) in the above referenced document. Erosion control measures including stabilized construction entrances and sediment barriers must be established in conjunction with site clearing and grading.

During construction, and until permanent vegetation or other ground covering is established, the erosion control facilities shall be upgraded as needed for unexpected storm events or site conditions and with the purpose of retaining sediment and sediment-laden water on the construction site.

1.38 INTERFERENCES, OBSTRUCTIONS AND SEWER CROSSINGS

At certain places, power, light and telephone poles may interfere with excavation and the operation of the CONTRACTOR's equipment. Necessary arrangements shall be made by the CONTRACTOR with utility companies for moving or maintaining such poles. The utility company affected by any such interferences shall be notified thereof so that the necessary moving or proper care of poles and appurtenances may have appropriate attention.

All costs resulting from any other interferences and obstructions, or the replacement of such, whether or not herein specifically mentioned, shall be included and absorbed in the unit prices of the CONTRACTOR's bid.

1.39 NOISE LIMITATIONS

The project areas are located within an Industrial zoned area. All applicable City, County ordinances and State and Federal regulations shall be complied with.

1.40 STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

A. Materials and equipment stored overnight shall be placed neatly on the job site. Unusable materials (i.e. rejected or damaged liner material, old concrete chunks, metal scraps, etc.) shall be expeditiously removed from the job site.

Provide appropriate barricades, signs, and traffic control devices in like-new condition where necessary to protect the public from any hazards associated with the storage of materials and equipment used for this project.

B. No equipment and/or materials shall be stored outside the immediate work area on public rights-of-way, in the following locations, or in the following manner:

1. In any maintained landscaped or lawn area.
2. In a manner that would totally eliminate an individual residents' street parking.
3. In front of any business.

The "immediate work area" is the area where work is taking place or will be taking place within one calendar day. The CONTRACTOR shall immediately move stored material or equipment which causes a nuisance or creates complaints.

1.41 COMPETENT PERSON DESIGNATION

CONTRACTOR shall designate a qualified and experienced "competent person" at the site whose duties and responsibilities shall include enforcement of Oregon - OSHA regulations regarding excavations, the prevention of accidents, and the maintenance and supervision of construction site safety precautions and programs.

1.42 EMERGENCY MAINTENANCE SUPERVISOR

The CONTRACTOR shall submit to the OWNER'S REPRESENTATIVE the names, addresses and telephone numbers of at least two employees responsible for performing emergency maintenance and repairs when the CONTRACTOR is not working. These employees shall be designated, in writing by the CONTRACTOR, to act as its representatives and shall have full authority to act on its behalf. At least one of the designated employees shall be available for a telephone call any time an emergency arises.

1.43 NOT USED

1.44 NOT USED

1.45 USE OF EXPLOSIVES

Portions of this project require the use of explosives for site excavation. When explosives are used for the prosecution of the work, the CONTRACTOR shall use the utmost care so as not to endanger life or property, cause slides or disturb materials outside the neat lines of the trenches or excavations. The use of explosives must be approved by the OWNER'S REPRESENTATIVE. The CONTRACTOR shall be responsible for obtaining all permits required for the use of explosives.

All explosives shall be stored in a safe, secure manner in compliance with local laws and ordinances, and all such storage places shall be marked clearly "Dangerous Explosives." No explosives shall be left in an unprotected manner along or adjacent to any highway, street, alley or other area, where such explosives could endanger persons or property. Storage of the explosives shall be in accordance with the requirements of the State Industrial Accident Commission or similar appropriate body having the jurisdiction in such matters in the state in which the work is performed.

Only persons experienced in handling explosives shall be allowed to use them on the work. Where state or local laws require that explosives be handled only by licensed personnel, it shall be the CONTRACTOR's responsibility to see that this requirement is met. The Blasting Contractor must be qualified by the OWNER'S REPRESENTATIVE prior to bidding. A Statement of Qualifications Form shall be submitted to the OWNER'S REPRESENTATIVE for review and approval by all prospective blasting contractors. Refer Section 00 20 90, Blasting Contractor Statement of Qualifications Form, for prequalification information.

See Section 31 23 18.20, Controlled Blasting for Rock Removal, for additional information and requirements.

All blasting work shall comply with the requirements of Section 31 23 18.20, Controlled Blasting for Rock Removal.

1.46 CONTAMINATED MATERIAL

A. General

It is possible that the CONTRACTOR may encounter contaminated material (soil and/or water) during excavation activities. This specification identifies requirements for handling and disposing contaminated media.

B. Definitions

1. "Contaminated material" is defined as soil, water, free product, Underground Storage Tanks (UST), buried abandoned utility lines containing residual or free product, solid waste, treated wood waste, chemical containers, or other solid, liquid, or gas substances with contamination levels above background levels.
2. "Hazardous substances" shall mean those substances or materials defined in the Oregon Revised Statutes (ORS) 465.200, as amended.
3. "Release" shall have the meaning as defined in ORS 465.200, as amended.
4. "Environmental laws" shall mean any applicable statute, law, ordinance, order, consent decree, judgment, permit, license, code, covenant, deed, common law, treaty, convention or other requirement pertaining to protection of the environment, health or safety, natural resources, conservation, wildlife, waste management or disposal, hazardous substances or pollution, including but not limited to regulation of releases to air, land, water, and groundwater.

C. Execution

1. Discovery of Contaminated Material

In the event that the CONTRACTOR, during the course of construction or during any other activities authorized under this contract, should encounter suspected contaminated material or any other materials suspected of posing a threat to human health and the environment, the CONTRACTOR shall notify the OWNER'S REPRESENTATIVE immediately and manage according to requirements identified below.

2. Discovery of Contaminated Soil

CONTRACTOR shall note evidence of contamination (odor, visual staining of soil, free liquid product seeping from soil, sheen on groundwater etc.) and note location of evidence on a sketch of the excavation and provide to the OWNER'S REPRESENTATIVE.

CONTRACTOR shall report the discovery to the OWNER'S REPRESENTATIVE immediately. CONTRACTOR shall stop all excavation activities, and secure the site to prevent entry by the public. The excavation shall not be backfilled. Protect all open excavations with berms, plates and fencing. CONTRACTOR may continue with work in other non-contaminated areas.

CONTRACTOR shall assist OWNER'S REPRESENTATIVE in collecting sample(s) of suspected contaminated media for testing and characterization. CONTRACTOR shall allow 21 days, at no cost to OWNER, for testing, results and instructions as to how to proceed with contaminated materials.

The CONTRACTOR shall obtain a copy of an approved soil disposal/acceptance permit (Disposal/Treatment Facility requires transporter to have a copy of the permit.)

CONTRACTOR will transport and dispose of contaminated material at an approved disposal/treatment facility.

CONTRACTOR shall provide the OWNER'S REPRESENTATIVE with a copy of the contaminated soil disposal receipt.

3. Handling of Contaminated Soil

After approval from the OWNER'S REPRESENTATIVE, excavate the soil in a manner that prevents commingling of contaminated and non-contaminated soil. OWNER'S REPRESENTATIVE will make determination (based on soil saturation) if contaminated soil can be directly transported to a treatment or disposal facility, or if soil needs to be stockpiled to reduce water content. OWNER'S REPRESENTATIVE will determine when stockpiled soil can be transported off-site.

CONTRACTOR will be responsible for stockpiling contaminated soil in containers or on impervious surface to prevent the spread of contamination. Any water runoff from the contaminated soil stockpile area(s) must be contained by CONTRACTOR and handled as contaminated water.

Minimize movement of excavation equipment over or through contaminated soil to prevent movement of contaminated soil into areas where no contaminated soil exists.

Stockpiles will be created on an approved site and shall be surrounded by a fence to limit access. The stockpiles must be covered and bermed during periods of rainfall to prevent run-on and run-off. The stockpiles shall be covered with a minimum 10 mil high density polyethylene (HDPE) plastic during periods of strong winds, nightfall, over the weekends, or during extended work stoppages. If dust is observed coming from the stockpiles, the stockpiles shall be either covered or the dust controlled with water.

Maintain excavation equipment in good working order. Prevent spillage of oil, fuel, or hazardous substances from equipment. In particular, promptly repair oil leaks from equipment and clean up any contaminated soil.

4. Transport of Contaminated Materials

CONTRACTOR shall comply with all applicable Federal, State, or local laws, codes, and ordinances that govern or regulate contaminated substance transportation. Contaminated soils placed in stockpiles shall be loaded into trucks in a manner that prevents the spilling or tracking of contaminated soil into areas of the site with

uncontaminated soil. Loose material falling onto the exterior of the truck during loading shall be removed before the truck leaves the loading area. Any material collected in the loading area shall either be placed back into the truck or back into the stockpile. If loading areas are unpaved, the surface soil shall be sampled at the conclusion of the loading activities to confirm that contaminated soil is not present. If loading areas are paved, any loose soil shall be cleaned from the pavement at the conclusion of the loading activities.

Specific truck haul routes shall be established before beginning off-site contaminated media transport. On-site truck routes shall be established to minimize or prevent movement of trucks over contaminated soils. Off-site truck routes shall be established to reduce the risk of releases of contaminated soils and impact on local traffic. The CONTRACTOR shall be responsible for ensuring that loaded truck weights are within acceptable limits. All trucks shall be covered before they leave the loading area.

The CONTRACTOR shall ensure that all drivers of vehicles transporting contaminated substances have in their possession during transport all applicable Oregon State and local vehicle insurance requirements, valid driver's license, and vehicle registration and license. The CONTRACTOR shall be responsible for informing all drivers of transport vehicle about:

- a. The nature of the material transported.
- b. Required routes to and from the off-site thermal treatment or disposal facility.
- c. Applicable County street regulations and requirements, and State of Oregon Department of Transportation codes, regulations and requirements.
- d. The County's requirement for proper handling and transportation of the substances.

The CONTRACTOR shall not allow contaminated substances to be spilled or tracked off-site at any time during the project. Trucks used for the transportation of contaminated substances off-site shall be water tight, substance compatible, licensed, insured, and permitted pursuant to federal, state, and local statutes, rules, regulations and ordinances.

If contaminated media is discarded prior to removal of contaminated material, the price per cubic yard of soil materials and price per 100 gallons of contaminated water will be negotiated with OWNER.

1.47 RESERVOIR CONTRACTOR QUALIFICATION PRIOR TO BIDDING

The Reservoir Contractor must be qualified by the OWNER'S REPRESENTATIVE prior to bidding. A Statement of Qualifications Form shall be submitted to the OWNER'S

REPRESENTATIVE for review and approval by those prospective reservoir contractors not already listed as prequalified contractors in Section 4, Prequalification, of the Contract Documents. Refer Section 00 20 10, Reservoir Contractor Statement of Qualifications Form for prequalification information.

1.48 TANK PAINTING CONTRACTOR QUALIFICATION PRIOR TO BIDDING

The Tank Painting Contractor must be qualified by the OWNER'S REPRESENTATIVE prior to bidding. A Statement of Qualifications Form shall be submitted to the OWNER'S REPRESENTATIVE for review and approval by those prospective painting contractors not already listed as prequalified contractors in Section 4, Prequalification, of the Contract Documents. Refer to Section 00 20 20, Painting Contractor Statement of Qualifications Form for prequalification information.

1.49 TRANSMISSION MAIN CONTRACTOR QUALIFICATION PRIOR TO BIDDING

The Transmission Main Contractor must be qualified by the OWNER'S REPRESENTATIVE prior to bidding. A Statement of Qualifications Form shall be submitted to the OWNER'S REPRESENTATIVE for review and approval by all prospective transmission main contractors. Refer Section 00 20 50, Transmission Main Contractor Statement of Qualifications Form for prequalification information.

1.50 BLASTING CONTRACTOR QUALIFICATION PRIOR TO BIDDING

The Blasting Contractor must be qualified by the OWNER'S REPRESENTATIVE prior to bidding. A Statement of Qualifications Form shall be submitted to the OWNER'S REPRESENTATIVE for review and approval by all prospective blasting contractors. Refer to Section 00 20 90, Blasting Contractor Statement of Qualifications Form for prequalification information.

END OF SECTION

SECTION 01 22 20
MEASUREMENT AND PAYMENT

PART 1 GENERAL

The work is divided into schedules as described below. Measurement and payment will be on a lump sum and unit price basis for work associated with the construction of the project in accordance with the prices set forth in the proposal for the individual work items. Where work is required but does not appear as a separate item in the proposal, the cost for that work shall be included and absorbed in the unit prices named in the proposal. Basis of measurement and payment for individual bid items will be as follows:

Common Items

1. Mobilization, bonds, insurance, and demobilization: Payment for mobilization, bonds, insurance, and demobilization will be on a lump sum basis. The amounts paid for this bid item in the contract progress payment will be based on the percent of the original contract amount that is earned from other contract items, as follows:
 - a. When 5 percent of the original contract amount is earned, 50% of the amount for the bid item will be paid.
 - b. When 95 percent work of the original contract amount is earned, 50% of the amount for the bid item will be paid.

This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the contract.

2. Traffic control: Payment for traffic maintenance and protection, flagging, temporary fencing and safety barricades, including all coordination, materials, and equipment, as required, will be on a lump sum basis.
3. Erosion control: Payment for installation of approved erosion control devices (silt fencing, straw bales, and other items), as required, including all labor, materials, and equipment, as required, will be on a lump sum basis.
4. Construction survey and staking: Payment for construction survey and staking, including all coordination, materials, labor, and equipment, as required, will be on a lump sum basis, complete.
5. Extra work as authorized: Extra work tasks include those items not specifically required or implied by the Contract that the Owner specifically requests in writing for the Contractor to perform. Payment for extra work will only be provided when approved in writing by the Owner's Representative.

Schedule A – Transmission Main Improvements

- A-1. Furnish and install Class 52 ductile iron pipe with Class A (compacted native material) trench backfill: Payment for furnishing and installing Class 52 ductile iron pipe with Class A (compacted native material) trench backfill, including all work and materials; Contractor inspection and acceptance; storage and transport of pipe; excavation to depths shown in the Drawings; all required joint restraint systems for pipe, fittings, valves, and appurtenances where shown in the Drawings; standard concrete thrust blocks (including concrete, excavation, and thrust plates) where shown in the Drawings; dewatering; wrapping of the piping in two layers of 8-mil polyethylene film where the proposed piping is within 10-feet horizontal of a natural gas line; and Class B pipe bedding, Class B pipe zone backfill, and Class A trench backfill materials; and general surface restoration will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed for native trench backfill, as indicated in the Drawings, without deduction for fittings and valves. Class B pipe bedding and pipe zone materials are understood to be imported granular material, compacted in place as shown in the Drawings. Class A and Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation, and backfill will be on the basis of the horizontal length of pipe laid without deductions for valves or fittings which may be included in the end-to-end measurement of a continuous section of pipe. Where pipe is laid on a continuous slope greater than 10 percent for a distance greater than 100 feet, payment will be made upon the average slope distance between 100-foot stations. When water mains intersect, the measurement of each main shall be to the intersection of the center lines of the connecting fittings.

The unit price shall include any incidental excavation, backfill, and additional work required to cutting existing piping, installation of branch-line fittings and/or connection to existing pipelines. Unit price shall also include as incidental the removal of existing fittings and piping as shown on the Drawings.

- A-2. Furnish and install Class 52 ductile iron pipe with Class B (imported granular material) trench backfill: Payment for furnishing and installing Class 52 ductile iron pipe with Class B (imported granular material) trench backfill, including all work and materials; Contractor inspection and acceptance; storage and transport of pipe; excavation to depths shown in the Drawings; all required joint restraint systems for pipe, fittings, valves, and appurtenances where shown in the Drawings; standard concrete thrust blocks (including concrete, excavation, and thrust plates) where shown in the Drawings; dewatering; wrapping of the piping in two layers of 8-mil polyethylene film where the proposed piping is within 10-feet horizontal of a natural gas line; and Class B pipe bedding, pipe zone backfill, and trench backfill materials; and general surface storation will be on a per linear foot basis for the pipe diameters shown. Pipe bedding, pipe zone, and trench backfill is understood to be imported granular material, compacted in place as shown in the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation and backfill will be on the same basis and shall include the same work as specified in Pay Item A-1.

- A-3. Furnish and install PVC pipe with Class A (compacted native material) trench backfill: Payment for furnishing and installing PVC pipe with Class A (compacted native material) trench backfill, including all work and materials; Contractor inspection and acceptance; storage and transport of pipe; excavation to depths shown in the Drawings; all required joint restraint systems for pipe, fittings, valves, and appurtenances where shown in the Drawings; standard concrete thrust blocks (including concrete, excavation, and thrust plates) where shown in the Drawings; dewatering; and Class B pipe bedding, Class B pipe zone backfill, and Class A trench backfill materials; and general surface restoration will be on a per linear foot basis for the pipe diameters shown. Measurement will be based on total length of piping constructed for native trench backfill, as indicated in the Drawings, without deduction for fittings and valves. Class B pipe bedding and pipe zone materials are understood to be imported granular material, compacted in place as shown in the Drawings. Class A and Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation and backfill will be on the same basis and shall include the same work as specified in Pay Item A-1.

- A-4. Furnish and install PVC pipe with Class B (imported granular material) trench backfill: Payment for furnishing and installing PVC pipe with Class B (imported granular material) trench backfill, including all work and materials; Contractor inspection and acceptance; storage and transport of pipe; excavation to depths shown in the Drawings; all required joint restraint systems for pipe, fittings, valves, and appurtenances where shown in the Drawings; standard concrete thrust blocks (including concrete, excavation, and thrust plates) where shown in the Drawings; dewatering; and Class B pipe bedding, pipe zone backfill, and trench backfill materials; and general surface restoration will be on a per linear foot basis for the pipe diameters shown. Pipe bedding, pipe zone, and trench backfill is understood to be imported granular material, compacted in place as shown in the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation and backfill will be on the same basis and shall include the same work as specified in Pay Item A-1.

- A-5. Furnish and install ductile iron pipe fittings: Payment for furnishing and installing ductile iron fittings will be made on a per each basis for the type and diameter of fittings shown. Fitting installation will be considered a separate pay item from work performed under other pay items. Fitting accessories including glands, bolts, and gaskets shall be considered incidental in the fitting weights for payment. Payment for joint restraint systems is included under the payment for restrained joint pipe.

- A-6. Furnish and install buried valves: Payment for furnishing and installing buried valves not included in other pay items, including valve boxes, covers, risers, extensions, and concrete

collars, if required, complete, will be on a per each valve basis for the diameters shown in the Drawings.

- A-7. Furnish and install 3/4-inch diameter combination air valve (CAV) assemblies: Payment for furnishing and installing 3/4-inch diameter combination air valve (CAV) assemblies, including piping and fittings; special coating for pipe; combination air valve; elbows; nipples; unions; isolation joints; valve box; excavation; pipe bedding and backfill; stand pipe; meter box; precast manhole; appurtenances; and removal and replacement of concrete curbs and sidewalks, as may be required, complete, within the pay limits as shown in the Drawings, will be on a per each basis. Excavation, sheeting, shoring, and dewatering shall be considered incidental to payment.
- A-8. Furnish and install fire hydrant assemblies: Payment for furnishing and installing fire hydrant assemblies will be on a per each basis. The unit price for hydrants shall include all costs for shackles, tie rods, pier blocks, gravel, painting, elbows, thrust blocks, and all other items for the complete installation of the hydrant. Hydrant isolation valves and tees will be paid for at the unit contract price each under the appropriate bid items.
- A-9. Excavation and backfill for water service laterals: Payment for excavation and backfill activities to facilitate the City installing new water meters and services shall be on a lump sum basis. Payment shall be full compensation for all associated excavation, hand excavation, backfill, pavement and surface restoration, and all utility locates on private property, where required, as necessary for the Owner to install Owner-supplied meters, meter boxes, and service laterals. Costs will also include coordination with the City of Pendleton and the City's coordination with private property owners. No additional payment will be made for special coordination with private property owners.
- A-10. Connections to existing water system piping: Payment for connecting to existing water system piping, including exploratory excavation as may be required to confirm piping locations and type; any additional excavation and backfill; cutting existing piping; removal and abandonment of existing utilities, fittings, valves, and appurtenances; and all other miscellaneous tie-in related work not included in other Bid Items, will be on a lump sum basis for the sizes and types as shown in the Drawings.
- A-11. Additional cost for utility trench rock excavation, hauling, and disposal: Payment for rock excavation and hauling will be made at the unit price per cubic yard of rock excavated and hauled to a designated off-site location. The additional cost for utility trench rock excavation and hauling will be paid for in addition to the linear foot price for pipe, trench excavation, and backfill in Pay Items A-1, A-2, A-3, and A-4. The pay limits for pipe trench shall be 18 inches below the pipe invert and the width shall be the nominal pipe diameter plus 18 inches on each side of the pipe. No payment will be made for utility trench rock excavation beyond these limits.

Rock excavation is defined in Section 31 23 18, Rock Removal, and as determined by the Owner's Representative. Rock excavation will be measured by surveying coordinates and

elevations of the solid rock surface prior to and following excavation of the rock; the total quantity of rock excavated will be calculated from these measurements. Rock measurement will be subject to approval by the Owner's Representative. Cost of surveying rock measurement shall be the responsibility of the Contractor. No additional payment will be made for common excavation beyond these limits to remove solid rock and/or boulders, nor will payment be made for select backfill beyond these limits placed to fill voids left by removing solid rock and/or boulders.

Contractor's attention is directed to Section 31 23 17, Trenching, which disallows the use of explosives and controlled blasting in the excavation and removal of rock for utility trench construction.

Rock materials developed from utility trench excavation will be hauled to 1118 Airport Road (Kube property) for off-site disposal.

- A-12. Additional cost for overexcavation and select backfill material for unsuitable trench conditions: Payment for overexcavation and select backfill material for unsuitable trench conditions will only be considered as approved by the Owner's Representative. When such pre-approval is obtained, payment will be made on a per cubic yard basis.
- A-13. Hydrostatic testing, flushing, and disinfection of water mains: Payment for hydrostatic testing, flushing, and disinfection of water mains will be on a lump sum basis per Alignment and shall include furnishing, installing, and removing temporary blow-off piping, including miscellaneous piping, valves, fittings, and thrust restraint. The Owner shall provide off-site laboratory analysis. Payment for any retesting shall be paid by the Contractor.
- A-14. Saw-cutting existing asphaltic concrete (AC) pavement and concrete surfacing: Measurement and payment for saw-cutting existing AC pavement and concrete surfacing shall include trench width limits plus 6 inches on each side of trench for tee-cut excavation. Payment for saw-cutting existing surfacing for cuts up to 4 inches in depth and for each 1-inch depth beyond the first 4-inch thickness shall be on a per linear foot of cutting basis.
- A-15. Hot mix asphaltic concrete (HMAC) trench resurfacing: Measurement and payment for trench resurfacing shall be on a per ton basis. Payment for HMAC) trench resurfacing shall include furnishing and installing of the asphaltic concrete and aggregate base materials, compaction, process control, acceptance testing, and other incidental work required to provide permanent HMAC pavement at thicknesses as shown on the Drawings and specified in Section 32 12 16, Asphaltic Concrete Pavement.
- A-16. Restoration of Old Airport Road, STA A13+20 to STA A36+80: Measurement and payment for the restoration of Old Airport Road for the segments indicated shall be as follows:
 - a. General surface restoration of roadway, including roadside drainage: Payment for general surface restoration, re-grading the roadway to original contours, and restoring

roadside drainage ditch to pre-construction quality or better will be on a lump sum basis.

- b. Compacted roadway base aggregate, 3/4-inch - 0, 2-inch depth, 15-foot width: The quantities of aggregate mixture will be measured on a volume basis. The quantity will be the number of square yards of aggregate roadway or roadway base constructed to the full thickness shown, with surface area determined by horizontal measurements. Payment shall be on a cubic yard basis. Payment shall include furnishing and placing all materials at locations and depths specified, and for furnishing all equipment, labor, testing, and incidentals, including proof rolling, necessary to complete the work as specified.
 - c. General surface restoration, outside of roadway: Measurement and payment for general surface restoration, outside of paved and gravel roadways, shall be on a lump sum basis. General surface restoration shall include all areas not covered under separate bid items following installation of all transmission main alignments.
- A-17. Abandon-in-place existing 8-inch diameter waterline in Old Airport Road and Airport Road from Westgate to existing Airport Reservoir 1 and 2: Payment for removing abandoned piping or abandoning pipe in place; disconnecting and capping new/live mains; capping abandoned pipe ends; removal/demolition of associated valves, valve boxes and vaults, test stations, meters and meter boxes, hydrants, abandoned services, and other appurtenances; excavation; pipe hole cutting; backfill; and restoring excavations, as required per Section 33 11 50, Existing Pipe Abandonment, will be on a lump sum basis.

Schedule B – New Airport Reservoir

- B-1. All work required to construct 2.0 MG welded steel New Airport Reservoir, complete: Measurement and payment for all work required to construct a 2.0-million-gallon (MG) steel reservoir, complete, other than as provided for under separate unit prices, will be made on a single lump sum basis. General work categories are described in the price breakdown below, with the sum of Items (a) through (k) below being equal to the total lump sum for Bid Item B-1.
- a. Shop drawings and approvals;
 - b. Site preparation, controlled blasting and rock excavation, general excavation, backfill, and grading;

Work includes site preparation, excavation and grading activities for all Schedule B work, including clearing and grubbing, controlled blasting and rock excavation, general excavation, detention facility excavation, onsite and related Schedule B utility trenching, materials stockpiling, additional costs for over-excavation for foundations, placement of flowable fill and imported structural fill, final grading, and any other work

shown on the Drawings unless specified under other bid items, for both the reservoir and booster pump station site.

Hauling and off-site disposal of materials generated from controlled blasting and rock excavation shall be paid for at the unit contract price under separate bid items.

- c. Dewatering;
 - d. Installation of permanent 2-inch depth of 3/4" - 0" crushed rock surfacing over site, extending 2 feet beyond site perimeter fencing, as shown in the Drawings;
 - e. Reservoir construction, including reservoir foundation, access hatches, roof vent, interior piping and pipe blocks, interior and exterior ladders with cabled fall prevention system, roof catwalk, and all other accessories as noted and shown in the Drawings;
 - f. Reservoir testing, disinfection, and start-up;
 - g. Site access driveway and reservoir site access road with surfacing, sidewalks, and features as noted and shown in the Drawings;
 - h. Site stormwater facilities, including drainage ditches and stormwater detention facility;
 - i. Sanitary improvements, including process water soakage trench;
 - j. Concrete reservoir site access stairway, complete; and
 - k. Final site grading, surface restoration, and site clean-up.
- B-2. Hauling and off-site disposal of rock material blasted and excavated from New Airport Reservoir and Booster Station site: Payment shall be on a lump sum basis and include all work associated with the hauling of all blasted and excavated rock materials from the Schedule B project site, including all related equipment, labor, and fees, to designated locations.
- a. To Northern Old Airport Road right-of-way
 - b. Alternative rock quarry disposal locations. Bidders shall provide a unit cost for one Alternative or a combination of the two Alternatives presented below to account for the hauling and off-site disposal of all remaining rock material blasted and excavated from New Airport Reservoir and Booster Station site.
 - 1) Alternative A: To private rock quarry at 3667 Westgate (US Highway 30), approximately 0.9 miles south of Schedule B project site
 - 2) Alternative B: To City of Pendleton rock quarry at NW A Avenue, approximately 1.8 miles west of Schedule B project site

B-3. Furnish and install Class 52 ductile iron pipe with Class B (imported granular material) trench backfill: Payment for furnishing and installing Class 52 ductile iron pipe with Class B (imported granular material) trench backfill, including all work and materials; Contractor inspection and acceptance; storage and transport of pipe; excavation to depths shown in the Drawings; all required joint restraint systems for pipe, fittings, valves, and appurtenances where shown in the Drawings; standard concrete thrust blocks (including concrete, excavation, and thrust plates) where shown in the Drawings; dewatering; wrapping of the piping in two layers of 8-mil polyethylene film where the proposed piping is within 10-foot horizontal of a natural gas line; and Class B pipe bedding, pipe zone backfill, and trench backfill materials, will be on a per linear foot basis for the pipe diameters shown. Pipe bedding, pipe zone, and trench backfill is understood to be imported granular material, compacted in place as shown in the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation and backfill will be on the same basis and shall include the same work as specified in Pay Item A-1.

B-4. Furnish and install ductile iron pipe fittings: Payment for furnishing and installing ductile iron fittings will be made on a per each basis for the type and diameter of fittings shown. Fitting installation will be considered a separate pay item from work performed under other pay items. Fitting accessories including glands, bolts, and gaskets shall be considered incidental in the fitting weights for payment. Payment for joint restraint systems is included under the payment for restrained joint pipe.

B-5. Furnish and install buried valves: Payment for furnishing and installing buried valves not included in other pay items, including valve boxes, covers, risers, extensions, and concrete collars, if required, complete, will be on a per each valve basis for the diameters shown in the Drawings.

B-6. Furnish and install flexible expansion joints: Payment for furnishing and installing flexible expansion joints shall be on a per each basis for the diameters and types shown on the Drawings, and shall include all trench excavation, pipe zone, bedding backfill material, and polyethylene material required for installation.

B-7. Furnish and install Reservoir Check Valve Vault, complete: Payment for check valve vault shall include all work required to construct and test all items for the valve vault and will be made on a lump sum basis. The unit price shall be full compensation for the precast concrete vault at the depth and size as shown in the Drawings, including excavation and backfill, drainage piping, water piping and fittings inside and immediately outside vault, silent check valves, piping specials and accessories, hatch, ladder, and any other work shown on the Drawings, complete, unless specified under other bid items.

B-8. Furnish and install chlorine injection lines: Payment for furnishing and installing chlorine injection lines will be on a per linear foot basis. The unit price for chlorine injection lines shall include furnishing and installing 1/2-inch diameter flexible PVC tubing within 1-1/2-

inch diameter C905 PVC carrier pipe as detailed in the Drawings; all required fittings; excavation and installation to 4-ft depth; dewatering; and Class B pipe bedding, pipe zone backfill, and trench backfill materials.

- B-9. Furnish and install 3/4-inch diameter water quality sampling service laterals: Payment for furnishing and installing 3/4-inch diameter water quality sampling service laterals shall be on a per each basis. Payment shall be full compensation for all associated excavation, hand excavation, backfill, surface restoration.
- B-10. Furnish and install fire hydrant assemblies: Payment for furnishing and installing fire hydrant assemblies will be on a per each basis. The unit price for hydrants shall include all costs for shackles, tie rods, pier blocks, gravel, painting, elbows, thrust blocks, and all other items for the complete installation of the hydrant. Hydrant isolation valves and tees will be paid for at the unit contract price each under the appropriate bid items.
- B-11. Connections to existing water system piping: Payment for connecting to existing water system piping, including exploratory excavation as may be required to confirm piping locations and type; any additional excavation and backfill; cutting existing piping; removal and abandonment of existing utilities, fittings, valves, and appurtenances; and all other miscellaneous tie-in related work not included in other Bid Items, will be on a lump sum basis for the sizes and types as shown in the Drawings.
- B-12. Hydrostatic testing, flushing, and disinfection of water mains: Payment for hydrostatic testing, flushing, and disinfection of water mains will be on a lump sum basis for all mains on the Schedule B project site and shall include furnishing, installing, and removing temporary blow-off piping, including miscellaneous piping, valves, fittings, and thrust restraint. The Owner shall provide off-site laboratory analysis. Payment for any retesting shall be paid by the Contractor.
- B-13. Furnish and install PVC drain pipe with Class B (imported granular material) trench backfill: Payment for furnishing and installing PVC pipe with Class B (imported granular material) trench backfill, including all work and materials; Contractor inspection and acceptance; storage and transport of pipe; excavation to depths shown in the Drawings; all required joint restraint systems for pipe, fittings, valves, and appurtenances where shown in the Drawings; standard concrete thrust blocks (including concrete, excavation, and thrust plates) where shown in the Drawings; dewatering; and Class B pipe bedding, pipe zone backfill, and trench backfill materials, will be on a per linear foot basis for the pipe diameters shown. Pipe bedding, pipe zone, and trench backfill is understood to be imported granular material, compacted in place as shown in the Drawings. Class B fill material shall be as specified within Section 31 23 17, Trenching.

The pay quantities for pipe, trench excavation and backfill will be on the same basis and shall include the same work as specified in Pay Item A-1.

- B-14. Furnish and install ditch inlets: Payment for furnishing and installing ditch inlets, complete, including concrete basin, frame and grate, excavation, backfill, adjustments for setting to final grade, piping connections, and any other incidental work as shown on the Drawings shall be made on a per each basis.
- B-15. Furnish and install 48-inch diameter reservoir monitoring manhole: Payment for furnishing and installing 48-inch diameter reservoir monitoring manhole shall be made at the unit price. The unit price shall be full compensation for the manhole in-place including excavation and backfill, cover and frame as specified, grade rings, piping connections, restrained flap valves, and any other work shown on the Drawings, complete.
- B-16. Furnish and install 48-inch diameter site drainage manholes: Payment for furnishing and installing 48-inch diameter site drainage manholes shall be made at the unit price for each manhole at the depth as shown on the Drawings. The unit price shall be full compensation for the manhole in-place including excavation and backfill, cover and frame as specified, beehive area drain tops as specified, grade rings, piping connections, and any other work shown on the Drawings, complete.
- B-17. Site drainage system testing and start-up: Payment for site drainage system testing and start-up will be on a lump sum basis for all new site drainage and reservoir overflow and drain facilities on the Schedule B project site and shall include furnishing and installing all miscellaneous piping, fittings, and air pressure testing equipment.
- B-18. Furnish and install site perimeter chain link fencing: Payment for site perimeter chain link fencing will be on a per linear foot basis and shall include all costs for materials, labor, and equipment necessary to install fencing per details provided in the Drawings.
- B-19. Furnish and install barbed and woven wire fencing: Payment for barbed and woven wire fencing will be on a per linear foot basis and shall include all costs for materials, labor, and equipment necessary to install fencing per details provided in the Drawings.
- B-20. Furnish and install motorized site access gate with personnel gate, complete, at Booster Station: Payment for the site access gate with personnel gate will be on a lump sum basis and shall include all materials, labor, and equipment necessary to construct and install gates, keypads, motorized controls, electrical service, and all other related systems per the Drawings and specifications.
- B-21. Furnish and install 20-ft wide gate (per ODOT Dwg RD820) with bollards and pedestrian access at Old Airport Road: Payment for the gates will be on a per each basis and shall include all materials, labor, and equipment necessary to construct and install gates and bollards per details provided in the Drawings.
- B-22. Old Airport Road gravel roadway improvements, STA RA1+00 to STA RA22+00: Measurement and payment for the construction of Old Airport Road shall be as follows:

- a. General excavation: Measurement for excavation and removal of existing materials to the depths shown in the roadway typical section shall be on a volume basis. The quantity will be the square yards of material excavated to the full thickness shown, with surface area determined by horizontal measurements. Payment shall be on a cubic yard basis. Payment shall include excavating, selecting, handling, and hauling of materials as specified and furnishing all labor, equipment, and materials necessary to complete the work as specified.
- b. Embankment in place, STA RA11+70 to STA RA14+20: Measurement for placement of embankment to the depths shown in the roadway typical section shall be on a volume basis. The quantity will be the square yards of material placed to the full thickness shown, with surface area determined by horizontal measurements. Payment shall be on a cubic yard basis. Payment shall include selecting, handling, hauling, placement, and compaction of materials as specified and furnishing all labor, equipment, and materials necessary to complete the work as specified.
- c. Compacted roadway aggregate base, 3/4-inch - 0", 8-inch depth: The quantities of aggregate mixture will be measured on a volume basis. The quantity will be the number of square yards of aggregate roadway or roadway base constructed to the full thickness shown, with surface area determined by horizontal measurements. Payment shall be on a cubic yard basis. Payment shall include furnishing and placing all materials at locations and depths specified, and for furnishing all equipment, labor, testing, and incidentals, including proof rolling, necessary to complete the work as specified.
- d. Hot mix asphaltic concrete (HMAC) roadway surfacing, STA RA1+00 to STA RA1+60: Measurement and payment for roadway resurfacing shall be on a per ton basis. Payment for HMAC roadway surfacing shall include furnishing and installing of the asphaltic concrete and aggregate base materials, compaction, process control, acceptance testing, and other incidental work required to provide permanent HMAC pavement at thicknesses as shown on the Drawings and specified in Section 32 12 16, Asphaltic Concrete Pavement.
- e. Cobble-lined roadside drainage ditch: Measurement and payment for the cobble-lined roadside drainage ditch shall be on a per linear foot basis. Payment for the roadside drainage ditch shall include furnishing and installing of the crushed rock materials, excavation, grading, compaction, and other incidental work required to construct the facility.

Schedule C – New Airport Booster Station

- C-1. All work required to construct 4,500 gpm New Airport Booster Station, complete: Measurement and payment for all project work required to construct a 4,500 gallon per minute (gpm) booster station, complete, will be made on a single lump sum basis. General work categories are described in the price breakdown below, with the sum of Items (a) through (e) below being equal to the total lump sum for Bid Item C-1.

- a. CMU building, complete;
- b. Mechanical piping, valves, fittings, and equipment;
- c. HVAC;
- d. Electrical and controls; and
- e. Generator with reinforced concrete pad.

Lump sum payment under this item shall cover all particular elements of the project as above generally outlined, whether or not specifically identified, as specified herein and as shown in the Drawings, except for work included separately under other unit price bid items.

Schedule D – Demolition and Removal of Existing Structures

- D-1. Demolition and removal of Gilliam Canyon Pump Station: Payment for demolition and removal of existing Gilliam Canyon Pump Station will be made on a lump sum basis. All work required to properly remove and dispose of the existing pump station including, but not be limited to, saw-cutting, excavation, removal of building structure, piping, electrical equipment, mechanical equipment, and the disposal of all materials shall be considered incidental to this pay item.
- D-2. Demolition and removal of Airport Reservoirs 1 and 2 and Airport Pump Station: Payment for demolition and removal of existing Airport Reservoirs 1 & 2 and Airport Pump Station will be made on a lump sum basis. All work required to properly remove and dispose of the existing reservoirs and pump station including, but not be limited to, saw-cutting, excavation, removal of structures, piping, electrical equipment, mechanical equipment, and the disposal of all materials shall be considered incidental to this pay item.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section contains administrative and procedural requirements for submittals for review, information, and for Project closeout.

- B. Section includes:
 - 1. Schedule of Submittals.
 - 2. Submittal requirements.
 - 3. Submittal procedures.
 - 4. Owner's Representative review.
 - 5. Resubmittal procedures.
 - 6. Product data.
 - 7. Shop Drawings.
 - 8. Samples.
 - 9. Design data.
 - 10. Test reports.
 - 11. Certificates.
 - 12. Manufacturer's instructions.
 - 13. Manufacturer's field reports.
 - 14. Erection Drawings.
 - 15. Construction progress schedules.
 - 16. Breakdown of contract price.
 - 17. Operation and maintenance (O&M) instructions.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Owner's Representative's responsive action.

- B. Informational Submittals: Written and graphic information and physical Samples that do not require Owner's Representative's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SCHEDULE OF SUBMITTALS

- A. Within 10 days after the Effective Date of the Contract, Contractor shall submit to Owner's Representative a preliminary Schedule of Submittals, including proposed list of major products proposed for use, with specification section reference, name of

manufacturer, supplier, trade name, subcontractor and model number of each product. Provide a schedule of specific target dates for the submission and return of submittals and shop drawings required by the Contract Documents.

- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.
- C. The list and schedule shall be updated and resubmitted when requested by the Owner's Representative.
- D. Contractor's Schedule of Submittals will be acceptable to the Owner's Representative if it provides a workable arrangement for reviewing and processing the required submittals.

1.4 SHOP DRAWING AND SAMPLE SUBMITTAL REQUIREMENTS

- A. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - 1. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - 2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - 3. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- B. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
- C. With each submittal, Contractor shall give Owner's Representative specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Owner's Representative for review of each such variation.

1.5 SUBMITTAL PROCEDURES

- A. Contractor shall submit Shop Drawings and Samples to Owner's Representative for review in accordance with the accepted Schedule of Submittals.
- B. Transmit each submittal with Owner's Representative-accepted transmittal form certifying compliance with requirements of Contract Documents.
- C. Sequentially number transmittal forms. Mark transmittal forms for resubmittals with original number and sequential alphabetic suffix.
- D. Show each Submittal with the following numbering and tracking system:
 - 1. Submittals shall be numbered according to specification section. For example, the first product submittal for Section 055000 would be "055000-1". Resubmittals of that submittal would be "055000-1.1", followed by "055000-1.2", and so on. The second product submittal for that Section would be "055000-2".
 - 2. Submittals containing product information from multiple sections of the specifications will not be reviewed. Contractor and/or their supplier shall divide submittals in a manner that meets the numbering and tracking system requirements stated herein.
 - 3. Alternative method of numbering may be used if acceptable to Owner's Representative.
- E. Identify: Project, Contractor, subcontractor and supplier, pertinent drawing and detail number, and specification Section number appropriate to submittal.
- F. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- G. Coordinate submission of related items.
 - 1. All shop drawings for interrelated items shall be scheduled for submission at the same time.
 - 2. The Owner's Representative may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the Owner's Representative will advise the Contractor in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.

- H. When hard copies of submittals are provided by the Contractor, six copies of all materials shall be provided to the Owner's Representative. Two copies of reviewed submittals will be kept by the Owner's Representative, two copies of reviewed submittals will be transmitted to the Owner, and two copies of reviewed submittals will be returned to the Contractor. If the Contractor requests that more than two copies of the reviewed submittal be returned, then the Contractor shall submit the appropriate quantity of submittals.
- I. When electronic transmittals of submittals are provided by the Contractor under established protocols described elsewhere in the Contract Documents or as jointly developed by the Owner, Owner's Representative and Contractor, provide electronic submittals in portable document format (PDF) in addition to the source document format (Word, Excel, AutoCAD, etc.). Reviewed submittals will be returned to the Contractor as PDF electronic files.
- J. For each submittal for review, allow not less than fourteen days for Owner's Representative review, excluding delivery time to and from Contractor.
- K. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- L. Allow space on submittals for Contractor and Owner's Representative review stamps or comments.
- M. When revised for resubmission, the Contractor shall identify changes made since previous submission. A narrative of changes shall be provided, and shop drawings or calculations shall indicate that a revision was made.
- N. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with review comments.
- O. Submittals not requested will not be recognized nor processed.
- P. Incomplete Submittals: Owner's Representative will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Owner's Representative.

1.6 OWNER'S REPRESENTATIVE REVIEW

- A. Informational submittals and other similar data are for Owner's Representative's information, do not require Owner's Representative's responsive action, and will not be reviewed or returned with comment.
- B. The Owner's Representative's review of submittals and shop drawings is not a check of any dimension or quantity and will not relieve the Contractor from responsibility for errors of any sort in the submittals and shop drawings.

- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. The Owner's Representative will review the submitted data and shop drawings and return to the Contractor with notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", "Revise and Resubmit", or "Submit Specified Item".
- E. If more than two submissions of an item are required to meet the Project specifications, Contractor shall be responsible for Owner's Representative's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.
- F. Owner's Representative will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Owner's Representative. Owner's Representative's review will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
- G. Owner's Representative's review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
- H. Owner's Representative's review of a separate item as such will not indicate approval of the assembly in which the item functions.
- I. Owner's Representative's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 1.4.C and Owner's Representative has given written acceptance of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Owner's Representative will document any such accepted variation from the requirements of the Contract Documents in a Field Order.
- J. Owner's Representative's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 1.4 A. and B.
- K. Owner's Representative's review of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

- L. Neither Owner's Representative's receipt, review, return of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
- M. Contractor shall perform the Work in compliance with the requirements and commitments set forth in returned Shop Drawings and Samples, subject to the provisions of Paragraph 1.6.I.

1.7 RESUBMITTAL PROCEDURES

- A. Contractor shall make corrections required by Owner's Representative and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Owner's Representative on previous submittals.
- B. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required review of an item with no more than two submittals. Owner's Representative will record Owner's Representative's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring review, and Contractor shall be responsible for Owner's Representative's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
- C. If Contractor requests a change of a previously reviewed submittal item, Contractor shall be responsible for Owner's Representative's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

PART 2 PRODUCTS

2.1 CONSTRUCTION PROGRESS SCHEDULES

- A. Within ten days after the Effective Date of the Contract, prepare and submit to the Owner's Representative a practicable schedule showing the order in which the Contractor proposes to carry out the Work, the dates on which the important features of the work will start, and the contemplated dates for completing same. In addition to a time-scaled bar chart schedule depicting the project critical path, the Contractor shall submit a detailed CPM logic diagram. The CPM diagram and time-scaled bar chart shall include the following:
 - 1. Construction activities
 - 2. Submittal and review of material samples and shop drawings
 - 3. Procurement and delivery of critical materials
 - 4. Fabrication, installation, and testing of special material and equipment

5. Duration of work, including completion times of all stages and their sub-phases

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable by manpower and equipment allocation, in common units of measure, or by delivery dates and shall be justifiable by the Contractor upon the request of the Owner's Representative.

Detailed subnetworks will include all necessary activities and logic connectors to describe the work and all restrictions to it. In the restraints, include those activities from the project schedule which initiated the subnetwork as well as those restrained by it.

Include a tabulation of each activity in the computer mathematical analysis of the network diagram. Furnish the following information as a minimum for each activity:

1. Event (node) number(s) for each activity
2. Activity description
3. Original duration of activities (in normal workdays)
4. Estimated remaining duration of activities (in normal workdays)
5. Earliest start date or actual start date (by calendar date)
6. Earliest finish date or actual finish date (by calendar date)
7. Latest start date (by calendar date)
8. Latest finish date (by calendar date)
9. Slack or float time (in workdays)

Computer printouts shall consist of at least a node sort and an "early start/total-float" sort.

- B. Attention is drawn to typical local climatic weather patterns and Work shall be coordinated accordingly.
- C. Complete project schedule shall be revised and resubmitted to the Owner's Representative at a minimum occurrence of every three weeks for review.
- D. Five-Week Lookahead Schedules: Provide each week at the weekly construction meeting. The previous week's completed work shall be shown on the schedule for a total of 6 weeks shown.

2.2 BREAKDOWN OF CONTRACT PRICE

- A. Within ten days after the Effective Date of the Contract, submit a complete breakdown of all lump sum bid items showing the value assigned to each part of the work, including an allowance for profit and overhead adding up to the total lump sum contract price.

- B. Breakdown of lump sum bids shall be coordinated with the items in the schedule and shall be in sufficient detail to serve as the basis for progress payments during construction.
- C. Owner's Representative will review the contract price breakdown and may request items to be further broken down or for more items be added in order to facilitate tracking of work progress for payment.
- D. Preparatory work, bonds, and insurance required in setting up the job will be allowed as a separate entry on the cost breakdown but shall not exceed 5 percent of the total base bid.
- E. Upon acceptance of the breakdown of the contract price by the Owner's Representative, it shall be used as the basis for all requests for payment.

2.3 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Owner's Representative for review for assessing conformance with information given and design concept expressed in Contract Documents. Submitted data shall be sufficient in detail for determination of compliance with the Contract Documents.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
 - 1. Note submittal will be returned to Contractor without review of submittal if products, models, options and other data are not clearly marked or identified.
- C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.4 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Owner's Representative for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Owner's Representative licensed in the state of Project responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. All dimensioned shop drawings shall be scalable and provided as full-sized (22" x 34") sheets. PDF electronic files shall print as scalable full-sized sheets.
- E. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.5 SAMPLES

- A. Samples: Action Submittal: Submit to Owner's Representative for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Owner's Representative for aesthetic, color, and finish selection.
 - 2. Submit Samples of finishes, textures, and patterns for Owner selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Owner's Representative will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. NOT USED.
- H. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.6 DESIGN DATA

- A. Informational Submittal: Submit data for Owner's Representative's knowledge as Contract administrator or for Owner.
- B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

2.7 TEST REPORTS

- A. Informational Submittal: Submit reports for Owner's Representative's knowledge and records as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.8 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Owner's Representative, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Owner's Representative.

2.9 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Owner's Representative's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Owner's Representative in quantities specified for Product Data.
- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

2.10 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Owner's Representative's knowledge and records as Contract administrator or for Owner.
- B. Submit report within 48 hours of observation to Owner's Representative for information.

- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.11 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Owner's Representative's knowledge and records as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Owner's Representative or Owner.

2.12 NOT USED

2.13 NOT USED

2.14 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

- A. Submit preliminary O&M materials for review by Owner's Representative. The equipment manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your equipment has this accessory..." or listings of equipment not furnished are eliminated. O&M materials will be returned to the Contractor for resubmittal if the O&M materials do not clearly indicate what specific equipment was furnished and all items not provided being clearly crossed out. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:
 - 1. Reviewed shop drawings and submittal data;
 - 2. Model, type, size and serial numbers of equipment furnished;
 - 3. Equipment and driver nameplate data;
 - 4. List of parts showing replacement numbers;
 - 5. Recommended list of spare parts;
 - 6. Complete operating instructions including start-up, shutdown, adjustments, cleaning, etc.;
 - 7. Maintenance and repair requirements including frequency and detailed instructions; and
 - 8. Name, address and phone numbers of local representative and authorized repair service.

- B. Following review of the preliminary O&M materials by the Owner's Representative and before acceptance of the Work, submit:
1. Four hard copies of complete final operation and maintenance instructions for all equipment supplied. Submit items in 8-1/2 x 11-inch heavy-duty three-ring binders when appropriate, or in 8-1/2 x 11-inch file folders. All binders and folders shall have clear plastic pockets on the front of the cover and the spine to allow for insertion of identifying information.
 2. Two searchable electronic PDF copies of full O&M materials. Provide each electronic copy on its own individual thumb drive or disc.

2.15 OTHER REQUIRED SUBMITTALS

- A. Other required submittals include the items listed below. This list is provided for Contractor's convenience only and may not be complete in all respects. Contractor shall provide all submittals specified or required, whether or not listed here.
1. Contractor Emergency Contact List.
 2. Erosion and Sediment Control Plan.
 3. Traffic Control and Protection Plan.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers quality control requirements supplementary to those of the General Conditions and Technical Specifications.

1.2 PROVISIONS

- A. CONTRACTOR'S Responsibility for Testing

The CONTRACTOR shall be responsible for the cost of all testing as specified in this section. Additional information has been provided regarding the payment responsibility for the OWNER with regards to the Project.

- B. OWNER'S Right to Perform Additional Tests

The OWNER or OWNER'S REPRESENTATIVE reserves the right to complete additional testing. In such cases, the Contractor shall provide safe access for the OWNER or OWNER'S REPRESENTATIVE and their inspectors to adequately inspect the quality of work and the conformance with project specifications.

1.3 QUALITY ASSURANCE

- A. Testing Requirements

An independently owned and operated laboratory approved by the OWNER'S REPRESENTATIVE shall perform all testing as specified herein.

- B. Testing

1. General

- a. All required testing of work and/or materials shall be conducted in the presence of the OWNER'S REPRESENTATIVE. The Contractor shall provide 48-hour notification to the OWNER and OWNER'S REPRESENTATIVE prior to conducting any and all quality assurance testing. Where applicable, work and materials shall only be buried with the consent of the OWNER'S REPRESENTATIVE.
- b. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample or samples of material to be tested shall be selected by such laboratory or agency or by the OWNER'S REPRESENTATIVE.

The CONTRACTOR shall furnish such samples of all materials without charge to OWNER.

- c. The results from any and all tests are made for the information of the OWNER. Regardless of any test results, the CONTRACTOR is solely responsible for the quality of workmanship and materials and for compliance with the requirements of the Drawings and Specifications.

2. Costs of Testing

- a. The CONTRACTOR shall be responsible for and shall pay for all tests as specified in Part 3 of this Section. Additional information has been provided regarding the payment responsibility for the OWNER with regards to the Project.
- b. With regards to all materials to be tested, where test results demonstrate that the material or workmanship does not meet the minimum requirements of the Contract Documents, additional testing shall be completed and shall be paid for by the CONTRACTOR with no reimbursement by the OWNER.

1.4 SPECIAL INSPECTIONS

Special inspections and testing as required by Chapter 17 of the IBC shall be conducted by OWNER-retained Special Inspectors and Testing Agencies as required and as indicated in the Contract Documents.

A. Special Inspectors and Testing Agencies Responsibilities

1. Verify that manufacturers maintain detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.
2. Promptly notify OWNER and CONTRACTOR of irregularities and deficiencies observed in the Work during performance of their services.
3. Submit certified written report of each test, inspection and similar quality control service to OWNER, CONTRACTOR and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
4. Submit final report of special inspections at Substantial Completion, including a list of unresolved deficiencies.
5. Re-test and re-inspect corrected work.

B. CONTRACTOR'S Responsibilities

1. Provide quality requirements to all subcontractors and enforce all requirements.
2. Notify OWNER, OWNER'S REPRESENTATIVE, Special Inspectors and Testing Agencies at least 48 hours in advance of time when Work that requires testing or special inspecting will be performed, unless otherwise indicated in the Contract Documents.
3. Pay for any CONTRACTOR requested testing and inspecting not required by the Contract Documents.
4. Pay for any re-testing or re-inspections by Special Inspectors and Testing Agencies for replacement work resulting from work that failed to comply with the Contract Documents. OWNER will deduct such costs from the Contract Price.
5. Submit copies of licenses, certifications, correspondence, records and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the OWNER, OWNER'S REPRESENTATIVE and Special Inspectors.
6. Where Special Inspection requires pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - a. Provide test specimens representative of proposed products and construction in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - b. Provide information on configurations of test assemblies, testing procedures and laboratory test records to adequately demonstrate capability of products to comply with performance requirements.
7. Cooperate with Agencies performing required tests, special inspections and similar quality control services. Notify Agencies in advance of operations to permit assignment of personnel. Provide the following:
 - a. Access to the Work.
 - b. Incidental labor, equipment and materials necessary to facilitate tests and special inspections.
 - c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.
 - d. Provide facilities for storage and field curing of test samples.

- e. Deliver samples to Testing Agencies.
- 8. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.
- 9. Schedule times for tests, special inspections, obtaining samples and similar activities. Distribute schedule to OWNER, OWNER'S REPRESENTATIVE, Special Inspectors, Testing Agencies and each party involved in portions of the work where tests and special inspections are required.

1.5 ENGINEER OF RECORD OBSERVATIONS

- A. The OWNER shall employ the Engineer of Record or an alternate Oregon-licensed Professional Engineer approved by the Engineer of Record to perform certain structural observations in accordance with Section 1704.5 of the International Building Code.
- B. Engineer of Record Responsibilities
 - 1. Verify that Contractor maintains detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.
 - 2. Promptly notify OWNER and CONTRACTOR of irregularities and deficiencies observed in the Work during performance of their services.
 - 3. Submit certified written report of each observation and similar quality control service to OWNER, CONTRACTOR and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 - 4. Submit final report of observations at Substantial Completion, including a list of unresolved deficiencies.
 - 5. Re-test and re-inspect corrected work.
- C. CONTRACTOR'S Responsibilities
 - 1. Provide quality requirements to all subcontractors and enforce all requirements.
 - 2. Notify Engineer of Record at least 48 hours in advance of time when Work that requires observation will be performed, unless otherwise indicated in the Contract Documents.

3. Pay for any re-observations by Engineer of Record for replacement work resulting from work that failed to comply with the Contract Documents. OWNER will deduct such costs from the Contract Price.
 4. Submit copies of licenses, certifications, correspondence, records and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the OWNER, OWNER'S REPRESENTATIVE and Engineer of Record.
 5. Cooperate with Engineer of Record performing required observations and quality control services. Notify Engineer of Record personnel in advance of operations to permit assignment of personnel. Provide the following:
 - a. Access to the Work.
 - b. Incidental labor, equipment and materials necessary to facilitate tests and special inspections.
 - c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.
 6. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.
 7. Schedule times for observations and similar activities. Distribute schedule to OWNER, OWNER'S REPRESENTATIVE, and Engineer of Record involved in portions of the work where tests and observations are required.
- D. For Engineer of Record observation requirements, see the following sheets within the Contract Documents:
1. Reservoir: Sheet RES-S-2.
 2. Booster Pump Station: Sheet BPS-S-2.

1.6 SUBMITTALS

A. Laboratory Test or Inspection Reports

Each report shall be signed and certified by the independently owned and operated testing laboratory. Unless otherwise specified, submit three (3) copies of each report to the OWNER or OWNER'S REPRESENTATIVE.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 FIELD TESTING SCHEDULE

A. The CONTRACTOR shall complete field testing in accordance with the following schedule. Additional source material testing shall be completed as necessary to establish the basis of field tests. The frequency of testing listed in this schedule lists the minimum number of tests per quantity of work completed by the CONTRACTOR. Testing locations to be determined by the OWNER’S REPRESENTATIVE.

Material to be Tested	Payment Responsibility for Initial Testing	Minimum Testing Frequency
Structural Backfill	OWNER	In-place compaction testing (w/ nuclear compaction gage) performed at 2-foot elevation increments, one test per 2,500 sf of material placed. See Article 3.5, Field Quality Control of Section 31 23 23, Fill for further details on testing requirements.
Trench Backfill	CONTRACTOR	In-place compaction testing (w/ nuclear compaction gage) performed at 2-foot elevation increments, one test per 200 lineal feet of pipeline trench as measured along pipe centerline. OWNER’S REPRESENTATIVE may reduce frequency to one test per lift for every 1,500 lineal feet of pipeline trench when satisfied with CONTRACTOR’s method of compaction. See Article 3.15, Field Quality Control of Section 31 23 17, Trenching for further details.
Gravel Roadway	CONTRACTOR	Subgrade preparation and proof rolling per Article 3.1, Subgrade Preparation, of Section 32 11 23, Aggregate Base Courses. In-place compaction testing (w/ nuclear compaction gage) performed at 6-inch elevation increments, one test per 200 lineal feet of gravel roadway as measured along roadway centerline. See Article 3.7, Field Quality Control of Section 32 11 23, Aggregate Base Courses for further details.

Material to be Tested	Payment Responsibility for Initial Testing	Minimum Testing Frequency
Asphalt Concrete	CONTRACTOR	<p>As required when placed. See detailed requirements in Article 3.3, Field Quality Control of Section 32 12 16, Asphalt Paving.</p> <p>Field Quality Control requirements shall also pertain to all work completed under Section 32 12 16.39, Asphalt Paving for Steel Tank Base.</p>
Concrete	OWNER	<p>As required when placed. See detailed requirements in Article 3.14, Quality Control Testing During Construction, Section 03 30 00, Concrete Work.</p>
Grout	OWNER	<p>Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Owner's Representative to insure continued compliance with Specifications. See detailed requirements in Article 1.5, Quality Assurance, Section 03 60 00, Grouting.</p>
Masonry Mortar and Grout	OWNER	<p>As required when placed. See detailed requirements in Section 04 05 10-1.4.</p>
Waterline – Hydrostatic testing and disinfection	CONTRACTOR	<p>As required. See Section 33 13 00, Testing & Disinfection of Water Utility Piping.</p>
Reservoir – Disinfection	CONTRACTOR	<p>As required. See Section 33 13 13, Disinfection of Water Utility Storage Tanks</p>
Reservoir –Testing and repair of leaks	CONTRACTOR	<p>As required. See Section 33 16 13.13-3.3(F), Ground-Level Steel Water Storage Tanks.</p>

END OF SECTION

SECTION 01 75 16

TESTING, TRAINING AND SYSTEM START-UP

PART 1 GENERAL

1.1 SCOPE

This section specifies equipment and system testing and start-up, services of manufacturer's representatives, training of OWNER's personnel and final testing requirements for the complete facility.

1.2 CONTRACT REQUIREMENTS

- A. Testing, training and start-up are requisite to the satisfactory completion of the Contract.
- B. Complete all testing, training, and start-up within the Contract Time(s).
- C. Furnish all necessary labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.
- D. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation, testing, and operator training.

1.3 START-UP PLAN

- A. Submit start-up plan for each piece of equipment and each system not less than 2 weeks prior to planned initial equipment or system start-up.
- B. Provide detailed Start-up Progress Schedule with the following activities identified:
 - 1. Manufacturer's services
 - 2. Installation certifications
 - 3. Operator training
 - 4. Submission of operation and maintenance manual
 - 5. Functional testing
 - 6. Performance testing
 - 7. Operational testing
- C. Provide testing plan with test logs for each item of equipment and/or system. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.

- D. Provide summary of shutdown requirements for existing systems if required, which are necessary to complete start-up of new equipment and systems.
- E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.4 GENERAL START-UP AND TESTING PROCEDURES

A. Mechanical Systems:

1. Remove rust preventatives and oils applied to protect equipment during construction.
2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.
3. Flush fuel system and provide fuel for testing and start-up.
4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
7. Perform cold alignment and hot alignment to manufacturer's tolerances.
8. Adjust V-belt tension and variable pitch sheaves.
9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
11. Install gratings, safety chains, handrails, shaft guards and sidewalks prior to operational testing.

B. Electrical Systems

1. Perform insulation resistance tests on wiring except 120-volt lighting, wiring, and control wiring inside electrical panels.
2. Perform continuity tests on grounding systems.

3. Test and set switchgear and circuit breaker relays for proper operation.
4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.
5. Check motors for actual full load amperage draw. Compare to nameplate value.

C. Instrumentation Systems

1. Bench or field calibrate instruments and make required adjustments and control point settings.
2. Leak test pneumatic controls and instrument air piping.
3. Energize transmitting and control signal systems, verify proper operation, ranges and settings.

1.5 FUNCTIONAL TESTING

- A. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.
- B. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.
- C. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.
- D. Conduct continuous 8-hour test under full load conditions. Replace parts which operate improperly.

1.6 CERTIFICATE OF PROPER INSTALLATION

- A. At completion of functional testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:
 1. Has been properly installed, aligned, adjusted and lubricated.
 2. Is free of any stresses imposed by connecting piping or anchor bolts.
 3. Is suitable for satisfactory full-time operation under full load conditions.
 4. Operates within the allowable limits for vibration.

5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
 6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly functioning.
- B. Furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:
1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.
 2. Control logic for equipment start-up, shutdown, sequencing, interlocks and emergency shutdown has been tested and is properly operating.
- C. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.7 TRAINING OF OWNER'S PERSONNEL

- A. Provide operations and maintenance training for items of mechanical, electrical and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions.
- B. Coordinate training schedule with City staff. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than two (2) sessions per week.
- C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems 2 weeks prior to training session for that piece of equipment or system.
- D. Satisfactorily complete functional testing before beginning operator training.
- E. The OWNER may videotape the training for later use with the OWNER's personnel.

1.8 MINIMUM SERVICE SCHEDULE

Minimum services as specified shall be provided in accordance with the following schedule:

Specification Section	Equipment	Minimum On-Site Time Requirements		
		1) Equipment Installation	2) Equipment Testing	3) Operator Training
43 21 15	Vertical Split Case Pumps	2 CWD	3 CWD	1 CWD
43 21 13	End Suction Centrifugal Pump	2 CWD	3 CWD	1 CWD
40 75 21	Water Quality Instruments	1 CWD	0.5 CWD	0.5 CWD
40 71 13	Electromagnetic Flow Meters	1 CWD	0.5 CWD	0.25 CWD
40 72 13	Ultrasonic Level Meters	1 CWD	0.5 CWD	0.25 CWD
40 05 23.74	Hydraulic Valves	0.5 CWD per valve	0.5 CWD per valve	0.25 CWD per valve
40 90 00	Instrumentation & Control	5 CWD	4 CWD	2 CWD

NOTE: CWD is defined as a consecutive working day consisting of 8 hours each from 8:00 a.m. to 5:00 p.m.

1.9 OPERATIONAL TESTING

- A. Conduct operational test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation.
- B. Conduct operational test for continuous seven (7) day period.
- C. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.
- D. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.
- E. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.10 RECORD KEEPING

- A. Maintain and submit to OWNER'S REPRESENTATIVE the following records generated during start-up and testing phase of project:
 1. Daily logs of equipment testing identifying all tests conducted and outcome.
 2. Logs of time spent by manufacturer's representatives performing services on the job site.
 3. Equipment lubrication records.

4. Electrical phase, voltage, and amperage measurements.
5. Insulation resistance measurements.
6. Pump torsional and lateral vibration analysis report.
7. Data sheets of control loop testing including testing and calibration of instrumentation devices and set-points.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 02 30 00

SUBSURFACE INVESTIGATION

PART 1 GENERAL

1.1 SUMMARY

- A. Subsurface investigations and reporting have been performed for the purpose of obtaining data for the planning and design of this project. Copies of such reporting are attached to the Contract Documents as Supplementary Information.

1.2 LIMITATIONS

- A. The subsurface investigations and reporting are being made available solely for the convenience of the Bidder and shall not relieve the BIDDER or the CONTRACTOR of any risk, duty to make examinations and investigations as required by Article 4 of the Instructions to BIDDERS, or any other responsibility under the Contract Documents.
- B. It is mutually agreed to by all parties:
 - 1. Written reports are reference documents and are not part of the Contract Documents.
 - 2. Subsurface investigations are for the purpose of obtaining data for planning and design of the project.
 - 3. Data concerning borings and test pits is intended to represent with reasonable accuracy conditions and material found in specific borings and test pits at the time the borings and test pits were made.
- C. It is expressly understood and agreed the OWNER and OWNER'S REPRESENTATIVE assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigation thus made, the records thereof, or of the interpretations set forth therein, or made by the OWNER in his use thereof; and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations, or records thereof, are representative of those existing throughout such areas, or any part, or that unforeseen developments may not occur.
- D. The OWNER'S subsurface investigations and reporting are made available to BIDDER or CONTRACTOR only on the basis of the understandings and agreement herein stated.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of existing facilities.
2. Abandoning and removing utilities.

B. Related Sections:

1. Section 31 05 16 - Aggregates for Earthwork.
2. Section 31 10 00 - Site Clearing.
3. Section 31 22 13 - Rough Grading.
4. Section 31 23 16 - Excavation.
5. Section 33 11 50 - Existing Pipe Abandonment.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit to Owner's Representative a copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.3 QUALITY ASSURANCE

A. Existing Conditions: Determine the extent of work required and limitations before proceeding with Work.

B. Conform to applicable local, state and federal codes for environmental requirements in relation to disposal of debris.

1. Burning at the Site for the disposal of refuse, debris, and waste materials resulting from demolition and site clearing operations shall not be permitted.

C. Permits: The CONTRACTOR is responsible for obtaining all necessary permits required for completion of the Work described in this Section.

D. Protection of Persons and Property: Meet all federal, state and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the Work and requirements of the General Provisions.

- E. If the existing material to be demolished and removed contains any hazardous materials which will require special handling upon removal, such as asbestos or lead, it is the responsibility of the CONTRACTOR to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Materials: All materials, equipment, miscellaneous items and debris involved, occurring or resulting from demolition, clearing and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or Specifications.
- B. Crushed Rock: As specified in Section 31 05 16-2.1, Aggregates for Earthwork. Of the size shown in the Drawings or specified herein.
- C. Sand: As specified in Section 31 05 16-2.2, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The OWNER assumes no responsibility for the actual condition of the facilities to be demolished. The CONTRACTOR shall visit the site, inspect all facilities and be familiar with all existing conditions and utilities.
- B. Demolition drawings identify major equipment and structures to be demolished only. Auxiliary utilities such as water, air, chemicals, drainage, lubrication oil, hydraulic power fluid, electrical wiring, controls, and instrumentation are not necessarily shown shall be considered incidental to all demolition work.
- C. Identify waste and salvage areas for placing removed materials.

3.2 PREPARATION

- A. Carefully coordinate the work of this Section with all other work and construction.
- B. Call Local Utility Line Information service at 1-800-332-2344, not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Disconnect or arrange for disconnection of utilities (if any) affected by required work.

3. Keep all active utilities intact and in continuous operations.

3.3 PROTECTION

- A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.
- B. Survey control: Protect bench marks, survey control points, and existing structures from damage or displacement.
- C. Preservation and Trimming of Trees, Shrubs and Other Vegetation: As specified in Section 31 10 00-3.4(C), Site Clearing.
- D. Landscaped Areas: Protect existing landscaped areas as specified in Section 31 10 00-3.4(D), Site Clearing.
- E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, guy wires, utility poles, and curbs.
- F. Repair and Replacement:
 - 1. Damaged items, including but not restricted to those noted above, shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of Work of this contract.
 - 2. Any damage to existing facilities or utilities to remain as caused by the CONTRACTOR'S operations shall be repaired at the CONTRACTOR'S expense.

3.4 DEMOLITION

- A. Areas which are to be excavated for the purpose of demolition shall be cleared and stripped in accordance with Section 31 10 00-3.6, Clearing and Grubbing.
- B. Carefully consider all bearing loads and capacities for placement of equipment and material on site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, consult with OWNER'S REPRESENTATIVE prior to the placement of such equipment or material.
- C. Demolition of Existing Structures:
 - 1. Excavate around existing structures as required to perform demolition operations and to plug associated existing pipelines where shown in the Drawing.

2. Provide shoring, bracing, and supports, as required, to insure adjacent structures are not damaged and structural elements of existing structure are not overloaded during demolition activities.
 - a. Increase structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract.
 - b. Remove all temporary protection when the Work is complete or when so authorized by the OWNER'S REPRESENTATIVE.
 3. Any floors that are to remain in place shall be completely cracked through to allow for drainage. Cracking shall be accomplished by dropping a demolition ball or by other methods approved by the OWNER'S REPRESENTATIVE.
 4. Remove and dispose of all exposed and/or protruding metalwork, piping, plumbing and conduits resulting from demolition activities, and all woodwork, roofing, and electrical and mechanical equipment removed from demolished structures.
 - a. Reinforcing bars shall be cut flush with final wall elevations as shown in the Drawings.
 - b. No detached metalwork, excluding concrete reinforcing bars, shall be buried with the concrete and masonry rubble.
- D. Backfill at Demolished Structures:
1. For structures designated to be abandoned and/or demolished in place, concrete and/or masonry rubble and excavated soils resulting from demolition activities shall be used for backfill or placed in the bottoms of said structures only as directed by the Owner's Representative.
 2. Concrete and masonry rubble used for backfilling shall be broken into pieces no larger than 12 inches on any one side.
 3. Materials resulting from abandonment / demolition activities approved for backfill shall be combined with imported filler sand to create a dense, compacted backfill.
 4. Backfilling or placement of the excavated material in the structures shall meet the following requirements.
 - a. Furnish, place and compact filler sand along with the concrete and masonry rubble so that all voids are filled and a dense, compacted backfill is obtained.
 - b. Filler sand shall be placed in horizontal layers completely filling all voids between pieces of rubble and not exceeding 12 inches in thickness.

- c. Each layer of filler sand shall be compacted to obtain at least 90 percent of maximum density as determined by ASTM Method D-698-78 (AASHTO T-99).
 - d. Water shall be furnished by the CONTRACTOR and added to each layer as required to maintain optimum moisture content.
 - e. The amount of filler sand used shall only be the amount needed to fill all voids created by placement of the concrete and asphalt rubble, as directed by the OWNER'S REPRESENTATIVE.
 - f. At locations where concrete and masonry rubble are used for backfill, it shall be placed such that a minimum of 3 feet of compacted non-rubble backfill material (crushed rock) exists between any rubble and finished grade. Protruding reinforcing bars shall be cut to lengths that allow granular backfill to be placed and compacted to required levels in and above the rubble.
- 5. Disposal of all materials not used for backfill shall be performed off-site and in compliance with applicable local, state, and federal codes and requirements.
 - 6. In areas where new construction will take place, no trace of these structures shall remain prior to placing of backfill.
- E. Backfilling within the footprint of new structures with rubble material resulting from demolition activities will not be allowed.
 - F. All existing improvements designated in the Drawings or specified to be removed including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing and similar structures occurring above, at, or below existing ground surface shall be included in the demolition work.
 - G. Unless otherwise specified, any resulting voids shall be backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.

3.5 EXISTING WATER UTILITY PIPING ABANDONMENT

- A. As specified in Section 33 11 50, Existing Pipe Abandonment.

3.6 ELECTRICAL AND CONTROL SYSTEM DEMOLITION

- A. All electrical and control system demolition work shall at all times be conducted in a safe and proper manner to avoid injury from electrical shock to all personnel.
 - 1. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable.

2. At no time shall live electrical wiring or connections or those which can become energized be accessible to any persons without suitable protection or warning signs.
3. Materials or equipment the OWNER is to salvage shall be marked prior to demolition activities. Coordinate salvage with OWNER.

3.7 ASPHALTIC CONCRETE DEMOLITION

- A. Asphalt pavement shall be removed to the limits shown in the Drawings.
- B. The limits of the removal shall be saw cut.
- C. Asphalt pavement may not be used as rubble fill.

3.8 REMOVAL

- A. Remove debris, rock, excavated materials, rubble, abandoned piping and extracted plant life resulting from abandonment and/or demolition activities from site.
- B. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- C. Removal: All material resulting from demolition, clearing and grubbing, and trimming operations shall be removed from the project site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.

3.9 GRADING

- A. All grading work shall be completed in accordance with Section 31 22 13, Rough Grading.

3.10 CLEANUP:

- A. During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, debris, and dust and shall leave all areas affected by the work in a clean, condition, as may be subject to Owner's Representative approval.
- B. Adjacent structures shall be cleaned of dust, dirt and debris resulting from demolition.
- C. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

SECTION 03 21 00
REINFORCING STEEL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes all the work necessary to furnish all labor, materials, equipment, and services necessary to furnish reinforcing steel, accessories, welding, equipment and services, and place concrete reinforcement.

- B. Section includes:
 - 1. Reinforcing steel.

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-In-Place Concrete Work.
- B. Section 04 22 00 – Concrete Masonry Units.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Shop Drawings: Submit shop drawings of detailed placing and bending lists for the OWNER'S REPRESENTATIVE approval before the reinforcement is fabricated.

- C. Mill Certificates: Mill test certificates shall be submitted to the OWNER'S REPRESENTATIVE to certify that the reinforcing steel meets the specified requirements. Mill test certificates shall be furnished and paid for by the CONTRACTOR.

- D. In addition, the OWNER'S REPRESENTATIVE may require that test samples be taken and test certificates be furnished by a reputable material testing laboratory at the OWNER's expense.

1.4 QUALITY CONTROL

- A. The OWNER'S REPRESENTATIVE may require that test samples be taken and test certificates be furnished by a reputable material testing laboratory at the OWNER's expense.

PART 2 PRODUCTS

2.1 DEFORMED REINFORCING BARS

- A. Unless otherwise specified, reinforcing steel shall be Grade 60 billet steel conforming to ASTM Specification A615 or ASTM 706.
 - 1. All such reinforcing shall be deformed steel bars with *deformations* conforming to the requirements set forth in ASTM Specification A615 or ASTM 706
 - 2. Stirrups and Ties shall be Grade 60 but Grade 40 may be used for #3 and smaller.
- B. Spiral reinforcement and steel wire shall be cold-drawn steel wire conforming to the requirements of ASTM Specification A82 unless shown otherwise on the Drawings.
- C. Welded Wire Fabric (WWF) shall conform to ASTM Specification A185.
- D. Bar and rod mats for concrete reinforcement conforming to ASTM A184
- E. Tie wire, 16 gauge or heavier black annealed wire.
- F. Varying grades shall not be used interchangeably in structures.
- G. Steel bending processes shall conform to the requirements of ACI 318.
- H. Bending or straightening shall be accomplished so that the steel will not be damaged.
- I. Kinked bars shall not be used.

2.2 PLAIN REINFORCING BARS

Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82 unless shown otherwise on the Drawings.

Plain smooth dowels and ¼-inch diameter smooth bars conforming to ASTM A615 Grade 60.

2.3 SUPPORTS

- A. Bar supports shall conform to ACI 315 and CRSI Manual of Standard Practice, Chapter 3, Bar Supports
- B. Bar supports shall consist of approved high density "adobes", stainless steel chairs, plastic spacers or plastic shim plates.
 - 1. Brick, broken concrete masonry units, spalls, rocks or similar materials **shall not** be used for support of reinforcing steel.

2. Steel chairs shall be furnished with plastic tips when incorporated into concrete exposed to view, such as in the roof slab.
 3. Plastic spacers shall be PRECO BARSPAN WHEELS, as manufactured by the PRECO CORPORATION or equal.
 4. Plastic shim plates may be used to support the plastic spacers and shall be used to support the vertical reinforcing in the corewall, unless shown otherwise on the Drawings.
- C. Hot-dipped Galvanized Reinforcing Bars
- When reinforcing bars are indicated on the Drawings to be hot-dipped galvanized, they shall be galvanized in accordance with ASTM A767 and ASTM A143. The grade of reinforcing bars shall be as specified under Section 2.1. The bars shall be galvanized in conformance with a Class 1 coating and shall be galvanized after fabrication and shearing.
- D. Steel Tie Wire: Annealed steel tie wire shall be used to fasten the reinforcing steel in place.

PART 3 EXECUTION

3.1 REINFORCING BARS

Comply with the specified codes and standards and Concrete Reinforcing Steel Institutes recommended practice for "placing reinforcing bars," for details and methods of reinforcement placement and supports, and as herein specified.

A. General

1. Mild steel reinforcing bars shall be furnished, cut, bent and placed as indicated on the Drawings.
2. At the time of placing concrete, all reinforcement shall be free from loose mill scale, rust, grease, oil, or other coating which might destroy or reduce its bond with concrete.
 - a. Reinforcing bars with rust, mill scale or a combination of both will not be acceptable without cleaning or brushing provided that upon wire brushing a sample, the dimensions including height of deformations and weights shall not be less than the applicable ASTM requirements. Steel reinforcement which is to be placed in the work shall be stored under cover to prevent rusting and shall be placed on blocking such that no steel touches any ground surface.

3. All reinforcing steel placed in the work shall be tied together and supported in such a manner that displacement during placing of concrete and shotcrete will not occur.
4. When there is a delay in depositing concrete, reinforcement shall be re-inspected and cleaned when necessary.

B. Cutting and Bending

1. Steel reinforcement shall be cut and bent in accordance with ACI 318 and with approved practices and machine methods, either at the shop or in the field.
2. Reinforcement shall be accurately formed to the dimensions indicated on the Drawings and on the bending schedule.
3. Bends for hooks on bars shall be made around a pin having a diameter not less than six times the minimum thickness of the bar.
4. All bars shall be bent cold.

C. Minimum Bar Spacing

The clear distance between parallel bars shall not be less than one and one-half times the diameter of the bars and, unless specifically authorized, shall in no case be less than 1-inch, nor less than the maximum size of coarse aggregate specified.

D. Concrete Cover (Minimum)

1. On all formed surfaces which will be exposed to water, ground or the elements, there shall be a nominal cover over the steel of 2.0-inches for bars number 6 through number 18 and 1-1/2 inches for bars number 5 and smaller, with an installation tolerance of + 1/4 inch. When crossing bars of different diameter are encountered in one face, one shall consider the bar size and location that will provide the largest cover over the nearest steel to the outside surface.
2. Unless otherwise specified in these specifications or shown on the Drawings, all reinforcing steel facing subgrades for concrete construction of the foundation or below-grade elements shall be given a nominal protective cover of 3.0-inch minimum. The largest cover shall be used when different size bars are encountered in one face.
3. The minimum cover over reinforcing steel for concrete construction of other facilities shall be as shown on the Drawings.
4. No "bury" or "carrier" bars will be allowed unless specifically approved by the OWNER'S REPRESENTATIVE.

E. Splicing

1. Except as shown or specified on the Drawings, reinforcing steel shall not be spliced at any location without specific approval by the STRUCTURAL ENGINEER OF RECORD. Splices in adjacent bars shall be staggered.
2. Where permitted or required, splices in reinforcing steel shall have sufficient lap to transfer full strength of the bar by bond and shear. Unless specified or shown otherwise on the Drawings, the bars at a lap splice shall be in contact with each other. In no event shall the lap be less than 40 diameters of the spliced bars.
3. Unless specified or shown otherwise on the Drawings, bars shall be lap spliced in accordance with ACI 318 and shall be fastened together with steel tie wire.
4. Unless shown otherwise on the Drawings, where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a minimum length equal to the lap splice length indicated on the Drawings. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.

F. Supports

1. All reinforcement shall be retained in place, true to indicated lines and grades, by the use of approved bar supports. The CONTRACTOR shall submit for OWNER'S REPRESENTATIVE'S approval, samples of all bar supports he proposes to use along with a written description of where each bar support will be used.
2. The supports shall be of sufficient quantity, strength and stability to maintain the reinforcement in place throughout the concreting operations. Bar supports shall be placed no further than 4 feet apart in each direction. Supports must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete. The CONTRACTOR shall be held responsible for providing the appropriate quantity and type of bar supports.
3. Do not place reinforcing bars more than two inches beyond the last leg on continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

G. Bar Tying

1. Bars shall be tied sufficiently often to prevent shifting. There shall be at least three ties in each bar length (this shall not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity).

2. Slab bars shall be tied at every intersection around the periphery of the slab. Wall bars and slab bar intersections shall be tied at not less than every fourth intersection, but at not greater than the following maximum spacings:

	Slab Bars (in)	Wall Bars (in)
Bars No. 5 and smaller	60	48
Bars No. 6 through No. 9	96	60
Bars No. 10 through No. 11	120	96

- H. Reinforcement Around Openings -- Where reinforcing steel has to be cut to permit passage of pipe or to create openings, and should no detail be shown for extra reinforcing in such areas, the area of steel removed by the creation of the opening must be replaced by placing at least double the area of steel removed by the opening equally around the openings. The steel shall be placed such that it extends 5 feet beyond the opening on each side to provide for sufficient bond.

END OF SECTION

SECTION 03 30 00

CONCRETE WORK

PART 1 GENERAL

1.1 SUMMARY

- A. The extent of concrete work is shown on the Drawings.
- B. Work includes providing formwork and shoring for cast-in-place concrete and installation of related items including reinforcing steel bar (rebar), anchor bolts, setting plates, bearing plates, anchorages, inserts, reveals, frames, nosings, sleeves and other items to be embedded in concrete.
- C. Definitions
 - 1. Batch: Used in this specification to define an overall class of concrete as delivered from a concrete batching plant or on-site batching operation. Batching operations can continue for hours or days and as long as the class of concrete is similar, the batch would be considered the same. Multiple mixer truck loads could be used to deliver a "batch" of concrete over the course of multiple hours or days.
 - 2. Batched/Batching: The loading of concrete, as combined and mixed at a batching/ready-mix plant, into a concrete mixer truck for delivery to the job site.
 - 3. Truckload: A standard concrete mixer truck size is assumed to have a concrete capacity of 8 cubic yards. A truckload is used to help define the frequency of testing which occurs per concrete mixer truck.
 - 4. Ready-Mix Concrete: Concrete that is manufactured in a batch plant, according to a set engineered mix design. This specification assumes ready-mix concrete will be delivered by mixer truck to the job site.

1.2 RELATED SECTIONS:

- A. Section 03 21 00 - Reinforcing Steel.
- B. Section 33 16 23 Ground-Level Steel Water Storage Tank

1.3 QUALITY ASSURANCE

- A. Codes and Standards

Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified here:

ACI 301 "Specifications for Structural Concrete for Buildings"

- ACI 311 "Recommended Practice for Concrete Inspection"
- ACI 318 "Building Code Requirements for Reinforced Concrete"
- ACI 347 "Recommended Practice for Concrete Formwork"
- ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"
- ACI 308 "Guide to External Curing of Concrete"

Concrete Reinforcing Steel Institute, "Manual of Standard Practice"

Comply with building code requirements which are more stringent than the above and all OSHA requirements.

B. American Society for Testing and Materials (ASTM)

1. C31, Making and Curing Concrete Test Specimens in the Field.
2. C33, Specification for Concrete Aggregate.
3. C39, Compressive Strength of Cylindrical Concrete Specimens.
4. C40, Organic Impurities in Fine Aggregate for Concrete.
5. C85, Cement Content of Hardened Portland Cement Concrete.
6. C88, Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
7. C94, Standard Specifications for Ready-Mixed Concrete.
8. C131, Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
9. C136, Method for Sieve Analysis to Fine and Coarse Aggregate.
10. C143, Slump of Portland Cement Concrete.
11. C150, Standard Specification for Portland Cement.
12. C156, Water Retention by Concrete Curing Materials.
13. C173, Air Content of Freshly Mixed Concrete by the Volumetric Method.
14. C231, Air Content of Freshly Mixed Concrete by the Pressure Method.
15. C233, Standard Method of Testing Air-Entraining Admixtures for Concrete.

16. C260, Standard Specifications for Air-Entraining Admixtures for Concrete.
17. C289, Standard Test Method for Potential Reactivity of Aggregates (Chemical Method).
18. C441, Standard Test Method for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to the Alkali-Aggregate Reaction.
19. C457, Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete.
20. C494, Standard Specifications for Chemical Admixtures for Concrete.
21. C670, Preparing Precision Statements for Test Methods for Construction Materials.
22. C803, Penetration Resistance of Hardened Concrete.

C. Workmanship

The CONTRACTOR is responsible for correction of concrete work that does not conform to the specified requirements, including strength, tolerances, and finishes. Correct deficient concrete as directed by the OWNER or OWNER'S REPRESENTATIVE. The CONTRACTOR shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

D. Concrete Testing Service

The OWNER or a representative of the OWNER will engage a special inspector/testing laboratory to perform material evaluation tests and to design concrete mixes. See detailed requirements in Part 3.14 "Quality Control Testing during Construction". Per the OWNER or OWNER'S REPRESENTATIVE requirements the CONTRACTOR shall notify the designated representative to schedule the special inspections and materials testing required by the project documents.

E. Testing Requirements

Materials and installed work may require testing and retesting, as directed by the OWNER or OWNER'S REPRESENTATIVE, at anytime during the progress of the work. Allow free access to material stockpiles and facilities at all times.

The costs for preparation of mix designs (if required by the OWNER to be performed by an independent testing laboratory) and testing of concrete and materials shall be borne by the OWNER, except when materials do not meet specified requirements, in which case such costs shall be borne by the CONTRACTOR.

F. Tests for Concrete Materials

1. Test aggregates by the methods of sampling and testing of ASTM C33.
2. For Portland cement, sample the cement and determine the properties by the methods of test of ASTM C150.
3. Submit written reports to the OWNER and OWNER'S REPRESENTATIVE, for each material sampled and tested prior to the start of work. Provide the project identification name and number, date of report, name of CONTRACTOR, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for intended use.
4. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing. The materials producer and the CONTRACTOR must sign certificates of compliance.

G. Allowable Tolerances:

1. Construct formwork to provide completed cast-in-place concrete surfaces complying with the tolerances specified in ACI 347, and as follows:
 - a. Variation from plumb in lines and surfaces of columns, piers, walls and rises; 1/4-inch per 10 feet, but not more than 1-inch. For exposed corner columns, control joint grooves, and other conspicuous lines, 1/4-inch in any bay or 20 feet maximum; 1/2-inch maximum in 40 feet or more.
 - b. Variation from level or grade in slab soffits, ceilings, beam soffits, and rises 1/4-inch in 10 feet, 3/8-inch in any bay or 20 feet maximum, and 3/4-inch in 40 feet or more. For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, 1/4-inch in any bay or 20 feet maximum and 1/2-inch in 40 feet or more.
 - c. Variation from position of the linear lines and related columns, walls, and partitions, 1/2-inch in any bay or 20 feet maximum, and 1-inch in 40 feet or more.
 - d. Variation in sizes and locations of sleeves, floor openings, and wall openings, 1/4-inch.
 - e. Variation in cross-sectional dimensions of columns and beams and thickness of slabs and walls, minus 1/4-inch and plus 1/2-inch.
 - f. Variations in footing plan dimensions, minus 1/2-inch and plus two (2) inches; misplacement or eccentricity, two (2) percent of the footing width in direction

of misplacement but not more than two (2) inches; thickness reduction, minus five (5) percent.

g. Variation in steps - In a flight of stairs, 1/8-inch for rise and 1/4-inch for treads; in consecutive steps, 1/16-inch for rise and 1/8-inch for treads.

h. Circular structures shall be constructed in a true circular form, with maximum variation of 1/4-inch from the dimensions shown on the plans.

2. Before concrete placement check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.

3. During concrete placement check formwork and related supports to ensure that forms are not displaced and that completed work will be within specified tolerances.

H. Quality Control Testing During Construction

See Section 3 - Execution.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. For information only, submit an electronic copy of manufacturer's data with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, water stops, joint systems, chemical floor hardeners, dry-shake finish materials, and others. Bind and submit in one submittal.

C. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with the ACE 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangements of concrete reinforcement. Include special reinforcement required at openings through concrete structures and indicate spacer or burner bars.

D. Submit shop drawings for fabrication and erection of specific finished concrete surfaces as shown or specified. Show the general construction of forms including jointing, special formed joints or reveals, location and pattern of form tie placement, and other items which affect the exposed concrete visually. Submit form drawings for building columns, walls, fascias, and intersections, and concrete pan and joist system. Submit for typical sections only. OWNER'S REPRESENTATIVE review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is the CONTRACTOR's responsibility.

- E. Submit electronic copy of laboratory test reports for concrete materials and mix design tests as specified.
- F. Material Certificates may be provided in lieu of materials laboratory test reports. The material manufacturer and the CONTRACTOR, certifying that each material item complies with, or exceeds, the specified requirements shall sign material certificates.

1.5 CONCRETE MIX DESIGNS

- A. All concrete materials shall be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.
- B. If the concrete mix designs specified herein have not been used previously by the ready-mix supplier or if directed by the OWNER'S REPRESENTATIVE, mix proportions and concrete strength curves for regular cylinder tests, based on the relationship of 7, 14 and 28 day strengths versus slump values of two (2), four (4), and six (6) inches, all conforming to these Specifications, shall be established by an approved ready-mix supplier or an independent testing laboratory. A laboratory, independent of the ready-mix supplier, shall be required to prepare and test all concrete cylinders.

Testing of concrete and materials shall be borne by the OWNER, except when materials do not meet specified requirements, in which case such costs shall be borne by the CONTRACTOR.

- C. The exact proportions by weight of all materials entering into the concrete delivered to the jobsite shall conform to the approved mix design unless specifically so directed by the OWNER'S REPRESENTATIVE or Laboratory for improved specified strength or desired density, uniformity and workability.
- D. The proportions of such mix design shall be based on a full cubic yard of hardened concrete.
- E. Ready-mix companies or jobsite batch plants shall furnish delivery tickets, signed by a Certified Weighmaster, on which each shall state the weight of aggregates, sand, cement, admixtures and water and the number of cubic yards of concrete furnished, which will be compared against the approved mix design.
- F. There shall be no variation in the weights and proportions of materials from the approved mix design.
- G. There shall be no variation in the quality and source of materials once they have been approved for the specific mix design.

1.6 READY-MIXED CONCRETE

Ready-mixed concrete shall conform to the requirements of ACI 301 and ASTM C 94. In case of conflict, ACI 301 shall govern.

1.7 SAMPLE

Upon request by the OWNER or OWNER'S REPRESENTATIVE the CONTRACTOR shall pour and finish one 2-foot square exposed aggregate concrete sample for OWNER'S REPRESENTATIVE approval prior to construction if exposed aggregate is included on job.

1.8 JOB CONDITIONS

Maintain continuous traffic control and access for vehicular and pedestrian traffic as required for other construction activities as well as to adjoining facilities for regular operation. Utilize flagmen, barricades, warning signs and warning lights as required, to maintain a safe entrance and passage on all roads or drives abutting the project.

PART 2 PRODUCTS

2.1 WALL FORMS

- A. Full Height Pours: The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.
- B. Wall Form Ties
 - 1. Form ties which remain in the wall of a subgrade water-retaining structure shall have waterstops and a 1.5 inch minimum breakback or cone depth.
 - 2. Snap ties, if used, shall not be broken until the concrete has reached the design concrete strength. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. The use of tie wires as form ties will not be permitted. Fully threaded stub bolts may be used in lieu of smooth ties with waterstops.
 - 3. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Provide A-58 SURE PLUG as manufactured by DAYTON SUPERIOR or approved equal.
 - 4. Ties shall positively secure the wall to the required dimension and hold the wall to that dimension prior to and during concrete placement.

C. Wall Form Stiffeners

1. Horizontal walers shall consist of structural steel channels, angles or tubing of adequate size to retain the concrete without deflecting.
2. As required the walers shall be rolled or welded to the proper radii or offset brackets shall be used for shaping the wall to the dimensions shown on the Drawings and shall be used both for inside and outside wall forms in direct contact with the wall panels and at vertical spacings of no more than 96 inches on center.
3. There shall be at least one such waler within 24 inches of the top and bottom of the wall.
4. The largest dimension of the steel waler shall be in the radial direction.
5. Vertical structural steel or wood members shall be spaced so as to have sufficient rigidity and strength to insure the proper vertical alignments with the aid of braces under all predictable stress conditions.
6. In lieu of the above, a different system and spacings may be used if it is satisfactorily demonstrated to the OWNER'S REPRESENTATIVE that it will be equally effective.

2.2 FORMS FOR EXPOSED FINISH CONCRETE

Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Finish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection. Use overlaid plywood complying with U.S. Product Standard PS-1 "B-B High Density Overlaid Concrete Form", Class I. Use flexible spring steel forms or laminated boards free of distortion and defects to form radius bends as required.

2.3 FORMS FOR UNEXPOSED FINISH CONCRETE

- A. Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.

2.4 FORM MATERIALS

A. Form Coatings

Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compound. Petroleum based coatings shall not be used for

structures in creeks and waterways. Biodegradable coatings shall be used which will not contaminate the creeks/waterways or an alternate method for stripping the form shall be proposed.

B. Chamfers, Reveals, Drips

Provide preformed PVC or shaped wood or metal of size and profile as shown on drawings.

C. Cylindrical Columns and Supports

Form round-section members with paper or fiber tubes, constructed of laminated plies using water-resistant type adhesive with wax-impregnated exterior for weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet concrete without deformation. Provide units having "seamless" interior to minimize spiral gaps or seams.

D. Pan Forms

Provide forms for concrete pan-type construction complete with covers and end enclosures to form a true, clean, smooth concrete surface. Design units for easy removal without damaging placed concrete. Block adjoining pan units if required to avoid lateral deflection of formwork during concrete placement and compaction. Provide standard or tapered end forms, as shown.

If required, factory-fabricate pan form units to required sizes and shapes of the following:

1. Steel - 16 gauge minimum, free of dents, irregularities, sag and rust, or
2. Glass-Fiber Reinforced Plastic - Molded under pressure with matched dies, 0.11 inches minimum wall thickness.

E. Inserts & Embeds

Provide metal inserts for anchorage of materials or equipment to concrete construction, not supplied by other trades and as required for the work. Provide anchors approved for resisting seismic and wind loads and for cracked concrete applications. The CONTRACTOR is responsible for insuring that all required anchorage not specified in the project documents is installed per current building code and applicable ICC report requirements.

2.5 REINFORCING MATERIALS

A. Reinforcing Bar (rebar): ASTM A615 or ASTM 706 and as follows below

Stirrups and Ties Grade 60 (Grade 40 may be used for #3 and smaller)

All other Uses Grade 60

- B. Steel Wire: ASTM A82, plain, cold-drawn, steel.
- C. Welded Wire Fabric (WWF): ASTM A185, welded steel wire fabric.
- D. Supports for Reinforcement

Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise specified. Wood, brick, concrete blocks and other devices **will not** be acceptable. For slabs-on-grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are hot-dip galvanized, after fabrication, or plastic protected or stainless steel protected.

- E. Fiber Reinforcement – Collated polypropylene fiber, $\frac{3}{4}$ "-inch, manufactured from 100% virgin homopolymer polypropylene, hydrophobic, in compliance with ASTM C116.

2.6 CONCRETE MATERIALS

- A. Portland Cement

ASTM C150, Type II unless otherwise acceptable to OWNER'S REPRESENTATIVE. Use only one (1) brand of cement throughout the project, unless otherwise acceptable to the OWNER'S REPRESENTATIVE. The use of ground granulated blast furnace slag is not allowed.

- B. Aggregates

ASTM C33 and as herein specified. Provide aggregates from a single source for all exposed concrete.

Local aggregates not complying with ASTM C33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the OWNER'S REPRESENTATIVE.

1. Fine Aggregate - Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances. Dune sand, bank-run sand and manufactured sand are not acceptable.
2. Coarse Aggregate - Clean, uncoated, processed aggregate containing no clay, mud, loam or foreign matter, as follows:
 - a. Crushed stone processed from natural rock or stone.

- b. Washed gravel, either natural or crushed. Use of pit or bank run gravel is not permitted.
 - c. Maximum Aggregate Size - Not larger than one-fifth (1/5) of the narrowest dimensions between sides of forms, one-third (1/3) of the depth of slabs, nor three-fourths (3/4) of the minimum clear space between individual reinforcing bars or bundles of bars.
3. These limitations may be waived if, in the judgment of the OWNER'S REPRESENTATIVE, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids.
 4. In general it is desired that normal commercial mixes using 1-1/2-inch or 3/4-inch maximum aggregate size be used.
 5. Aggregate for exposed aggregate concrete shall consist of selected aggregate of washed clean river gravel in color range of medium to dark in browns and grays; material uniformly sized 5/8-inch to 3/4-inch.
- C. Water: Clean, fresh, potable.
 - D. Air Entraining Admixture: ASTM C260.
 - E. Water-Reducing Admixture: ASTM C494, Type A or F
 - F. Set-Control Admixtures: ASTM C494, as follows:
 1. Type B, Retarding.
 2. Type C, Accelerating.
 3. Type D, Water-reducing and Retarding.
 4. Type E, Water-reducing and Accelerating.

Calcium chloride will not be permitted in concrete, unless otherwise authorized in writing by the OWNER'S REPRESENTATIVE.

2.7 RELATED MATERIALS

A. Waterstops

Provide flat, dumbbell type or centerbulb type waterstops at construction joints and other joints as shown. Size to suit joints or as shown. Provide PVC waterstops complying with Corps of Engineer's CRD-C 572. Waterstops provided to be Greenstreak 701 or approved equal. Split face waterstops will not be acceptable under any circumstances.

B. Bituminous and Fiber Joint Filler

Provide resilient and non-extruding type premolded bituminous impregnated fiberboard units complying with ASTM D1751, FS HH-F-341, Type 1 and AASHTO M 213. Provide one of the following products:

1. Elastite; Philip Carey/Celotex
2. Flexcell; Celotex Corp.
3. Crane Fiber 1390; W.R. Grace & Co.
4. Fibre; W.R. Meadows, Inc.
5. Tex-Lite; J & P Petroleum Prod. Inc.
6. Sonoflex; Sonneborn/Contech, Inc.

C. Joint Sealing Compound: See Section 07 92 00, Joint Sealants.

D. Moisture Barrier

Provide moisture barrier cover over all prepared base material. Use only materials that are resistant to decay when tested in accordance with ASTM E154. The moisture barrier consists of heavy Kraft papers laminated together with glass fiber reinforcement and overcoated with black polyethylene on each side. Provide Moistop, St. Regis, or equal.

E. Form Ties (for forms other than wall forms)

Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Unless otherwise shown, provide ties so portion remaining within concrete after removal is at least 1.5 inches inside concrete. Unless otherwise shown, provide form ties, which will not leave holes larger than 1-inch in diameter in concrete surface.

F. Concrete Curing Materials

Concrete curing materials shall be in accordance with ACI 301 Section 5 and ACI 308.1 Section 2.

1. Water-based resin curing compound. W.R. Meadows, Inc. 1100, Euclid Kurez DR VOX, or approved equal.
2. Acrylic curing and sealing compound. W.R. Meadows, Inc. CS-309-30, or approved equal.
3. Water emulsion acrylic curing and sealing compound formulated of acrylic polymers of water-based carrier. W.R. Meadows, Inc. VOCOMP-20, Euclid Luster Seal WB, or approved equal.

G. Epoxy Adhesive

For application to wire-brushed and prepared existing concrete to be mated to new concrete.

1. W.R. Meadows, Inc. INTRALOK, Sika Sikadur-32 Hi-Mod, Sika Armatec-100 EpoCem, or approved equal.
2. Apply per manufacturer's recommendations.

H. Chemical-Hardener Finish: Provide Hornolith from Tamms Industries, or approved equal.

I. Non-slip Aggregate Finish

Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof and non-glazing, and is unaffected by freezing, moisture and cleaning materials.

J. Non-shrink Grout: See Section 03 60 00, Grouting.

2.8 PROPORTIONING NORMAL CONCRETE

A. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1. All measurements shall be by weight. All concrete admixtures will either be by the same supplier to insure compatibility. If different suppliers are used a memorandum from EACH admixture supplier will be provided stating the compatibility of their product with the other supplier's products.

B. The slump shall be between two inches and four inches when tested in accordance with ASTM Specifications C 143. Variations in the slump range may be allowed by the OWNER'S REPRESENTATIVE if admixtures, such as water reducers or superplasticizers, are utilized in the concrete mix. Regardless of the measured slump, the maximum allowable water-cement ratios as specified here-in, shall be strictly adhered to.

C. Compressive Strength, Water and Cement Content

Notwithstanding what has been stated here-before, and unless shown otherwise on the Drawings, the concrete shall meet the following requirements. All concrete except as noted otherwise on the drawings shall have 4,500 psi 28-day compressive strength and a maximum water/cement ratio of 0.42. Up to a maximum of 15% of cementitious material may be fly ash in accordance with ASTM C618. The use ground granulated blast furnace slag is not allowed for any surfaces in contact with potable water.

D. Retarding Densifiers

1. All concrete (as defined in 2.9 below) used for wall construction shall also contain DARATARD-17, as manufactured by Grace Const. Products, Cambridge, MA or MBL-82, as manufactured by Master Builders, Cleveland, OH in the amounts recommended by the additive manufacturer whenever the air temperature during the pour exceeds 85° F.
2. To be considered as equal, any alternate product offered for consideration shall contain no calcium chloride, and shall be compatible with air-entrained cements and air-entraining admixtures conforming to the applicable ASTM, AASHTO, ANSI and Federal specifications.
3. CONTRACTOR shall certify that admixtures do not contain calcium chlorides or other corrosive materials.

E. Air-Entraining Agents

1. All concrete that that is specified to be air entrained or that may be exposed to freeze/thaw action either during construction or the service life of the structure must be air entrained.
2. Air-entraining agents shall meet ASTM C 260, ASTM C 233 and ASTM C 457.
3. The total volumetric air content of the concrete before placement shall be six (6) percent +/- 1.5 percent as determined by ASTM C 173 or ASTM 231 for mixes using a 3/4" nominal aggregate size.
4. Subject to these Specifications, consideration will be given to the following products: PROTEX "AES," GRACE "DAREX AEA," MASTER BUILDERS "MB-AE10," or SIKA CHEMICAL "AER."

F. Water Reducing Admixtures

1. In addition to air-entrainment, approved water reducing additives, which do not affect the ultimate performance of any steel in any way, may be added to maintain the maximum water content below that specified herein. Water reducing additives shall conform to ASTM C 494, Type A or D.
2. The use of water reducing additives shall not permit a reduction in the minimum specified cement content or in the specified amount of air-entrainment.
3. Admixtures shall contain no calcium chloride, tri-ethanolamine or fly ash. All admixtures shall be from the same manufacturer.
4. Superplasticizers, if allowed by the OWNER'S REPRESENTATIVE, shall conform to ASTM C 494, Type F or G, batch plant added using second or third generation only.

5. Set control admixtures if allowed by the OWNER'S REPRESENTATIVE, shall conform to ASTM C 494, Type B (retarding) or Type C (accelerating).
- G. Fiber reinforcement admixture shall be included in the ready-mix concrete design used for filling and channeling the wet well chambers. Fibers shall be used in strict accordance with the manufacturer's directions.

2.9 CONCRETE MIXING

A. Ready-Mix Concrete

1. Comply with the requirements of ASTM C94, and as herein specified. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When the air temperature is between 85°F and 90°F, reduce the mixing and delivery time from 1-1/2 hours to 75 minutes, and when the air temperature is above 90°F, reduce the mixing and delivery time to 60 minutes.
2. Minimum Mix Time: Once all materials are in the drum, the minimum mixing time shall be for 10 minutes before concrete is placed.

PART 3 EXECUTION

3.1 FORMS

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formworks so concrete members and structures are of correct size, shape, alignment, elevation and position.
- B. Design formworks to be readily removable without impact shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms complying with ACI 347, to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

- E. Erect falsework and support; brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place concrete structures.

Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances.

- F. Forms for Exposed Concrete

Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes. Do not use metal cover plates for patching holes or defects in forms. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections. Use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material, which will produce bow. Assemble forms so they may be readily removed without damage to exposed concrete surfaces. Form molding shapes, recesses and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

Corner Treatment - Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines, except as otherwise indicated.

- G. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings of forms at inconspicuous locations.
- H. Chamfer exposed corners and edges, reveals and drips as shown using wood, metal, PVC or rubber strips fabricated to produce uniform smooth lines and tight edge joints. A ½ inch chamfer at exposed edges is typical unless noted otherwise.
- I. Provisions for Other Trades - Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such ties. Accurately place and securely support items built into forms.
- J. Cleaning and Tightening - Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms after concrete placement if required to eliminate mortar leaks.

3.2 PLACING REINFORCEMENT

Detail and place according to ACI Manual SP-66. Unless otherwise noted, minimum cover shall be 1-1/2 inches for No. 5 and smaller bars, 2.0-inches for No. 6 and larger bars or for any bars exposed to exterior or wet environments, and 3.0-inches when poured against earth. Unless otherwise noted, bend all horizontals reinforcing a minimum of two (2) feet at corners and wall intersections.

- A. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.
- B. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
- C. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Do not place reinforcing bars more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.
- D. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh plus two (2) inches, and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.3 JOINTS

- A. Construction Joints - Locate and install construction joints not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the OWNER'S REPRESENTATIVE. Install and locate other construction joints as specified.
- B. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints. Unless otherwise specified, reinforcement shall be lapped in accordance with ACI Standards.
- C. Waterstops - Provide waterstops in construction joints as shown on the drawings. Install waterstops to form a continuous diaphragm in each joint. Make provisions to support and protect waterstops during the progress of the work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions. Protect waterstop material from damage where it protrudes from any joint.
- D. Isolation Joints in Slabs-on-Ground - Construct isolation joints in slabs-on-ground at all points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams and elsewhere as indicated.

- E. Control Joints in Slabs-on-Ground - Construct control joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/4-inch wide by one-fifth (1/5) to one-fourth (1/4) of the slab depth, unless otherwise shown.
 - 1. Form control joints by the following methods
 - a. Inserting a premolded hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with the slab surface. After the concrete has cured, remove inserts and clean groove of loose debris.
 - b. Saw cutting a control joint in the required location. Plan for saw cutting so work does not damage reinforcing or violate edge distance minimums.
 - 2. Joint sealant material shall be as specified above.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. General - Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.
- B. Edge Forms and Screed Strips for Slabs - Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screed strips by the use of strike-off templates or accepted compacting type screeds.
- C. Cast in Place Reglets - Place in straight and continuous lines as detailed to enable flashing to be applied continuously without deviation at reglet joints more than 1/8-inch. Miter corners for continuous reglet joint where outside corners occur. At inside corners extend one section 1-inch past corner. Adequately anchor or secure reglets per manufacturer's instructions prior to pouring and during construction to insure dimensional tolerances and alignment. Vibrate concrete to insure concrete cover adjacent to and around reglet. Visually inspect after pour and patch as required.

3.5 PREPARATION OF FORM SURFACES

Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed. Thin formcoating compounds only with thinning agent of type, and in amount, and under conditions of the form-coating compound manufacturer's directions. Use dissipating-type form oil at surfaces to receive cement plaster finish. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.6 CONCRETE PLACEMENT

A. Pre-Placement Inspection

1. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades in setting such work as required. Notify STRUCTURAL ENGINEER OF RECORD in time for inspection prior to pouring.
2. Remove all garbage and debris from the base of formwork. Items such as aluminum cans, food containers, plywood, and their like are to be cleaned-up and disposed.
3. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used.
4. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
5. Concrete Curbs and Paving - Do not place concrete until subbase is completed and approved by the STRUCTURAL ENGINEER OF RECORD as required to provide uniform dampened condition at the time concrete is placed. Moisten subbase as required to provide uniform dampened condition at the time concrete is placed.

B. Place concrete in compliance with the practices and recommendations of ACI 304 and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete, which is being integrated, with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure, which will cause segregation.
2. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.
3. Do not use concrete which becomes non-plastic and unworkable or does not meet the required quality control limits or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the project site and dispose of in an acceptable location. Do not use concrete whose allowable mixing time has been exceeded.

C. Concrete Conveying

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practicable by methods, which will prevent segregation and loss of concrete mix materials.
2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice and other deleterious materials.
3. The CONTRACTOR shall provide traffic control on the narrow access roads to the work sites.
4. The CONTRACTOR shall not wash concrete trucks/chutes/equipment off at the project site unless plastic tarps and hay bales are employed to contain the concrete. The CONTRACTOR will be required to haul off-site all concrete contaminated soil.

D. Placing Concrete into Forms

1. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
2. Do not interrupt successive placement; do not permit cold joints to occur.
3. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.
4. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Vibration of forms and reinforcing will not be permitted.
5. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete at least six (6) inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

6. Do not place concrete in supporting elements until the concrete previously placed in columns and walls is no longer plastic.

E. Placing Concrete Slabs

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.
2. Consolidate concrete during placing operations using mechanical vibrating equipment so the concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground, as specified for formed concrete structures. Consolidate concrete in the remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other acceptable methods. Limit the time of vibrating consolidation to prevent bringing an excess of fine aggregate to the surface.
4. Bring slab surfaces to the correct level with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.
5. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

F. Bonding

1. Roughen surfaces of set concrete at all joints except where bonding is obtained by use of concrete bonding agent, and clean surfaces of laitance, coatings, loose particles and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly and not to leave laitance, loose particles of aggregate or damaged concrete at the surface.
2. Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:
 - a. At joints between footings and walls or columns, and between walls or columns and beams or slabs they support, and elsewhere unless otherwise specified herein, dampen, but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete.
 - b. At joints in exposed work; at vertical joints in walls; at joints in girders, beams, supported slabs and other structural members; and at joints designed to contain liquids; dampen, but do not saturate the roughened and cleaned surface of set concrete and apply a liberal coating of neat cement grout.

- c. Use neat cement grout consisting of equal parts Portland cement and fine aggregate by weight and not more than six (6) gallons of water per sack of cement. Apply with a stiff broom or brush to a minimum thickness of 1/16-inch. Deposit fresh concrete before cement grout has attained its initial set.
 - d. In lieu of neat cement grout, bonding grout may be a commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instructions of the bonding material manufacturer.
 3. Prepare for bonding of fresh concrete to fully cured hardened concrete or existing concrete by using an epoxy-resin-bonding agent as follows:
 - a. Handle and store epoxy-resin adhesive binder in compliance with the manufacturer's printed instructions, including safety precautions.
 - b. Mix the epoxy-resin adhesive binder in the proportions recommended by the manufacturer, carefully following directions for safety of personnel.
 - c. Before depositing fresh concrete, thoroughly roughen and clean hardened concrete surfaces and coat with epoxy-resin grout not less than 1/16-inch thick. Place fresh concrete while the epoxy-resin material is still tacky, without removing the in-place grout coat, and as directed by the epoxy-resin manufacturer.

G. Cold Weather Placing

1. Protect all concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.
2. When the air temperature has fallen to or is expected to fall below 40°F, provide adequate means to maintain the temperature in the area where concrete is being placed at either 70°F for three (3) days or 50°F for five (5) days after placing. Provide temporary housing or coverings including tarpaulins or plastic film. Keep protections in place and intact at least 24 hours after artificial heat is discontinued. Keep concrete moist. Avoid rapid dry-out of concrete due to over-heating and avoid thermal shock due to sudden cooling or heating.
3. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50°F, and not more than 80°F, at point of placement.
4. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms,

reinforcing steel and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.

5. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

H. Hot Weather Placing

1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.
3. Cover reinforcing steel with water soaked burlap if it becomes too hot so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
4. Wet forms thoroughly before placing concrete.
5. Do not use retarding admixtures unless otherwise accepted in mix designs.

3.7 FINISH OF FORMED SURFACES

A. Rough Form Finish

For formed concrete surfaces not exposed to view in the finish work or covered by other construction, unless otherwise shown or specified. This is the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.

B. Smooth Form Finish

Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view. Or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, damp proofing, painting or other similar system.

Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.

C. Curb Finishes

Curbs shall be screeded off accurately to true lines and planes or warped surfaces as indicated or directed. Finish smooth. Arises shall be true and straight or properly eased where curved and neatly rounded with approved tool. Smooth trowel finish with corners rounded to 3/4-inch radius.

D. Grout Cleaned Finish (Sacked)

Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment, and to all exposed to view interior and exterior building surfaces, typical.

Combine one part Portland cement to 1-1/2 parts fine sand by volume, and mix with water to the consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.

Thoroughly wet concrete surfaces and apply grout immediately to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

E. Related Unformed Surfaces

At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.8 MONOLITHIC SLAB FINISHES

A. Float Finish

1. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing or sand bed terrazzo, and as otherwise shown on drawings or in schedules.
2. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power-driven float, or both. Consolidate the surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Check and level the surface plane to a tolerance not exceeding 1/4-inch in 10 feet when tested with a 10-foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill at low

spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

B. Trowel Finish

1. Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and slab surfaces that are to be covered with resilient flooring, paint, or other thin-film finish coating system.
2. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.
3. Consolidate the concrete surface by the final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in 10 feet when tested with a 10-foot straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

C. Exposed Aggregate Finish

1. Screed to true plane, bullfloat surfaces, provide uniform double troweled finish. After troweling, let set until hard enough to wash without disturbing coarse aggregates. Simultaneously brush and spray with water to expose large aggregate and produce texture to match approved sample. Water cure or keep wet for 25 hours.
2. Scrub surface after 24 hours with a one (1) part muriatic acid to 10 part water solution. Rinse thoroughly.

D. Broom Finish (Non-Slip)

1. Apply non-slip, broom finish to exterior concrete platforms, steps and ramps and elsewhere as shown on the drawings or in schedules.
2. Immediately after trowel finish, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route or in the direction of water flow. Use fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the OWNER'S REPRESENTATIVE before application.

E. Chemical-Hardener Finish

1. Apply chemical curing-hardening compound or chemical-hardener to all interior concrete floors which will not receive applied finish materials. Mask adjacent work and surfaces to avoid over spray. Apply liquid chemical-hardener after complete curing and drying of the concrete surface.

2. Dilute the liquid hardener with water and apply in accordance with the manufacturer's printed directions. Evenly apply each coat and allow for drying between coats in accordance with manufacturer's printed directions.
3. After the final coat of chemical-hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

F. Non-slip Aggregate Finish

Apply non-slip aggregate finish to concrete stair treads, platforms, ramps, and elsewhere as shown on the drawings or in schedules.

After completion of float finishing and before starting trowel finish, uniformly spread 25 pounds of dampened non-slip aggregate per 100 square feet of surface. Tamp aggregate flush with surface using steel trowel, but do not force the non-slip aggregate particles below surface. After broadcasting and tamping, apply trowel finish as herein specified. After curing, lightly work the surface with a steel wire brush, or an abrasive stone, and water to expose the non-slip aggregate.

3.9 SCHEDULE OF CONCRETE SURFACE FINISHES

Also see Section 09 90 00, Painting and Coating for protective coating requirements.

<u>Surface Description</u>	<u>Type</u>	<u>Finish Requirement</u>
A. Interior Horizontal Slabs	Slab	Trowel Finish
B. Exterior Horizontal Slabs	Slab	Broom Finish (Non-Slip)
C. Ring Foundation for Steel Formed Reservoir		Trowel Finish on Exposed Horizontal Surface. Smooth Form on Vertical Sides.

3.10 CONCRETE CURING AND PROTECTION

A. General

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

2. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.
3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least seven (7) days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

B. Curing Methods

Perform curing of concrete by moist curing, by moisture-retaining cover curing, by membrane curing or by combinations thereof, as herein specified. Provide the curing methods indicated as follows:

1. For concrete floor slabs provide moisture curing, moisture cover curing or liquid membrane/chemical curing-hardening curing. If liquid membrane curing is used, it must be compatible with concrete hardening compounds to be applied later.
2. For other concrete work, provide moisture curing or moisture cover curing. Do not use liquid membrane or chemical curing-hardening curing on any concrete work to receive any applied finishes.
3. For curing, use only water that is free of impurities, which could etch or discolor exposed, natural concrete surfaces.
4. Provide moisture curing by any of the following methods:
 - a. Keeping the surface of the concrete continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Covering the concrete surface with the specified absorptive cover thoroughly saturated with water and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges with a 4-inch lap over adjacent absorptive covers.
5. Provide moisture-cover curing as follows - Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete placed in the widest practicable width with sides and ends lapped at least three (3) inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

6. Provide liquid membrane curing as follows:
 - a. Apply the specified membrane-forming curing compound to damp concrete surfaces as soon as the water film has disappeared. Apply uniformly in a coat continuous operation by power spray equipment in accordance with the manufacturer's directions. Recoat areas, which are subjected to heavy rainfall within three (3) hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period.
 - b. Do not use membrane-curing compounds on surfaces, which are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete. Such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to the OWNER'S REPRESENTATIVE.
 7. Curing formed Surfaces - Cure formed concrete surfaces, including the undersides of girders, beams, supported slabs and other similar surfaces by moist curing with the forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
 8. Curing Unformed Surfaces
 - a. Initially cure unformed surfaces, such as slabs, floor topping and other flat surfaces by moist curing, whenever possible.
 - b. Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.
 - c. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise acceptable to the OWNER'S REPRESENTATIVE.
 9. Provide liquid curing-hardening compound as follows:
 - a. Apply to horizontal surfaces when concrete is dry to touch by means of power spray, hand spray or hair broom in accordance with manufacturer's directions.
- C. Temperature of Concrete during Curing
1. When the atmospheric temperature is 40°F and below, maintain the concrete temperature between 50°F and 70°F continuously throughout the curing period. When necessary, make arrangements before concrete placing for heating, covering, insulation or housing as required to maintain the specified temperature and moisture conditions continuously for the concrete curing period. Provide cold weather protections complying with the requirements of ACI 306.

2. When the atmospheric temperature is 80°F, and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation wind breaks or shading, and for fog spraying, wet sprinkling or moisture-retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protections complying with the requirements of ACI 305.
 3. Maintain concrete temperature as uniformly as possible and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete, which exceed 5°F in any one-hour and 50°F in any 24-hour period.
- D. Protection from Mechanical Injury - During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.11 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In - Fill-in holes and openings in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the work.
- B. Curbs - Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations - Provide machine and equipment bases and foundations as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

3.12 REMOVAL OF SHORES AND FORMS

- A. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support the work without excessive stress or deflection.

Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until the concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

- B. Formwork not supporting weight of concrete, such as sides of beams, walls, columns and similar parts of the work, may be removed after cumulative curing at not less than

50°F for 24 hours after placing concrete. Providing the concrete is sufficiently hard to not be damaged by form removal operations and provided curing and protection operations are maintained.

- C. Formwork supporting weight of concrete, such as beam soffits, joints, slabs and other structural elements, may not be removed in less than 14 days and until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in place concrete by testing field-cured specimens representative of concrete location or members.
- D. Form facing material may be removed four (4) days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.
- E. Re-Use of Forms

Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use “patched” forms for exposed concrete surfaces, except as acceptable to the Architect.

No forming material will be allowed to be built permanently into exposed visible surfaces.

3.13 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas
 - 1. Repair and patch defective areas with cement mortar immediately after removal of forms but only when directed by the OWNER’S REPRESENTATIVE.
 - 2. Cut out honeycomb, rock pockets, voids over 1/2-inch diameter and holes left by tie rods and bolts down to solid concrete but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the OWNER’S REPRESENTATIVE.
 - 3. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, the patching mortar will match the color of the surrounding concrete. Provide test areas at inconspicuous location to verify

mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

4. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.
- B. Repair of Formed Surfaces
1. Repair exposed-to-view formed concrete surfaces that contain defects, which adversely affect the appearance of the finish. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of the OWNER'S REPRESENTATIVE. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolt; fins and other projections on the surface; and stains and other discolorations that cannot be removed by cleaning.
 2. Repair concealed formed concrete surfaces that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces. Surface defects, as such, include cracks in excess of 0.01-inch wide, cracks or any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts, and spalls except minor breakage at corners.
- C. Repair of Unformed Surfaces
1. Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.
 2. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
 3. Repair finished unformed surfaces that contain defects, which adversely affect the durability of the concrete. Surface defects, as such, include crazing, cracks in excess of 0.01-inch wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets and other objectionable conditions.
 4. Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so those repairs can be made without damage to adjacent areas.
 5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh

concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the OWNER'S REPRESENTATIVE.

6. Repair defective areas, except random cracks and single holes not exceeding 1-inch diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with a neat cement grout coating, or use concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same material to provide concrete of the same type or class as the original adjacent concrete. Place, compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
7. Repair isolated random cracks and single holes not over 1 inch in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean off dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place dry-pack before the cement grout takes its initial set. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.
8. For repair of existing unformed surfaces, mechanically remove all loose concrete as required to expose sound aggregate. Clean concrete surfaces to achieve a contaminate free, open textured surface. Square cut or under cut perimeter to minimum depth as specified by the repair mortar manufacturer. Remove all loose concrete around the exposed steel and hand tool or blast clean all portions of rebar with visible rust to near white metal finish. If half of the diameter of the reinforcing steel is exposed, chip out behind the reinforcing to a 1/2-inch minimum depth. Splice new reinforcing steel to existing where corrosion has depleted the cross-section area by 25%. Apply a corrosion inhibitor/primer/bonding agent to all exposed rebar and other steel components and to concrete surfaces to be repaired per manufacturer's requirements, such as Sika Armatec 110 . Apply a polymer-modified, cement-based, repair mortar, trowel applied as specified by the manufacturer, such as Sika MonoTop 615.
9. Repair methods not specified above may be used subject to the acceptance of the OWNER'S REPRESENTATIVE.

3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. The OWNER or a representative of the OWNER will engage a special inspector/testing laboratory to perform all tests and to submit test reports to the OWNER, OWNER'S REPRESENTATIVE, and the CONTRACTOR.
- B. Concrete shall be sampled and tested for quality control during the placement of concrete, as follows:
 - 1. Sampling Fresh Concrete - ASTM C172, except modified for slump to comply with ASTM C94.
 - 2. Slump Test - ASTM 143; one (1) test for each set of compressive strength test specimens. Samples shall be taken at point of discharge.
 - 3. Air Content - ASTM C231, pressure method; one (1) for each set of compressive strength test specimens.
 - 4. Compression Test Specimen - ASTM C31; One (1) Set which consist of a minimum of four (4) standard cylinders to allow for compressive strength testing, unless otherwise directed. If early loading of members or sections is desired by the CONTRACTOR, additional tests cylinders shall be collected for testing. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
 - 5. Concrete Temperature - Test hourly when air temperature is 40°F and below, and when 80°F and above; and each time a set of compression test specimens is made.
 - 6. Compressive Strength Tests - ASTM C39; One (1) Set for each 100 cubic yards or fraction thereof, of each concrete class placed in any one (1) day, OR for each 5,000 square feet of surface area placed, OR as per minimums outlined below.
 - a. When the frequency of testing will provide less than five (5) Sets of cylinders by which to perform strength tests for a given class of concrete, conduct testing, as follows.
 - 1) For a class of concrete with a total batch size of greater than 500 cubic yards or 25,000 square feet of surface area, collect test Sets as outlined above.
 - 2) For a class of concrete with a total batch size of less than 500 cubic yards or 25,000 square feet of surface area, but greater than 300 cubic yards or 15,000 square feet of surface area, collect four (4) Sets for testing. Two (2) Sets near the beginning of pouring, one (1) Set mid-way through pouring and one (1) Set towards the end of pouring.

- 3) For a class of concrete with a total batch size of less than 300 cubic yards or 15,000 square feet of surface area, but greater than 50 cubic yards or 2,500 square feet of surface area, collect four (3) sets of testing. One (1) Set near the beginning of pouring, one (1) Set mid-way through pouring and one (1) Set towards the end of pouring.
 - 4) When the total quantity of a given class of concrete is less than 50 cubic yards, and NO anchors are embedded in the concrete, the OWNER'S REPRESENTATIVE may waive the strength tests if, in their judgment, adequate evidence of satisfactory strength is provided. Otherwise testing shall occur as outlined in 3.14.B.6.a
- b. Testing Procedure: A Set of specimens with yield four (4) cylinders. Therefore, five (5) Sets will yield 20 cylinders, four (4) Sets will yield 16 cylinders, three (3) Sets will yield 12 cylinders, From each set test one (1) cylinder at seven (7) days, test two (2) cylinders at 28 days, and one (1) cylinder shall be retained in reserve for later testing if required. Additional cylinders can be obtained, at the CONTRACTOR's or OWNER's discretion, for testing at alternate times.
 - c. If required by the building official, perform strength tests of cylinders cured under field conditions. Field cured cylinders shall be taken and molded at the same time and from the same samples as the laboratory cured test cylinders. When the strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
- C. Report test results in writing to the OWNER'S REPRESENTATIVE and the CONTRACTOR on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of CONTRACTOR, name of concrete supplier and concrete mixing truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength and type of break for both 7-day tests and 28-day tests.
 - D. Additional tests - The testing service will make additional tests of in-place concrete when test results indicate the specified concrete strengths and other characteristics have not been attained in the structure, as directed by the OWNER'S REPRESENTATIVE. The testing service shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. CONTRACTOR shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes all work necessary to form, mix, place, cure, repair, finish, and perform all other work as required to produce finished grout, in accordance with the requirements of the Contract Documents.
- B. Work covered in this Section includes:
 - 1. Grouting around reservoir bases.
 - 2. Patching, grouting, and sealing.
 - 3. Grouting of door frames in CMU wall
 - 4. Grouting for support of plumbing, fire sprinklers, and HVAC equipment
 - 5. Grout for support of mechanical, electrical, and communications equipment
 - 6. Removal of loose and spalling grout and concrete.
 - 7. Anchoring cement for metal fabrications

1.2 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete Work.
- B. Section 05 50 00 – Miscellaneous Metals

1.3 SUBMITTALS

- A. Certified Test Results: Verifying the compressive strength, shrinkage, and expansion requirements specified herein for grout used around ground supported steel reservoir bases or for grouts as required by the OWNER'S REPRESENTATIVE.
- B. Manufacturer Technical Data and Strength Test Results: For sack-mix grouts used on minor-structure/systems provide datasheet information verifying the compressive strength, shrinkage, and expansion requirements specified herein for grout used.
- C. Manufacturer's Literature: Containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grout used in the work.

1.4 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as specified in Section 03 30 00, Cast-in-Place Concrete Work and as referred to herein.

Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified.

B. Codes and Standards

1. American Society for Testing and Materials (ASTM)

- a. C1084, "Standard Test Method for Portland-Cement Content of Hardened Hydraulic-Cement Concrete"
- b. C109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)"
- c. C191, "Standard Test Method for Setting Time of Hydraulic Cement"
- d. C131, "Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine"
- e. C136, "Standard Test Method for Sieve Analysis to Fine and Coarse Aggregate"
- f. C143, "Standard Test Method for Slump of Hydraulic Cement Concrete"
- g. C150, "Standard Specification for Portland Cement"
- h. C488, "Standard Test Method for Pull-Out Strength"
- i. C531, "Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes"
- j. C579, "Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes"
- k. C827, "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures"
- l. C827, "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures"
- m. C882, "Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear"
- n. C939, "Standard Test Method for Flow of Grout for Preplaced – Aggregate Concrete (Flow Cone Method)"
- o. C942, Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory ""
- p. C1090, "Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic Cement Grout"

- q. C1107, "Standard Test Method for Packaged Dry, Hydraulic Cement Grout (Non-Shrink)"
 - r. C1437, "Standard Test Method for Flow of Hydraulic Cement Mortar"
 - s. E488, "Standard Test Method for Strength of Anchors in Concrete and Masonry Elements"
2. American Concrete Institute (ACI)
- a. "Guide to Hot Weather Concreting", ACI 305R.
 - b. "Guide to Cold Weather Concreting", ACI 305R.
 - c. "Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces", ACI 305R, as supplemented and modified herein.
3. CRD-C 621, Corps of Engineers Specification for Non-Shrink Grout

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2-year experience installing similar products.

Field Tests

- A. A compression test sample group will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the OWNER'S REPRESENTATIVE to ensure continued compliance with these specifications. The sample specimens will be made by the CONTRACTOR or their representative.
 - 1. A standard compression test sample group shall consist of (6) standard cube test specimens.
 - a. A standard compression test sample group allows for three (3) tests to occur at seven (7) days and three (3) tests to occur at 28 days, and each additional time period as appropriate.
 - 2. At a minimum, one (1) compression test sample groups shall be taken for each type of grout mix used with a minimum of one (1) test group taken per day at the start of each new days pour.
 - a. For a daily pour volume consisting of three (3) cubic feet or less, one (1) compression test sample group shall be taken.
 - b. For daily pours in excess of three (3) cubic feet, an additional compression test sample group will be collected for testing at three (3) cubic feet intervals.

- c. For different grout mixes, apply the sampling requirements of 1.5.A.2a and 2b to each mix design.

EXAMPLE: For a 3ft³ pour, collect 1 test group. For an 6ft³ pour collect 2 test groups. For a 3ft³ pour, which is poured at a rate of 1.5ft³ per day, collect 1 test group per day for 2 total. For two different mix designs, collect test groups, as listed above, for each mix.

- B. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the OWNER'S REPRESENTATIVE.
- C. All grout, already placed, which fails to meet the requirements of these specifications, is subject to removal and replacement at the cost of the CONTRACTOR.
- D. The cost of all laboratory tests on grout shall be borne by the CONTRACTOR and the CONTRACTOR shall obtain the specimens for testing. The CONTRACTOR shall also be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The CONTRACTOR shall supply all materials necessary for fabricating the test specimens.

1.6 DELIVERY HANDLING AND STORAGE

- A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.
- B. Handle products in accordance with manufacturer's printed recommendations. Do not place grout when temperature or humidity will affect the performance or appearance of the grout.
- C. Store products in a dry area. Protect from direct sunlight.
- D. Do not place grout on dirty, wet, or frozen substrates.

PART 2 PRODUCTS

2.1 PREPACKAGED GROUTS

- A. High Strength Non-shrink grout: This type of grout is to be used wherever grout is required in the Contract Documents unless another type is specifically referenced.
 - 1. High Strength Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation of each type of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.

Early Height Change, ASTM C827	0.0 to +0.3%		
Hardened Height Change, ASTM C1090	+0.2 to +0.4%		
Effective Bearing Area	95%		
Compressive Strength, ASTM C942	Plastic	Flowable	Fluid
1 Day (min.)	1,000 psi	1,000 psi	1,000 psi
28 Days (min.)	5,000psi	5,000psi	5,000psi
Bond Strength, ASTM C882			
28 Days	2000psi		
Application Temperature	40°F to 90°F		
Material Temperature	40°F to 90°F		

- B. General Purpose Non-Shrink Grout shall have minimum 28-day compressive strength of 2500 psi when tested and meet the shrinkage and expansion requirements listed for high strength non-shrink grout.
- C. Anchoring Cement shall have minimum 28-day compressive strength of 3000 psi when tested and comply with ASTM C-928 R-2.
- D. Application
 - 1. High Strength Non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under the exterior rim of the steel tank and all equipment base plates, and at all locations where grout is specified in the contract documents.
 - 2. General Purpose Non-Shrink Grout shall be used for non-structural, non-repair interior or exterior grout applications.
 - 3. Anchoring Cement shall only be used with approval of the OWNER'S REPRESENTATIVE and only for non-repair, non-structural applications.

2.2 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

- B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed four (4) inches.

2.3 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers approved by the OWNER'S REPRESENTATIVE. Shovel measurement shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

- A. All surface preparation, curing, and protection of cement grout shall be as specified by the manufacturer. The finish of the grout surface shall match that of the adjacent concrete.
- B. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the OWNER'S REPRESENTATIVE.

3.2 GROUTING PROCEDURES

Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution of prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

3.3 Installation

A. Examination

1. Examine substrates and conditions under which materials will be installed. Do not proceed with Installation until unsatisfactory conditions are corrected.
2. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas landscaping from contact due to mixing and handling of materials.

B. Surface Preparation

Comply with manufacturer's printed instructions and the following:

1. Mechanically remove all unsound concrete to the limits indicated on the drawings. Remove cement paste and laitance to expose sound aggregate.

2. Clean surface to receive grout of all materials including dust, oil, dirt, and grease or Efflorescence.
 3. Dampen with clean water before patching and remove standing water.
- C. Specialized Installation Requirements
1. Steel Reservoir Grouted Bearing Surface:
 - a. Support wall plates above cleaned bearing surfaces with wedges or shims.
 - b. Fill space below bearing plates supporting structural members and stationary equipment with non-metallic non shrink grout to depth and thickness as shown on the drawings.
 - c. Slope the face of grout to ensure water flows away from grouted edge.
 2. Grout Below Bearing Plates:
 - a. Support bearing plates above cleaned bearing surfaces with double-nutted anchor bolts or wedges.
 - b. Fill space below bearing plates supporting structural members and stationary equipment with non-metallic non shrink grout.
 - c. Fill space below bearing plates supporting vibrating equipment with metallic non shrink grout.
 3. Grout in Steel Bollards:
 - a. Fill steel bollards with non-metallic non shrink grout.
 - b. Smooth trowel grout to 1-inch-high convex curve at top of bollards.
 4. Grout in Steel Door Frames: Install non-metallic non shrink grout between masonry rough opening and door frames in masonry walls, fully filling frames with grout.
- D. Formwork:
1. Comply with manufacturer's printed instructions and the following:
 - a. Forms must be watertight, strong, properly braced, and properly coated.
 - b. Allow a minimum clearance of 2 inches between forms and baseplate for grout entry.
 - c. Allow a minimum grout head of 6 inches.
 - d. Slope form on placing side to assist in grout movement and to prevent trapping air.

- e. Allow 1-inch horizontal clearance and 1-inch vertical clearance for height above bottom of baseplate.
 - f. Provide venting of forms to avoid entrapment of air.
- E. Mixing Requirements:
 - 1. Comply with manufacturer's printed instructions and the following:
 - a. Do not re-temper with additional water.
- F. Placement of Grout Materials:
 - 1. Comply with manufacturer's printed instructions and the following:
 - a. The area to be grouted should be thoroughly flushed and soaked with clean water prior to grouting. Leave no standing water.
 - b. Place the grout quickly and continuously use light rodding or strapping to eliminate air bubbles.
 - c. Place grout mixture into prepared areas from one side or the other, rapidly and continuously, to reduce air entrapment. Avoid placing grout from opposite sides.
 - d. Grout temperature should be maintained from 50°F to 90°F to achieve specified results. Use cold water in hot weather or hot water in cold weather to achieve desired grout temperature. Do not use if temperature is expected to go below 32°F within a 12-hour period.
- G. Curing Requirements:
 - 1. Utilize a damp cure of at least 3 days is necessary to control the Non-Shrink characteristics and maintain strength levels.
 - 2. Cover fresh grout and anchoring cement with plywood where exposed to construction traffic for 24 hours minimum.
- H. Cleaning After Grout Placement
 - 1. Remove excess material before material cures. If material has cured, remove using mechanical methods that will not damage substrate.

3.4 Completion

- A. Adjusting Defective Work: Replace or patch grout and anchoring cement as directed by OWNER/OWNER'S REPRESENTATIVE/ARCHITECT

END OF SECTION

SECTION 04 05 17

MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SCOPE

- A. This Section includes all labor, materials and equipment required to complete masonry mortar and grout work required by the Contract Documents including, but not limited to, these major items:
 - 1. Installation
 - 2. Grouting.
 - 3. Placement of vertical and horizontal reinforcing.
 - 4. Cleaning of masonry.

- B. Section Includes:
 - 1. Masonry Grout.
 - 2. Mortar.
 - 3. Admixtures.
 - 4. Masonry cleaners.

- C. Related Sections:
 - 1. Section 03 30 00 – Cast-in-Place Concrete Work
 - 2. Section 04 22 00 – Concrete Masonry Units

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
 - 2. ASTM C204 - Standard Test Methods for Fineness of Hydraulic Cement by Air-Permeability Apparatus.
 - 3. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
 - 4. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
 - 5. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
 - 6. ASTM C476 - Standard Specification for Grout for Masonry.

1.3 SUBMITTALS

- A. Masonry Grout design: Indicating type and proportions of the ingredients according to the proportion requirements herein and ASTM C 476.
 - 1. In lieu of Masonry Grout design, submit the mix designs and grout strength test performed in accordance with ASTM C 476.
- B. Mortar design: Indicating type and proportions of ingredients in compliance with the proportion specification herein and ASTM C 270.
 - 1. In lieu of mortar design, submit the mix design and mortar tests performed in accordance with the property specification of ASTM C 270.
- C. Color samples for OWNER selection of mortar color.
- D. Material certificates certifying each material is in compliance for all Mortar and Grout materials and admixtures.
- E. Construction procedures for Cold Weather Construction and/or Hot Weather Construction.
 - 1. Adhere to the procedures and general practices provided for cast-in-place concrete in Section 03 30 00 Cast-in-Place Concrete Work
- F. Masonry Cleaner: Product information

1.4 QUALITY ASSURANCE

- A. Testing Service -- The OWNER will engage an independent testing laboratory to perform material evaluation tests and to perform required Special Inspections.
- B. Materials and installed work may require testing and retesting, as directed by the OWNER or OWNER'S REPRESENTATIVE, at any time during the progress of the Work. Allow free access to material stockpiles and facilities at all times. All initial testing required by the Contract Documents shall be done at the OWNER's expense. Testing expenses for the retesting of rejected materials and installed work will be charged back to the CONTRACTOR.
- C. Minimum Testing Frequency:
 - 1. An independent testing agency or laboratory shall make test specimens of masonry grout and mortar on job site.
 - 2. One mortar test and one grout test shall be taken for each 5,000 square feet of wall area but at least one set of tests shall be taken.

3. The use of testing and inspection does not relieve the CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the Contract Documents.

D. Inspection Criteria:

1. Masonry construction shall be inspected and evaluated in accordance with the requirements of Chapter 17 of the Oregon Structural Specialty Code, per TMS 402/ACI 530/ASCE 5 Table 1.19.3 – Level C Quality Assurance and TMS 602/ACI 530.1/ASCE 6, Table 5 – Level C Quality Assurance requirements (ACI 530 Table 1.19.1, Table 1.19.2, & Table 1.19.3), unless otherwise indicated.
2. The Contract Documents shall dictate the required level of inspection per above reference or provide a project specific special inspection program.
3. If the Contract Drawings do not specify the level of required inspection, provide Level C Quality Assurance, or obtain written direction from the OWNER'S REPRESENTATIVE to the required level of inspection.

E. Environmental:

1. The cold weather construction provisions of ACI 530.1/ASCE6/TMS 602, Article 1.8 C shall be implemented when the ambient temperature falls below 40 degrees F or the temperature of the masonry units is below 40 degrees F.
2. The hot weather construction provisions of ACI 530.1/ASCE 6/TMS 602, Article 1.8 D shall be implemented when the ambient temperature exceeds 100 degrees F or when the temperature exceeds 90 degrees F and the wind velocity is greater than 8 mph.
3. No salt, anti-freeze chemicals or related materials permitted. Store masonry units and bagged materials off ground and protect from rain.
4. Do not build on work having film of water or frost on surfaces.
5. Protect work by covering in rainy weather; protect green masonry from freezing.
6. Before stopping work for day, cover tops of walls at new work with non-staining waterproof covering extended 2 feet minimum down both sides of wall and secured.

- F. Delivery, Storage and Handling – Deliver and store packaged materials in original, unopened containers and store in dry weathertight enclosures. Stockpile and handle aggregates to prevent segregation and contamination. Maintain sand for volume proportioning of mortar and grout in a damp loose condition.

PART 2 PRODUCTS

2.1 MORTAR AND GROUT MATERIALS

- A. Cement: Type I Portland cement conforming to ASTM C150.
- B. Fine and coarse aggregate: ASTM C404 for grout.
- C. Sand:
 - 1. Clean, sharp, well graded, and free from salt, loam, clay, and other foreign matter.
 - 2. Sand shall conform to ASTM C144 for mortar.
 - 3. Sand shall be graded as follows:

Sieve Size	Percent Passing
4	100
8	95 – 100
16	70 -100
30	40 – 75
50	15 – 35
100	2 – 15
200	0

- D. Lime: Hydrated type conforming to ASTM C207, Type S.
- E. Water: Clean, fit for drinking (potable), and free from strong acids, alkalis, oils, or organic material.
- F. Waterproofing admixture: Powder.
 - 1. Type: Grace Hydratite Plus, CemMaster Hydrolox 400, BASF Rheomix, BASF Rheopel or approved equal.
- G. Accelerator or retardant
 - 1. May be added when required by weather conditions.
 - 2. Type: Anti-Hydro, Grace Dehydratine 80 or Dehydratine 80M, BASF Pozzolith, Sika Plastiment, Sonneborn Sonotard, Trimex, or approved equal.
- H. Intrusion (water-reducing) admixture for masonry grout.
 - 1. Type: BASF Pozzolith, IntrusionAid or approved equal.
- I. Water-reducing admixture for mortar.
 - 1. Type: BASF Rheomix or approved equal.

J. Mortar Color.

1. Pure natural finely milled inert water insoluble non-bleeding and free of deleterious fillers or extenders.
2. Color shall be as shown on the Drawings.
3. Color shall be selected by OWNER from manufacturer's standard range of colors.

2.2 PROPORTION OF MIXES

A. Mortar

1. Conform to ASTM C270 and be of the type and color specified.
2. Type S with minimum 28-day compressive strength of 1,800 psi minimum.
3. Mixed by volume in ratio of 1-part Portland cement (6 sacks per cubic yard minimum), 1/4 to 1/2-part lime, 2-1/4 to three (3) parts (to cement-lime combined volume) sand.
4. Pointing mortar shall be one part cement, 1/4 lime, three (3) parts sand by volume. Add one (1) pound of water-reducing admix for mortar per bag of cement and one pound per cubic foot of lime.
5. Add waterproofing in amounts recommended by manufacturer, 0.2 pounds of waterproofing per 100 pounds of cement minimum.
6. Do not use admixtures containing more than 0.2 percent chloride ions.
7. Limit the maximum percentage of mineral oxide or carbon black job site pigments by weight of cement as follows: For pigmented Portland cement-lime mortar; 10 percent maximum mineral oxide pigment or 2 percent maximum carbon black pigment.

B. Masonry grout

1. Conform to ASTM C476.
2. Minimum 28 days compressive strength greater than or equal to 2,500 psi, seven (7) sacks of cement minimum per cubic yard.
3. Waterproofing admix and intrusion admix in amounts recommended by manufacturer, 0.2 lb. of waterproofing per 100 pounds of cement minimum.

C. Masonry grout for pouring:

1. Fluid consistency, seven (7) to eight (8) inches slump.

2. Accurately mix by volume 1-part Portland cement: two (2) parts minimum to three (3) parts maximum of damp loose sand: two (2) parts maximum of 3/8-inch minus aggregate.
 3. For masonry grout spaces less than three (3) inches in any dimension, omit 3/8-inch minus aggregate.
- D. Masonry grout for pumping:
1. Without segregation of the constituent parts.
 2. Mixed to a consistency that has a slump between eight (8) to eleven (11) inches.
- E. Empty bags for waterproofing and intrusion admixes shall be retained for verification prior to their disposal. Use accelerator or retardant in strict accordance with manufacturer's printed instructions.

2.3 MASONRY CLEANER

- A. Sure Kleen #101 Lime Solvent or approved equal.

PART 3 EXECUTION

3.1 MIXING

- A. Masonry grout shall be plant batched.
- B. Mortar:
1. All tools and equipment used in mixing of mortar shall be clean and free of contaminants.
 2. Measure materials by volume or equivalent weight, not by shovel.
 3. Supply only as much water as necessary to obtain desired workability; required compressive strength must be met.
 4. Mix by placing 1/2 of the water and sand in the operating mixer. Then add the cement, lime and the remainder of the sand and water.
 5. After all ingredients are in the batch mixer, they shall be mechanically mixed for not less than three (3) minutes.
 6. Hand mixing shall not be employed.
 7. Heat aggregates when air temperature is below 32 degrees F to maintain mortar at 70 to 120 degrees F until used.

8. Maintain workability of mortar by retempering.
 - a. Retemper by adding only as much water as required to maintain high plasticity.
 - b. Retempering shall only be done by adding water within a basin formed from mortar on a mortar board and working mortar into water.
 - c. Discard all mortar which has begun to stiffen, or which is unused after 2-1/2 hours from the initial mixing.

3.2 INSTALLATION

- A. See Section 04 22 00, Concrete Masonry Units.
- B. All masonry shall be laid true straight level, plumb and neatly in accordance with the drawings; lay out in advance so that no concrete unit less than eight (8) inches in length occur except where necessary as in reveals, etc.
- C. All units shall be saw cut accurately to fit all openings, and for electrical and plumbing work.
 1. No plumbing or electrical boxes or conduit shall be placed in any cell or course that contains reinforcing.
 2. All cutting shall be done with masonry saw and produce neat and true surface.
- D. All units shall be sound, dry, clean, and free from cracks and chips.
- E. No construction supports shall be attached to the wall except where specifically permitted by the OWNER'S REPRESENTATIVE.
- F. Units shall be "air" dry at time of laying.

3.3 REINFORCEMENT

- A. The following minimum requirements shall be met unless shown otherwise:
 1. Provide #5 verticals at the spacing shown on the drawings.
 2. Locate two #5 at each jamb of door, window, louver, and other openings and end of walls; run full height of wall. Reinforcement adjacent to openings need not be provided for openings smaller than 16-inches in either the horizontal or vertical direction, unless the spacing of distributed reinforcing is interrupted by such openings.
 3. Position one #5 vertical at each wall corner and each wall intersection; run full height of wall.

4. Dowel verticals to foundation with one #5 dowel four (4) feet long minimum per vertical; embed dowel two (2) feet in foundation unless otherwise shown on drawings.
5. Horizontal reinforcement, unless shown otherwise, shall be two #4 rebars in the bond beams which are located at the spacing shown on the drawings and at all floor and roof levels. Bend rebar at corners and intersections, or supply two (2) feet by two (2) feet rebar of same size and number as horizontal reinforcement. Horizontal reinforcement shall be anchored around vertical reinforcing bars with a standard hook at all wall ends, corners, and intersections that are not continuous around the corner or through the intersection. For openings, minimum lintel size and reinforcement shall be two (2) #4 rebars in bottom of 8-inch lintel for less than four (4) feet span, and two (2) #4 rebars in bottom and top of 24-inch lintel for four (4) feet to 10 feet span. Lintel reinforcement to extend two (2) feet beyond each side of jamb.
6. Before placing reinforcement remove mud, oil, mill scale, loose rust, ice, and any other coatings from it. Position reinforcement accurately; center in cells unless noted otherwise. Secure against displacement, holding vertical reinforcement firmly in place by means of frames, rebar spacers, or other suitable devices, and place horizontal reinforcement as laying progresses. Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 192 diameters of the reinforcement.
7. Minimum clear distance between longitudinal bars shall be nominal diameter of bar or 1-inch, whichever is larger. Minimum thickness of mortar or grout between masonry and reinforcement shall be 1/4-inch for fine grout and 1/2-inch for coarse grout. Unless noted otherwise, reinforcing bars and dowels shall be lapped 40 bar diameters or 2-foot six (6) inches minimum, where spliced end shall be separated by 1 bar diameter or wired together.
8. Splice reinforcement only at points shown on Drawings or reviewed shop drawings; any other locations must be specifically reviewed by OWNER'S REPRESENTATIVE.
 - a. Splices in adjacent bars shall be staggered; in horizontal reinforcement of walls separate at least 10 feet longitudinally for bars of same tier.
 - b. Splices in reinforcement shall be made only at such points and in such a manner that the structural strength of the member will not be reduced.
 - c. Lapped splices shall provide sufficient lap to transfer the working stress of the reinforcement by bond and shear.
 - d. Minimum lap shall be 40 bar diameters, where spliced end shall be separated by 1 bar diameter or wired together.

- e. Welded or mechanical connections shall develop the full yield strength of the reinforcement.
 - f. Bond beams shall be continuous around corners.
9. When a foundation dowel does not line up with a vertical core, it shall not be sloped more than one horizontal in six vertical. Dowel shall be grouted into a core in vertical alignment, even though it may be in cell adjacent to cell holding vertical wall reinforcing.
 10. Bond beam reinforcement shall be laid continuously on webs of bond beam units. Intersecting masonry walls shall be tied to one another by horizontal reinforcement, unless noted otherwise; where masonry walls intersect with concrete walls, connect with 1/2-inch diameter by 15-inch mechanical bolts in flush shells at bond beams.
 11. To allow bonding masonry, clean laitance from top of concrete foundation before proceeding. The staging joint on foundations or slabs shall be laid with full mortar coverage except at the area where grout occurs, which shall be kept free of mortar so that grout is in contact with the foundation slabs.
 12. Lay units in regular running bond except where soldier or other coursing is shown on drawings; maintain even module. Corners shall have same masonry bond by overlapping units. Joints shall be uniform throughout all work having same type of masonry units.
 13. At running bond, thread vertical reinforcing through alternately overlapping cells. Lay units according to "face and shell" method; provide full mortar coverage on all face shells, and on faces and webs surrounding vertical and horizontal cells to be filled with grout.
 14. Do not furrow bed joints. Shove tightly each new unit against existing unit so that mortar bonds well to both.
 15. Rock closures into place. Do not pound corners and jambs to fit stretcher units after they are set in position. Remove all excess grout and mortar spilled on masonry units during construction.
 16. Dry brush all masonry surfaces at end of each day's work. Stop off horizontal run of masonry by racking back one-half length of unit in each course at end of day's work. Tothing is not permitted. Where fresh masonry joins partially set masonry, remove loose units and mortar clean and then lightly wet exposed surface of set masonry before starting new work.
 17. Joints of walls to be covered or furred may be left flush, without tooling. Joints of all walls which are to be exposed shall be tooled when "thumb right" hard mortar

is partially set but still sufficiently plastic to bond) with round jointer or bar to produce a dense, slightly concave surface, well bonded at edges. All tooling shall be done with a tool which compacts the excess mortar out of joint rather than dragging it out. Joints which are not tight at the time of tooling shall be raked out, pointed, then tooled. If it is necessary to move to a unit after it has been once set in place, the unit shall be removed from wall, cleaned, and set in fresh mortar. Remove any mortar fins from joint junctions.

18. Unless shown otherwise on drawings, provide 8-inch lintel for concrete masonry openings four (4) feet wide or less and 16-inch lintel for openings greater than four (4) feet wide. Forms and shores for lintels shall be substantial. Brace or tie forms to maintain position and shape. Forms shall be tight with no leakage of mortar or grout. Do not remove forms and shores until masonry has hardened sufficiently to carry its own weight and other temporary loads that may be placed on it during construction, 10 days minimum.

3.4 MASONRY GROUTING

- A. Masonry grouting shall be by low lift method.
 1. The repetitive construction procedure of erecting a masonry wall to a height not greater than four (5) feet, grouting the wall as required and then repeating this cycle until the top of the wall is reached shall be classified as low-lift grouting. Grout shall be placed while mortar joints are still soft and plastic or the grout spaces shall be cleaned of mortar droppings and protruding mortar joints shall be removed.
- B. Cells containing reinforcement or embedded items shall be solidly filled with grout. Before grouting starts, reinforcing steel shall be secured in a place and observed by OWNER'S REPRESENTATIVE and inspected by Building Inspector from governmental unit having authority.
- C. Vertical cells to be filled shall have vertical alignment to maintain continuous unobstructed cell area. To confine grout to horizontal masonry beams, the tops of unfilled cell cavities or cores in masonry units under beams shall be covered with metal lath, or special bond beam or lintel units shall be used, or another method may be employed if approved by OWNER'S REPRESENTATIVE, building paper shall not be permitted.
- D. All bolts, anchors, etc., inserted in walls shall be fully and solidly grouted in place. Embedment shall not be less than 3/4 of the wall thickness, unless otherwise noted.
- E. Masonry shall cure at least 24 hours before grouting. Keep clean of mortar and drippings those cavities and cores which are to be grouted. Mortar projections and droppings shall be washed out of spaces and off reinforcing with a jet stream of water.

- F. Masonry grout shall be poured in lifts not exceeding five (5) feet. All masonry shall be laid using the Low-Lift grouting method with maximum grout pour heights not to exceed five (5) feet unless otherwise allowed in writing by the OWNER'S REPRESENTATIVE. In addition, grout pour heights shall not exceed the maximum grout pour height limits of Table 7 of TMS 602/ACI 530.1/ASCE 6, based upon the minimum grout space dimensions for grouting of cells of hollow units. Lay masonry until location of a bond beam or horizontal lintel beam is reached, but not to exceed the limits of Table 7 of TMS 602/ACI 530.1/ASCE 6, and then grout full the vertical cells required to be grouted and fill the beam or lintel without pause.
- G. To ensure complete filling of grout space, consolidate grout at time of pouring by puddling and then reconsolidate by later puddling before the plasticity is lost. Consolidate pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.
- H. Solid grout hollow metal door and window frames; for all wall openings over two (2) feet wide, solid grout from lintel to floor or roof above in one continuous operation.
- I. Place grout within 1 1/2 hour from introducing water in the mixture and prior to initial set.

3.5 MASONRY CLEANING

- A. All mortar and grout must be thoroughly set and cured before cleaning. Remove excess mortar or mortar stains or efflorescence; scraping devices shall be nonferrous. Protect all adjacent surfaces, including sash and other corrodible metalwork, from damage by cleaning solvent.
- B. Saturate all exposed masonry with water immediately before cleaning, apply solution of cleaner as per manufacturer's instructions and rinse thoroughly with fresh, clean water immediately after cleaning. Do small sections at a time, working from top to bottom. Repeat as necessary.
- C. Tuckpoint any loose or defective mortar joints. At conclusion of masonry work, remove scaffolding and equipment used in work and remove debris, refuse and surplus masonry material.

END OF SECTION

SECTION 04 22 00

CONCRETE MASONRY UNITS

PART 1 GENERAL

1.1 SCOPE

- A. Work included under this section shall include all materials and perform labor required to execute this work as indicated on the drawings, as specified and as necessary to complete the work, including, but not limited to, these major items:
 - 1. Concrete masonry units.
 - 2. Vertical and horizontal reinforcing and dowels projecting into subsequently placed concrete.
 - 3. Setting of flashing and other work to be embedded in masonry.
- B. Related Sections:
 - 1. Section 04 05 17, Masonry Mortar and Grout.

1.2 SUBMITTALS

- A. Samples -- Before any concrete unit masonry materials are delivered to the job site, submit one sample of each proposed concrete masonry unit.
- B. Submit color samples for OWNER selection of concrete masonry unit colors.
- C. Material Certificates -- Prior to delivery of concrete masonry materials, anchors, ties, fasteners, and metal accessories to the job site, deliver a letter from the manufacturer of the proposed masonry units, anchors, ties, fasteners, and metal accessories certifying that all such units to be delivered to the job site are in strict conformance with the provisions of this Section.
- D. Construction procedures for Cold Weather Construction and/or Hot Weather Construction for review and approval by OWNER in compliance with the requirements herein prior to use on the project.
- E. A letter of certification from the Supplier of the materials prior to delivery of the materials to the site to verify f'm according to the Chapter 17 of the International Building Code (IBC).

1.3 QUALITY ASSURANCE

A. Qualifications of Workers

1. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
2. Provide one skilled journeyman mason who shall be present at all times during execution of this portion of the work and who shall personally direct all work performed under this Section.

B. Standards, Specifications and Codes

Comply with the applicable provision of the following codes, specifications and standards to the extent indicated by reference thereto:

1. American Concrete Institute (ACI)
2. American Society of Testing and Materials (ASTM)
3. National Concrete Masonry Association (NCMA)
4. Structural Clay Products Institute (SCPI)
5. American Society of Civil Engineers (ASCE)
6. The Masonry Society (TMS)
7. The International Building Code (IBC)

Comply with building code requirements which are more stringent than the above and all O.S.H.A. requirements.

C. Testing Service -- The OWNER will engage an independent testing laboratory to perform material evaluation tests and to perform required Special Inspections.

D. Materials and installed work may require testing and retesting, as directed by the OWNER or OWNER'S REPRESENTATIVE, at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. All testing required by the contract documents shall be done at the OWNER's expense. Testing expenses for the retesting of rejected materials and installed work will be charged back to the CONTRACTOR.

E. Inspection Criteria:

1. Masonry construction shall be inspected and evaluated in accordance with the requirements of Chapter 17 of the Oregon Structural Specialty Code, per TMS 402/ACI 530/ASCE 5 Table 1.19.3 – Level C Quality Assurance and TMS 602/ACI 530.1/ASCE 6, Table 5 – Level C Quality Assurance requirements (ACI 530 Table 1.19.1, Table 1.19.2, & Table 1.19.3), unless otherwise indicated.

2. The Contract Documents shall dictate the required level of inspection per above reference or provide a project specific special inspection program.
 3. If the Contract Drawings do not specify the level of required inspection the CONTRACTOR shall provide Level C inspection or obtain written direction from the OWNER'S REPRESENTATIVE to the required level of inspection.
- F. Minimum Testing Frequency:
1. An independent testing agency or laboratory shall verify the compressive strength (f'_m) of the proposed construction prior to construction and at regular intervals during construction as indicated in the Contract Documents, but at least one test for every 5,000 square feet during construction.
 2. The compressive strength (f'_m) shall be determined for each wythe of multiwythe walls.
 3. Unless specifically directed within the Contract Documents, use the unit strength method specified by TMS 602/ACI 530.1/ASCE 6.
 4. The use of testing and inspection does not relieve the CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the

1.4 PRODUCT HANDLING

- A. Store materials under cover in a dry place and in a manner to prevent damage or intrusion of foreign matter. During freezing weather protect all masonry units with tarpaulins or other suitable material. Store masonry units under covers that will permit circulation of air and prevent excessive moisture absorption. Protect concrete masonry units from wetting.
- B. Handle unit on pallets or flatbed barrows.
- C. Replacements -- In the event of damage, immediately make all repairs and replacements necessary to the approval of the OWNER and at no additional cost to the OWNER.
- D. Reinforcing, metal ties, and anchors shall be protected from contact with soil and water and before being placed shall be free of loose rust and other coatings that will reduce or destroy bond.
- E. Environmental Conditions - Implement the following special construction procedures based on the environmental conditions encountered during masonry construction.

Failure to maintain the conditions specified below during the construction of masonry work will be just and sufficient cause for such work to be rejected.

1. Cold Weather - The cold weather construction provisions of TMS 602/ACI 530.1/ASCE 6, Article 1.8 C shall be implemented when the ambient temperature falls below 40 degrees F or the temperature of the masonry units is below 40 degrees F. All masonry units and all work on which new masonry is constructed shall be free of frost, ice, snow, and surface moisture and their temperature shall not be lower than 40 degrees F. Protect green masonry from freezing. No salt, anti-freeze chemicals or related materials are permitted.
2. Hot Weather - The hot weather construction provisions of TMS 602/ACI 530.1/ASCE 6, Article 1.8 D shall be implemented when the ambient temperature exceeds 100 degrees F or when the temperature exceeds 90 degrees F and the wind velocity is greater than 8 mph.
3. Wet Weather - Store masonry units and bagged materials off ground and protected from rain. Do not build on work having a film of water on any surfaces. Protect work by covering in rainy weather. Before stopping work for the day, cover the tops of walls at new work with non-staining, waterproof covering extended 2 feet minimum down both sides of wall and secured in place.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. As indicated on the Drawings.
- B. Unit shall be in modular sizes. Exposed-to-view units in anyone building shall be of the same appearance. The texture of units shall match the approved samples for the types of construction and locations designated on the plans. Units shall not contain iron spots or other substances that will stain plaster or paint.
- C. Hollow load-bearing units shall conform to ASTM C90 type 1, Grade N.
- D. The composition shall be 50 percent lightweight (pumice) and 50 percent sand. The lightweight aggregate shall conform to ASTM C331 and the sand shall conform to ASTM C33.
- E. Minimum compressive strength of all blocks shall be 2,000 psi based on the net area.
- F. Maximum water absorption permitted for units at the time of delivery to the job site shall be 15 pounds per cubic foot (15 pcf) of concrete as an average of five units for normal weight aggregate per ASTM C140.

- G. Maximum moisture content permitted for standard weight aggregate units at time of delivery shall be 30 percent of total absorption. The tests for moisture content shall be determined from an average of five units per ASTM C140.
- H. Maximum linear shrinkage shall not exceed 0.035-inch/unit. Concrete masonry units shall include lintel, and bond beam units, and special shapes and sizes required to complete the work indicated.
- I. Certification required above shall show results of tests made not more than 12 months prior to delivery of concrete masonry units to the job site, shall show compliance with the specified values, and shall certify that the mix design, yield per batch, and curing procedures for the units delivered to the job site will be equal to those submitted for the test.
- J. Unit Colors. Pure natural finely milled inert water insoluble non-bleeding and free of deleterious fillers or extenders. Colors shall be as shown on the plans. Colors shall be selected by OWNER from manufacturer's standard range of colors.

2.2 MORTAR AND GROUT

Provide mortar and grout as indicated on the drawings in conformance with the requirements of Section 04 05 17, Masonry Mortar and Grout, of these specifications.

2.3 REINFORCEMENT STEEL

Provide reinforcement steel as indicated on the drawings and in conformance with the requirements of Division 3 of these specifications and of Section 04 05 17, Masonry Mortar and Grout.

2.4 OTHER MATERIALS

All other materials, not specifically described but required of a complete and proper installation of the work of this Section, shall be as selected by the CONTRACTOR subject to the approval of the OWNER.

PART 3 EXECUTION

3.1 INSPECTION

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

3.2 COORDINATION

Carefully coordinate with all other trades to ensure proper and adequate interface of the work of other trades with the work of this Section.

3.3 INSTALLATION

- A. Masonry shall be plumb, true to line, with level courses accurately spaced, and built to thickness and bond pattern indicated. Where no pattern is indicated, masonry shall be laid in running bond pattern. Concrete masonry units shall be dry when laid. Each unit shall be adjusted to final position in the wall while mortar is still soft and plastic. Any unit disturbed after mortar has stiffened shall be removed and re-laid with fresh mortar. Chases shall be built in and not cut in. Chases shall be plumb and shall be minimum one unit length from jambs of openings. Chases and raked-out joints shall be kept from mortar or debris. Spaces around metal door frames and other built-in items shall be solidly filled with mortar as each course is laid. Anchors, wall plugs, accessories, flashings, and other items to be built in shall be installed as the masonry work progresses. All cutting and fitting of masonry, including that required to accommodate the work of other sections shall be done by masonry saws.
- B. Where fresh masonry joins masonry that is partially set or totally set, clean the exposed surface of the set masonry, and remove all loose mortar. If it is necessary to “stop off” a horizontal run of masonry, this shall be done by raking back one-half brick or block length in each course. Tothing will not be permitted.
- C. Before closing up any pipe, duct or similar inaccessible spaces or shafts with masonry, remove all rubbish and sweep out the area to be enclosed.
- D. Provide level and solid bearing in masonry walls under all bearing structural floor and roof elements. Solid bearing shall be bond beams unless otherwise indicated.
- E. All masonry walls shall extend to underside of floor beams or roof metal decking unless otherwise indicated.
- F. If blowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt at no additional cost to the OWNER.
- G. Mortar Beds and Joints
 - 1. Hollow units shall be laid with full mortar coverage on horizontal and vertical face shells, except that webs shall be also be bedded in all courses of the starting course on footings and solid foundation walls, and where adjacent to cells or cavities to be reinforced and/or filled with grout or concrete.
 - 2. Horizontal and vertical face joints shall be 3/8-inch thick unless otherwise indicated. Vertical joints shall be shoved tight. Mortar joints in exposed or painted

surfaces shall be tooled when thumbprint hard to a flush joint. Joints in unparge masonry below grade shall be pointed tight with a trowel. Mortar joints in surfaces to be plastered, stuccoed, or covered with other masonry shall be cut flush. Mortar protrusions extending into cells or cavities to be reinforced and filled shall be removed.

H. Placing Reinforcement

1. Place reinforcing as covered in Section 04 05 17 – 3.3, Masonry Mortar and Grout, of these specifications.
 - a. Vertical reinforcement shall be rigidly secured at the top and bottom of CMU wall and at intervals necessary to hold the reinforcing in proper position.
 - b. Reinforcement shall be placed at the wall centerline unless indicated otherwise.

I. Low-Lift Grouting

1. Place reinforcing as covered in Section 04 05 17 – 3.4, Masonry Mortar and Grout, of these specifications.
 - a. Set steel lintels in beds of mortar. Fill spaces around jambs and head of metal door buck and frames solidly with mortar.

J. Pointing and Cleaning

1. At the completion of the work, all holes in joints of masonry surfaces to be exposed or pointed except weep holes shall be filled with mortar and suitably tooled, masonry walls shall be dry brushed at the end of each day's work and also final pointing, and shall be left clean and free from mortar spots and droppings. Any cracks in masonry shall be repaired. Defective joints shall be cut out and repointed.
2. Remove efflorescence, mortar spots and other areas that appear unclean with cleaning agent to a sample wall area as directed by the OWNER. The OWNER retains the right to change proposed cleaning methods and shall be notified before any additional cleaning agent is used. The cleaning methods agent shall be applied to a small section of the wall at a time and work shall proceed from the top to the bottom. Protect all metal sashes, lintel, louvers, and other corrodible parts when masonry is cleaned.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. The extent of metal fabrications work is shown on the Drawings and includes items fabricated from iron, steel, stainless steel and aluminum shapes, plates, bars, sheets, strips, tubes, pipes, and castings which are not a part of structural steel or other metal systems in other sections of these specifications.
- B. Section Includes:
 - 1. Shop-fabricated metal items.
 - 2. Hoist Beams and Divider Beams
 - 3. Bollards
 - 4. Ladders.
 - 5. Seismic Anchors and Anchor Chairs
 - 6. Anchor bolts.
 - 7. Stairs.
 - 8. Handrails and railings.
 - 9. Reinforced Railing
 - 10. Gratings.
 - 11. Access hatches.
 - 12. Rough Hardware
 - 13. Miscellaneous fabrications, framing, and supports.

1.2 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete Work.
- B. Section 09 90 00, Painting and Coating.
- C. Section 33 16 23, Ground-Level Steel Water Storage Tank

1.3 REFERENCE STANDARDS

- A. Aluminum Association:
 - 1. AA DAF-45 - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.

2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
 3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. American National Standards Institute:
1. ANSI A14.3 - American National Standard (ASC) for Ladders - Fixed - Safety Requirements.
- D. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 2. AWS D1.1 - Structural Welding Code - Steel.
 3. AWS D1.6 - Structural Welding Code - Stainless Steel.
- E. ASTM International:
1. ASTM A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 2. ASTM A36 - Standard Specification for Carbon Structural Steel.
 3. ASTM A47, grade as selected - Malleable Iron Castings.
 4. ASTM A48, Class 30 - Gray Iron Castings.
 5. ASTM A53- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 6. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
 7. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 8. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

9. ASTM A193 - Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications.
10. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
11. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
12. ASTM A283, Grade C - Steel Plates to be Bent or Cold Formed.
13. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
14. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
15. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless-Steel Pipes.
16. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
17. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
18. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
19. ASTM A513 - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
20. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
21. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
22. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
23. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
24. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
25. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

26. ASTM A992 - Standard Specification for Structural Steel Shapes.
27. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings.
28. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings.
29. ASTM B177 - Standard Guide for Engineering Chromium Electroplating.
30. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
31. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
32. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
33. ASTM B 308, Alloy 6061-T6, Anodic Coating Class I, AA-C22-A41, anodized after fabrication - Structural Aluminum Shapes and Plates.
34. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
35. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
36. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
37. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
38. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.
39. ASTM F436 - Standard Specification for Hardened Steel Washers.
40. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
41. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.

F. Builders Hardware Manufacturers Association (BHMA):

1. ANSI/BHMA A156.20 - American National Standard for Strap and Tee Hinges and Hasps.

- G. National Ornamental & Miscellaneous Metals Association:
 - 1. NOMMA Guideline 1 - Joint Finishes.
- H. SSPC: The Society for Protective Coatings:
 - 1. SSPC - Steel Structures Painting Manual.
 - 2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
 - 3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
 - 4. SSPC SP 1 - Solvent Cleaning.
 - 5. SSPC SP-7 Brush-off Blast Cleaning.
 - 6. SSPC SP 10 - Near-White Blast Cleaning.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Data: For information only, submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in miscellaneous metal work, including paint products.
- C. Shop Drawings:
 - 1. General: Submit copies of shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work which are not completely shown by the manufacturer's data sheets.
 - a. Include plans, elevations and details of sections and connections and fabricators proposed shop coat paint or galvanizing specifications.
 - b. Show anchorage and accessory items.
 - c. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete construction.
 - d. Indicate welded connections using standard AWS A2.4 welding symbols.
 - e. Indicate net weld lengths.
 - 2. Stairs, Handrails and Railings:
 - a. Indicate profiles, sizes, and accessories.

- b. Clearly identify connection on Shop Drawings with complete details to the extent that all connections can be made without further reference to the Contract Documents.
- c. Include information indicating weld type, joint preparation information such as degree of bevel, weld length, etc. Indicated root openings, back-ups, filler, runout tabs, etc.
- d. Indicate changes from the Contract Documents on the Shop Drawings. Structural calculations for any proposed changes or alterations to the configuration shown in the drawings. Calculations shall be Stamped by a Structural Engineer licensed in the State of Oregon.

3. Gratings:

- a. Indicate details of gratings, plates, component supports, anchorages, openings, perimeter construction details, and tolerances.

D. Samples:

- 1. Submit two sets of representative samples of materials, illustrating factory finishes as may be requested by the OWNER'S REPRESENTATIVE.
- 2. OWNER'S REPRESENTATIVE'S review will be for color, texture, style and finish only.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Transporting, handling, storing, and protecting products shall be in accordance with manufacturer's requirements.
- B. Inspection: Accept metal fabrications on-site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather or by ground contact.

1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to preparation of Shop Drawings and fabrication. Indicate field measurements on Shop Drawings.
 - 1. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication.

PART 2 PRODUCTS

2.1 GENERAL

- A. For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, roughness and defects which impair strength, durability, and appearance. Remove such blemishes by grinding or by welding and grinding prior to cleaning, treating and application of surface finishes including zinc coatings.

2.2 HOIST BEAMS AND DIVIDER BEAMS

- A. Hoist and Divider Beams:
 - 1. Steel, wide-flange sections.
 - 2. Shape and Size: As required to support applied loads with maximum deflection of 1/240 of the span.
 - 3. Shop Finish: Prime paint, one coat.

2.3 BOLLARDS

- A. Description:
 - 1. Steel pipe, concrete filled.
 - 2. Crowned cap.
 - 3. Size: 6-inch diameter, length as indicated on Drawings.
 - 4. Shop Finish: Prime paint, one coat]
- B. Concrete Fill:
 - 1. Minimum Compressive Strength: 3,000 psi.
 - 2. As specified in Section 03 30 00, Concrete Work.
- C. Anchors: Concealed type as indicated on Drawings.

2.4 LADDERS

- A. See Section 33 16 23.10, Ground-Level Steel Water Storage Tank Accessories for additional interior and/or exterior ladder information and fall prevention requirements.
- B. Exterior Ladder:
 - 1. ANSI A14.3.

2. Steel-welded construction.
3. Siderails:
 - a. Size: 1/2 by 2 inches.
 - b. Spacing: 20 inches o.c.
4. Rungs:
 - a. Solid rod. Hex rod or gnarled rebar.
 - b. Size: 1-inch diameter.
 - c. Spacing: 12 inches o.c.
5. Mounting:
 - a. Space rungs as shown on Drawings, minimum of 7 inches from wall surface.
 - b. Provide steel mounting brackets and attachments per Drawings.
6. Shop Finish: Prime paint, one coat.
7. Ladder Safety Cage:
 - a. Steel bar sections, as shown on Drawings, minimum 1/4 by 2 inches.
 - b. Bottom Hoop:
 - 1) Size: As shown on Drawings, minimum 18-inch radius.
 - 2) Location: Maximum 74 inches above finished floor or roof.
 - c. Other Hoops:
 - 1) Size: As shown on Drawings, minimum 14-inch radius.
 - 2) Spacing: Maximum 48 inches o.c.
 - d. Vertical Bars Spacing: 10 inches o.c.
 - e. Finish: Match ladder finish.
8. Ladder Security Enclosure:
 - a. Description: Formed to enclose ladder siderails and rungs when closed and to swing free of ladder rungs and siderails with minimum 1-1/2-inch clear to siderails in open position.

- b. Sheet steel.
 - 1) Thickness: Minimum 16 gage/0.058 inch formed to enclose ladder siderails and rungs when closed and to swing free of ladder rungs and siderails with minimum 1-1/2-inch clear to siderails in open position.
- c. Provide continuous steel hinge full height of enclosure.
- d. Provide steel hasp for padlocking in closed and open position.
- e. Finish: Match ladder finish.

C. Interior Tank Ladder:

- 1. Steel-welded construction.
- 2. Siderails:
 - a. Size: 1/2 by 2 inches.
 - b. Spacing: 20 inches o.c.
- 3. Rungs:
 - a. Solid rod. Hex rod or gnarled rebar.
 - b. Size: 1-inch diameter.
 - c. Spacing: 12 inches o.c.
- 4. Mounting:
 - a. Space rungs as shown on Drawings, minimum of 7 inches from wall surface.
 - b. Provide steel mounting brackets and attachments per Drawings.
- 5. Shop Finish: Prime paint, one coat.

2.5 NOT USED

2.6 NOT USED

2.7 ANCHOR BOLTS

- A. All anchors shall be epoxy anchors or expansion anchors as shown in the Drawings.
- B. Materials:
 - 1. As shown in the Drawings.

2. For direct bury:
 - a. Malleable iron complying with ASTM A47.
 - b. Cast steel complying with ASTM A27.
 - c. Iron and steel galvanized in compliance with ASTM A153.
 3. For wetted atmospheric conditions
 - a. Type 316 stainless steel.
 4. Threaded rod, nuts, bolts, and washers:
 - a. Material matching anchor insert type.
- C. Types:
1. Threaded-type Concrete Inserts:
 - a. Internally threaded to receive machine bolts.
 - b. Malleable iron, ASTM A47.
 - c. Cast steel, ASTM A27.
 - d. Stainless steel, type 316, ASTM A320.
 2. Wedge-type Concrete Inserts:
 - a. Box-type ferrous castings designed to accept bolts having special wedge-shaped heads.
 3. Slotted-type Concrete Inserts:
 - a. Box-type welded construction with slot designed to receive square head bolt and with knockout cover.
- D. Manufacturers:
1. Hilti, Inc.
 2. Simpson Strong-Tie Co., Inc.
 3. DeWalt, Inc.
 4. Proprietary products as named in the Drawings.

2.8 STAIRS

- A. Meet all applicable codes and Occupational Safety and Health Administration (OSHA) requirements.
- B. Configuration: As shown on the drawings.

- C. Minimum Design Live (Pedestrian) Load: Fabricate stair assembly to support uniform live load of 250 lb./sq. ft. and moving concentrated load of 500 pounds. with deflection of stringer or landing framing not to exceed 1/360 of span.
- D. Fabricate stair assembly to NAAMM AMP 510, industrial class.
- E. Materials: As shown in the Drawings.
- F. STAIRS – Self-supporting exterior stair system
 - 1. An exterior self-supporting stair-system shall be constructed to provide access onto the reservoir’s roof as shown on the drawings. The stairs shall be of galvanized steel fabrication as shown on the drawings and shall include guardrails and landings which shall be located a maximum 12 ft rise interval. The steps shall have a rise of 7.5 in and run of 10 in. The stairs shall be founded on concrete foundation as shown on the drawings.
 - a. Any proposed design alteration to ease constructability, transport, or cost shall be provided as part of the submittal package for review and acceptance by the Engineer of Record.
 - 2. Meet all applicable codes and Occupational Safety and Health Administration (OSHA) requirements.
 - 3. Minimum Design Live (Pedestrian) Loads:
 - a. Treads: Fabricate stair assembly to support uniform live load of 100 lb./sq. ft. and moving concentrated load of 300 lb./4 sq. in. with deflection of stringer or landing framing not to exceed 1/360 of span.
 - b. Landing: Per Section 2.13
 - c. Railing: Per Section 2.11
 - d. Seismic: Stairs shall withstand the effects of earthquake motions determined according to ASCE 7-10. Component Importance Factor is 1.5.
 - 4. Fabricate stair assembly to NAAMM AMP 510, industrial class.
 - 5. Exterior Stair Layout Notes
 - a. General:
 - 1) Use welding for joining pieces together, unless otherwise indicated. Fabricate units so that mechanical fasteners used do not appear on finished surfaces. Make joints true and tight and make connections of parts "light

proof" tight. All welds to be continuous, and ground smooth where exposed.

- 2) Construct stair units to conform to sizes and arrangements indicated. Provide metal framing, hangers, columns, railings, struts, clips, brackets, bearing plates and other components for the support of stairs and landings. Erect stair work to line, plumb, square, and true with runs registering level with floor and platform levels.
- 3) Provide brackets and bearing surfaces as detailed and as required to anchor and contain the stairs on the supporting structure.

b. Stair Framing:

- 1) Fabricate stringers of structural steel channels, plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers.
- 2) Construct platforms of structural steel channel headers and miscellaneous framing members, as indicated. Bolt or weld headers to stringers and newels. Bolt or weld framing members to stringers and headers.

c. Treads and Platforms:

- 1) Provide tread and floor grating to meet loads as outlined.
- 2) Treads shall include integral nosing and back edge stiffeners. Weld steel supporting brackets to stringers, and treads to brackets.
- 3) Fabricate platforms of steel floor grating of the thickness shown. Provide nosing matching that on treads, at all landings. Secure floor plates to platform framing members by welding.

d. Stair Railings and Handrails: Per Section 2.11

6. Finish.

- a. Galvanize components and framing members, pipe fittings, brackets, fasteners, and other ferrous metal components.

2.9 HANDRAILS AND GUARDRAILS

- A. Railing Shall meet requirements of OSHA and local codes.
- B. Railing assembly and attachments to resist lateral force of 200 lb. at any point without damage or permanent set. Test according to ASTM E935.

C. Construction:

1. Include guardrails, handrails, midrails and toe plates in accordance with OSHA requirements.
 - a. Guard Height: 3 foot 6-inch high.
 - b. Handrail Height: Min. 2 foot 6-inch to Max 3 foot 2-inch.
2. Outside diameter:
 - a. 2-inch for components (based on 1-1/2-inch Schedule 40 pipe).
3. Top corners of handrail are to be bent to the smallest radius possible without causing grain separation or otherwise impairing the work.
4. Radius Sections -- Roll to radii shown on Drawings.
5. Vertical segments of handrail are to be set plumb and mount as shown on Drawings or as otherwise specified.
6. Spacing between vertical segments will be according to Drawings.

D. Welded Connections:

1. Cope intersections of rails and posts, weld joints of tailings or use welding connectors, at fabricator's option.
 - a. Other methods of welding may be used when acceptable to the OWNER'S REPRESENTATIVE.
2. Weld corners and seams continuously and in accordance with the recommendations of AWS.
3. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces.
4. Discoloration of finished surfaces and sharp edges will not be acceptable.

E. Materials: As shown on the Drawings.

2.10 GRATINGS

- A. Meet all applicable codes and Occupational Safety and Health Administration (OSHA) requirements.
- B. Minimum Design Live (Pedestrian) Load: Fabricate stair assembly to support uniform live load of 250 lb./sq. ft. and moving concentrated load of 500 pounds with deflection of stringer or landing framing not to exceed 1/360 of span.

C. Layout:

1. Provide removable grating sections with end-banding bars for each panel.
2. Exposed connections shall fit accurately together to form tight hairline joints.
3. Install all gratings with bearing bars spanning the shortest dimension unless shown otherwise on the plans.
4. Provide welded positioning tabs in support angles at each grating section to prevent lateral movement of grating sections.
5. Layout units to allow grating removal without disturbing items penetrating grating.

D. Penetrations:

1. Provide for notched gratings and banding for penetrations as indicated.
2. Provide banding for openings in grating of same material and size as bearing bars unless otherwise indicated.
3. Wherever bar gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar of same material and size as bearing bars to the cut ends of the bars.
4. Divide panels into sections only to the extent required for installation wherever bar grating platforms, runways, etc., are to be placed around previously installed pipes, ducts, and structural members.

E. Materials: As shown on the Drawings.

1. For exterior stairs McNichols as manufactured by McNichols Co., Inc., or approved equal are acceptable materials.
2. For interior stairs: Duragrate, as manufactured by Strongwell Corporation, or approved equal, are acceptable materials. Molded Fiberglass Grating shall meet NSF-61 certifications.

2.11 ACCESS HATCHES

- A. See Specification 33 16 23.10 Ground-Level Steel Water Storage Tank Accessories for reservoir access hatch information.
- B. Use materials of the size and thickness shown in Drawings or, if not shown in the Drawings, of the size recommended by product manufacturer.

- C. Work to the dimension shown in the Drawings or accepted on final shop drawings, using proven details of fabrication and support.
- D. Use the type of materials shown or specified for the various components of the Work.

2.12 ROUGH HARDWARE

- A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting systems. Acceptable manufacturers are Simpson or approved equal.
- B. Manufacture or fabricate items of sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere furnish galvanized steel washers.

2.13 MISCELLANEOUS FABRICATIONS, FRAMING AND SUPPORTS

- A. Provide miscellaneous steel framing and supports required to complete the Work.
- B. Fabricate miscellaneous units to the sizes, shapes and profiles shown in the Drawings or, if not shown, of the required dimensions to receive adjacent grating, plates doors, or other work to be retained by the framing.
- C. Except as otherwise shown, fabricate from structural steel shapes and plate and steel bars, all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection.
- D. Cut, drill, and tap units to receive hardware and similar items to be anchored to the work.
- E. Equip units with integrally welded anchors for casting into concrete, bolting to structural steel or building into masonry. Furnish inserts if units must be installed after concrete is placed.
- F. Galvanize all miscellaneous fabrications unless otherwise noted.

2.14 NON-SHRINK GROUT

- A. Where required for anchoring, patching, or sealing, grouting, and sealing compounds shall conform to the requirements of Section 03 60 00, Grouting.

2.15 MATERIALS

- A. Materials listed below shall be provided unless otherwise noted in the Drawings or other sections of these specification.

B. Steel:

1. Structural W Shapes: ASTM A992.
2. Structural Shapes: ASTM A36.
3. Channels and Angles: ASTM A36.
4. Steel Plate: ASTM A36.
 - a. Steel Plate to be Bent or Cold Formed: ASTM A283, Grade C.
5. Hollow Structural Sections: ASTM A500, Grade B.
6. Structural Pipe: ASTM A53, Grade B, Schedule 40 unless shown otherwise in Drawings.
7. Bar: ASTM A36.
 - a. Cold-Finished Steel Bar: ASTM A108, grade as selected by fabricator.
8. Sheet Steel: ASTM A653, Grade 33 Structural Quality.
9. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.
10. Standard Bolts: ASTM A307; Grade A.
 - a. Washers: ASTM F844.
11. High Strength Bolts: ASTM F3125, Grade A325.
 - a. Washers: ASTM F436; Type 1.
12. Nuts: ASTM A563; heavy-hex type.
13. Welding Materials: AWS D1.1; type required for materials being welded.

C. Stainless Steel:

1. Bars and Shapes: ASTM A276; Type 316.
2. Tubing: ASTM A269; Type 316.
3. Pipe: ASTM A312, seamless; Type 316.
4. Plate, Sheet, and Strip: ASTM A666; Type 316.
5. Bolts, Nuts, and Washers: ASTM A354; Type 316.
6. Welding Materials: AWS D1.6; type required for materials being welded.

D. Aluminum:

1. Structural Aluminum Shapes and Plates: ASTM B308, Alloy 6061, Temper T66, Anodic Coating Class I, anodized after fabrication.
2. Aluminum-Alloy-Drawn Seamless Tubes: ASTM B210 Alloy 6063, Temper T6.
3. Aluminum-Alloy Bars: ASTM B211 Alloy 6063, Temper T6.
4. Bolts, Nuts, and Washers: Stainless steel or Steel, galvanized.
5. Welding Materials: AWS D1.1; type required for materials being welded.

E. Bolts, Nuts, and Washers for Equipment and Piping:

1. Select fasteners for the type, grade and class required for the installation of miscellaneous metal items.
2. Carbon Steel:
 - a. General: Zinc-coated, ASTM A153.
 - b. Structural Connections: ASTM A307, Grade 2 (60 ksi), hot dip galvanized.
 - c. Anchor Bolts: ASTM A307, Grade 2 (60 ksi), hot dip galvanized.
 - d. Pipe and Equipment Flange Bolts: ASTM A193, Grade B-7.
 - e. High Strength Bolts: ASTM F3125, Heavy Hex Head.
3. Stainless Steel: Type 316 stainless steel, Class 2; ASTM A193 for bolts; ASTM A194 for nuts.
 - a. Where stainless steel bolts are in contact with dissimilar metals, glass epoxy insulating sleeves and washers shall be used to electrically isolate the bolts.

2.16 FABRICATION

A. Workmanship:

1. Use materials of the size and thicknesses shown in the Drawings or, if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use as approved by the OWNER'S REPRESENTATIVE.
2. Work to the dimensions shown in the Drawings or accepted on Shop Drawings, using proven details of fabrication and support.
3. Use the type of materials shown in the Drawings or specified for the various components of work.

4. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
 5. Ease exposed edges to a radius of approximately 1/32-inch, unless otherwise shown in the Drawings.
 6. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.
- B. Fit and shop-assemble items in largest practical sections for delivery to Site.
- C. Fabricate items with joints tightly fitted and secured.
- D. Continuously seal join members by means of continuous welds in accordance with the recommendations of AWS, unless otherwise noted or approved.
- E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.
- F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- H. Loose Bearing and Leveling Plates:
1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.
 2. Drill plates to receive anchor bolts and for grouting as required.
 3. Galvanize after fabrication.
- I. Miscellaneous Steel Trim:
1. Provide shapes and sizes for profiles shown in the Drawings.
 2. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges.
 3. Use concealed field splices wherever possible.

4. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.
- J. Fabrication Tolerances:
1. Squareness: 1/8-inch maximum difference in diagonal measurements.
 2. Maximum Offset between Faces: 1/16-inch.
 3. Maximum Misalignment of Adjacent Members: 1/16-inch.
 4. Maximum Bow: 1/8-inch in 48 inches.
 5. Maximum Deviation from Plane: 1/16-inch in 48 inches.

2.17 FINISHES

- A. Steel:
1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
 2. Do not prime surfaces in direct contact with concrete or where field welding is required.
 3. Prime-paint items with one coat, except where galvanizing is specified.
 4. Coatings as specified per Section 09 90 00, Painting and Coating.
 - a. Primer paint selected must be compatible with the required finish coats of paint.
 - b. At locations in contact with potable water, use only primer approved for potable water use.
 5. Galvanizing for Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123; hot dip galvanize after fabrication.
 6. Galvanizing for Fasteners, Connectors, and Anchors:
 - a. Hot-Dip Galvanizing: ASTM A153.
 - b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.
 7. Chrome Plating: ASTM B177, nickel-chromium alloy, polished finish.
 8. Sheet Steel: Galvanized.
 9. Bolts: Hot dip galvanized.
 10. Nuts: Hot dip galvanized.
 11. Washers: Hot dip galvanized.

12. Touchup Primer for Galvanized Surfaces: ASTM A780 (A780M), A1. Repair Using Zinc-Based Alloys (Heat and Stick Method).

B. Stainless Steel:

1. Satin-Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.
2. Mirror-Polished Finish: Number 8, mirror polish with preliminary directional polish lines removed.

C. Aluminum:

1. Protection of All Aluminum:
 - a. Aluminum surfaces in contact with cementitious, masonry or dissimilar materials, apply the following coating system:
 - 1) One (1) coat of epoxy primer, 1 to 2 mils dry film (D.F.).
 - 2) Followed by two (2) coats of Bitumastic, 6 to 8 mils D.F.
 - 3) Followed by two (2) coats of tarset material, 6 to 8 mils D.F.

D. Shop Painting

1. Shop painting of metal fabrications shall be allowed only at the sole discretion of the OWNER'S REPRESENTATIVE.
2. Shop paint miscellaneous metal work in accordance with Section 09 90 00, Painting and Coating, with the following exceptions:
 - a. Those members or portions of members to be embedded in concrete or masonry.
 - b. Surfaces and edges to be field welded.
 - c. Galvanized surfaces.
3. Remove scale, rust, and other deleterious materials before the shop coat of paint is applied.
 - a. Clean off heavy rust and loose mill scale in accordance with SSPC SP-7, Brush-off Blast Cleaning.
 - b. Remove oil, grease and similar contaminates in accordance with SSPC SP-1, Solvent Cleaning.

4. Immediately following surface preparation, brush, or spray on metal primer paint, applied in accordance with the manufacturer's instructions or as specified below.
 5. Apply one (1) shop coat of metal primer paint to fabricated metal items, except apply two (2) coats of paint to surfaces which will be inaccessible after assembly or erection. Change color of second coat to distinguish it from the first.
- E. Touch-up Painting, Pre-painted Items:
1. Immediately after erection, clean field welds, bolted connections, and abraded areas of the shop paint, and paint all exposed areas with the same material as used for shop painting.
 2. Apply touch-up coatings by brush or spray to provide a minimum dry film thickness of the original coating thickness.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal and aluminum where Site welding is required.
- B. Furnish setting drawings, diagrams, templates, instructions, and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections. Coordinate delivery of such items to the project Site.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, and free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.
- C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
- D. Fit exposed connections accurately together to form tight hairline joints.

- E. Grind joints smooth and touch-up shop paint coat.
- F. Do not weld, cut, or abrade the surfaces of exterior units which have been hot dip galvanized after fabrication and are intended for bolted or screwed field connections.
- G. Field-weld components indicated on Drawings and Shop Drawings.
- H. Perform field welding according to AWS D1.1 with regards to procedures of manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work.
- I. Obtain approval of OWNER'S REPRESENTATIVE prior to Site cutting or making adjustments not scheduled.

3.4 TOLERANCES

- A. Maximum Variation from Plumb: 1/4-inch per story or for every 12 feet in height, whichever is greater, non-cumulative.
- B. Maximum Variation from Level: 1/16-inch in 3 feet and 1/4-inch in 10 feet.
- C. Maximum Offset from Alignment: 1/4-inch.
- D. Maximum Out-of-Position: 1/4-inch.

3.5 FIELD QUALITY CONTROL

- A. Welding: Inspect welds according to AWS D1.1.
- B. Replace damaged or improperly functioning hardware.
- C. After erection, touch up welds, abrasions, and damaged finishes with prime paint to match shop finishes.
 - 1. For galvanizing repair, repair any damaged areas by heat and stick method as may be required.
- D. Touch up factory-applied finishes according to manufacturer-recommended procedures.

3.6 ADJUSTING

- A. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION

SECTION 06 05 23

WOOD, PLASTIC, AND COMPOSITE FASTENINGS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the requirements for fasteners and adhesives used in the construction of the wood, plastic, and composite elements of the project.
- B. Section includes:
 - 1. Rough carpentry hardware.
 - 2. Nails.
 - 3. Bolts and screws.
 - 4. Framing anchors.
 - 5. Joist, rafter, and beam hangers.
 - 6. Adhesives.

1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry.
- B. Section 06 17 53 - Shop-Fabricated Wood Trusses.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's data on all materials.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's handling, delivery, storage, and installation requirements.

PART 2 PRODUCTS

2.1 ROUGH CARPENTRY HARDWARE

Rough carpentry hardware used in building construction shall conform to the latest provisions of the Oregon State Structural Specialty Code, the International Building Code (IBC), and to any local codes and ordinances.

2.2 NAILS

- A. Steel Common Nails: For framing, appropriately sized for the materials being joined.

- B. Hot-Dipped Galvanized Nails: Wherever exposed.
- C. Stainless Steel Nails: At locations where stainless-steel hardware is specified. Do not mix dissimilar materials without approval of the OWNER'S REPRESENTATIVE.
- D. Treated Wood: Hot-dipped galvanized or stainless-steel nails are required at all locations where they are in contact with treated wood.
- E. The number and size of nails connecting wood members shall be per the Contract Documents but shall not be less than that set forth in Table 2304.9.1 of the IBC for any members.

2.3 BOLTS AND SCREWS

- A. Conforming to ASTM A307, Grade A, appropriately sized for the materials being joined.
- B. Use galvanized bolts and screws where exposed or in contact with treated wood or embedded into concrete.

2.4 FRAMING ANCHORS & JOIST, RAFTER AND BEAM HANGERS

- A. Use galvanized, minimum 18-gauge steel of the size and type required for the materials connected.
- B. Post hot-dip galvanize all connection hardware in contact with pressure treated wood, or use stainless steel connectors.
- C. Manufacturers:
 - 1. Simpson "Strong-Tie".
 - 2. Teco "MiTek".
 - 3. Approved equal.

2.5 ADHESIVES

Use gun grade adhesive suitable for bonding various metals and non-metallic materials such as wood, plastic, and glass without primer.

PART 3 EXECUTION

3.1 GENERAL

- A. Use only skilled workers and the highest standards of the craft.
- B. Lay out, cut, fit, and install all rough carpentry items.
- C. Anchor sufficiently to ensure rigidity and permanence as noted on the Drawings.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish materials, labor, equipment, and services necessary to provide rough framing as shown on the Drawings and as specified herein.
- B. Section includes:
 - 1. Lumber.
 - 2. Plywood.
 - 3. Building paper.

1.2 RELATED SECTIONS

- A. Section 06 05 23 - Wood, Plastic, and Composite Fastenings.
- B. Section 06 17 53 - Shop-Fabricated Wood Trusses.

1.3 SUBMITTALS

- A. In accordance with Section 01 33 00, Submittal Procedures.
- B. Submit a complete list of products, product information, type, and grade for prior to beginning building construction.

1.4 QUALITY ASSURANCE

- A. All work specified herein shall conform to the latest provisions of the International Building Code (IBC), and the local Codes and Ordinances of all Governmental agencies having jurisdiction over the Project.
- B. Where special inspection of wood structural elements is required in the Contract Documents, an independent testing agency or laboratory shall perform special inspection of the elements indicated in the Contract Documents. The OWNER or an agent of the OWNER will engage a testing laboratory acceptable to the OWNER'S REPRESENTATIVE to perform the required Special Inspections and/or Material Tests.
- C. Materials and installed work may require testing and retesting, as directed by the OWNER'S REPRESENTATIVE, at any time during the progress of the work.
 - 1. Allow free access to material stockpiles and facilities at all times.

2. All testing required by the contract documents shall be done at the OWNER'S expense.
3. Testing expenses for the retesting of rejected materials and installed work will be charged back to the CONTRACTOR.

1.5 DELIVERY, HANDLING AND STORAGE

- A. Immediately upon delivery to Site, place materials in an area protected from weather.
- B. Store materials a minimum of six (6) inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation.
- C. Do not store seasoned materials in wet or damp portions of building.
- D. Protect sheet materials from breaking corners and damaging surfaces while unloading.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Lumber grading rules and wood species shall be in conformance with the latest edition of U.S. Department of Commerce, National Institute of Standards and Technology, Product Standard DOC PS 20 and the National Forest Products Association.
- B. Wood members shall conform to the requirements above and provide design values equal to those published in the "Design Values for Wood Construction," a supplement to the 2018 edition of the National Design Specification for Wood Construction, published by the National Forests Products Association.
- C. Plywood grading rules shall be in conformance with the latest edition of U.S. Product Standards PS 1 and PS 2, and be Engineered Wood Association (APA) rated Exposure 1.

2.2 GRADE MARKS

- A. Each piece of lumber shall be stamped or branded with the grade as determined by an approved grading association indicating conformance with the latest edition of U.S. Product Standard DOC PS 20.
- B. Each panel of plywood shall be identified with the appropriate grade trademark of the American Plywood Association.
- C. Moisture content shall not exceed 19 percent, unless otherwise specified.

2.3 LUMBER

- A. Dimensions given are nominal. Surface four sides (S4S), unless specified otherwise.
- B. Unless otherwise noted, lumber shall be as follows:

Use	Minimum Grade
General framing, studs, plates, blocking, furring, braces and nailers	Douglas Fir-Larch No. 2
Structural light framing, two (2) inches to four (4) inches thick, two (2) inches to six (6) inches wide	Douglas Fir-Larch No. 2
Structural joists, rafters, and planks, two (2) inches to four (4) inches thick, five (5) inches and wider and headers	Douglas Fir-Larch No. 2
Beams, stringers, posts, timber	Douglas Fir-Larch No. 1
Fascia Board	Fiber cement board manufactured by James Hardie or approved equal
Sills and Plates	Douglas Fir-Larch No. 2, Treated in accordance with IBC 2303.1.9

2.4 PLYWOOD

- A. Roof Sheathing:
 - 1. Conform to APA-rated sheathing and shall be identified with the appropriate trademark.
 - 2. Minimum sheathing shall be Exposure 1, 1/2-inch or greater, grade CDX. Span rated 32/16 per APA.
- B. MDO -- APA rated Medium Density Overlay exterior glue.

PART 3 EXECUTION

3.1 GENERAL

- A. Use only skilled workers and the highest standards of the craft.
- B. Plan work in advance and perform in proper sequence to facilitate prompt and continuous progress of the work.
- C. Lay out, cut, fit, and install all rough carpentry items.
- D. Anchor sufficiently to ensure rigidity and permanence and as noted on Drawings.

E. Provide for installation and support of other work.

3.2 CONDITIONS OF SURFACES

A. Verify that surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

3.3 INSTALLATION

A. Plates

1. Set level and flush with outside face of concrete or masonry unit walls or as shown on the Drawings.
2. Anchor into concrete or masonry unit walls with specified anchors.
3. Location and spacing of plate anchorages shall be as shown or if not shown in conformance with current local building codes.

B. Engineered Trusses: See Drawings for requirements and Section 06 17 53, Shop-Fabricated Wood Trusses.

C. Roof Sheathing

1. Install plywood with face grain perpendicular to supports, using panel with continuous end joints over two or more spans staggered between panels and locate over supports.
2. Allow minimum space 1/16-inch (1.6 mm) between end joints and 1/8-inch at edge joints for expansion and contraction of panels.
3. Support edge joints by use of ply clips or lumber blocking, unless noted otherwise on Drawings.

D. Ceiling Plywood

1. Install ceiling plywood where shown on Drawings with joints transverse to the members they attach to.
2. Attach plywood sheets to wood framing using finish nails.
3. Countersink nails.
4. Spackle and sand joints, knot holes, and nail holes as required to provide a smooth uniform surface prior to application of paint coating system as specified in Section 09 90 00, Painting and Coating.

E. Fastener Requirements:

1. Connections for wood members shall be in accordance with the Contract Drawings and Section 06 05 23, Wood, Plastic, and Composite Fastenings.
2. The number and size of nails connecting wood members shall not be less than that set forth in Table 2304.9.1 of the IBC.

END OF SECTION

SECTION 06 17 53

SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the requirements for design, manufacture, and supply of wood trusses as shown on the Drawings and as specified.
- B. Section includes:
 - 1. Design and performance criteria.
 - 2. Lumber.
 - 3. Metal connecting hardware.
 - 4. Manufacturing requirements.

1.2 RELATED SECTIONS

- A. Section 06 05 23 - Wood, Plastic, and Composite Fasteners.
- B. Section 06 10 00 - Rough Carpentry.

1.3 DEFINITIONS

- A. BCSI: Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses jointly produced by the Structural Building Components Association and the Truss Plate Institute.
- B. Contractor: The person who contracts with the OWNER, who constructs the Building in accordance with the Construction Documents and the Truss Submittal Package. The term "CONTRACTOR" shall include those subcontractors who have a direct contract with the CONTRACTOR to construct all or a portion of the construction.
- C. Cover/Truss Index Sheet: Sheet that is signed and sealed by an Oregon licensed Professional Engineer, by the Truss Design Engineer, and shall contain the following information: (1) identification of the Building, including Building name and address, lot, block, subdivision, and city or county; (2) identification of Construction Documents by drawing number(s) with revision date; (3) specified Building Code; (4) computer program used; (5) roof dead and live loads; (6) floor dead and live loads; (7) wind load criteria from a specifically defined code (e.g., ASCE 7) and any other design loads (such as ponding, mechanical loads, etc.); ; (8) a listing of the individual identification numbers and dates of each Truss Design Drawing referenced by the Cover/Truss Index Sheet; and (9) name, address, date of drawing and license number of Truss Design Engineer.

- D. Framing Structural System: Completed combination of Structural Elements, Trusses, connections, and other systems, which serve to support the Building's self-weight and the specified loads.
- E. Truss: Individual metal-plate-connected wood component manufactured for the construction of a Building.
- F. Truss Design Drawing: Written, graphic and pictorial depiction of an individual Truss that includes the information required in the Standard.
- G. Truss Design Engineer: Person who is licensed to practice engineering as defined by the Legal Requirements of the Jurisdiction in which the Building is to be constructed and who supervises the preparation of the Truss Design Drawings.
- H. Truss Designer: Person responsible for the preparation of the Truss Design Drawings.
- I. Truss Manufacturer: Person engaged in the fabrication of Trusses.
- J. Truss Placement Diagram: Illustration identifying the assumed location of each Truss.
- K. Truss Submittal Package: Package consisting of each individual Truss Design Drawing, and, as applicable, the Truss Placement Diagram, the Cover/Truss Index Sheet, Lateral Restraint and Diagonal Bracing details designed in accordance with generally accepted engineering practice, applicable BCSI defined lateral restraint and diagonal bracing details, and any other structural details germane to the Trusses.

1.4 DESIGN

- A. Trusses shall be designed in accordance with the Standard and, where any applicable design feature is not specifically covered herein, design shall be in accordance with the applicable provisions of the latest edition of the American Forest & Paper Association's (AF&PA's) National Design Specification® (NDS®) for Wood Construction and all applicable Legal Requirements.
- B. Truss Manufacturer shall furnish Truss Design Drawings and Calculations prepared in accordance with all applicable Legal Requirements and signed and stamped by an Oregon licensed Professional Engineer.
- C. The Truss Manufacturer shall furnish a Truss Placement Diagram, which shall provide, at a minimum, the location assumed for each Truss based on the Truss Manufacturer's interpretation of the Construction Documents.
- D. The Truss Manufacturer shall submit the Truss Submittal Package to the OWNER and OWNER'S REPRESENTATIVE for review and approval prior to the manufacturing of the Trusses.

- E. The Truss Design Drawings shall include, at a minimum, the information specified below (per the Standard):
1. Building Code used for Design, unless specified on Cover/Truss Index Sheet.
 2. Slope or depth, span and spacing.
 3. Location of all joints and support locations.
 4. Number of plies if greater than one.
 5. Required bearing widths.
 6. Design loads as applicable, including:
 - a. Top Chord live load (for roof Trusses, this shall be the controlling case of live load or snow load);
 - b. Top chord dead load;
 - c. Bottom chord live load;
 - d. Bottom chord dead load;
 - e. Additional loads and locations;
 - f. Environmental Load Design Criteria (wind speed, snow, seismic, and all applicable factors as required to calculate the Truss loads); and
 - g. Other lateral loads, including drag strut loads.
 7. Adjustments to Wood Member and Metal Connector Plate design values for conditions of use.
 8. Maximum reaction force and direction, including maximum uplift reaction forces where applicable.
 9. Metal Connector Plate type, manufacturer, size, and thickness or gauge, and the dimensioned location of each Metal Connector Plate except where symmetrically located relative to the joint interface.
 10. Size, species, and grade for each Wood Member.
 11. Truss-to-Truss connection and Truss field assembly requirements.
 12. Calculated span to deflection ratio and/or maximum vertical and horizontal deflection for live and total load and KCR (creep factor) as applicable.

13. Maximum axial tension and compression forces in the Truss members.
14. Fabrication tolerance per the Standard.
15. Required Permanent Individual Truss Member Restraint location and the method of Restraint/Bracing to be used per the Standard.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber:

1. identified by grade mark of a lumber inspection bureau or agency approved by the American Lumber Standards Committee.
2. Of the size, species, and grade as shown on the Truss Design Drawings, or equivalent as approved by the Truss Design Engineer/ Truss Designer.
3. In accordance with Article 2.3, Lumber of Section 06 10 00, Rough Carpentry.
4. Adjustment of value for duration of load or conditions of use shall be in accordance with the latest edition of the National Design Specification for Wood Construction (NDS).
5. Fire retardant treated lumber, if applicable, shall meet the specifications of the fire retardant chemical manufacturer, the Truss design and the Standard and shall be re-dried after treatment in accordance with the American Wood-Preservers' Association (AWPA) Standard C20 Structural Lumber – Fire Retardant Treatment by Pressure Processes. Allowable values must be adjusted in accordance with NDS. Lumber treater shall supply certificate of compliance.

B. Metal Connector Plates:

1. Manufactured by a Truss Plate Institute (TPI) member plate manufacturer.
2. Shall not be less than 0.036 in. thick (20 gauge).
3. Meet or exceed ASTM A653/A653M grade 33.
4. Galvanized coating, meeting, or exceeding ASTM A924/924M, coating designation G60. Working stresses in steel are to be applied to effectiveness ratios for plates as determined by test and in accordance with the Standard.
5. In highly corrosive environments, special applied coatings or stainless steel may be required as noted on the Contract Documents.

6. At the request of the OWNER'S REPRESENTATIVE, a TPI member plate manufacturer shall furnish a certified record that materials comply with steel specifications.

2.2 MANUFACTURING

Trusses shall be manufactured to meet the quality requirements of the Standard and in accordance with the information provided in the final approved Truss Design Drawings.

PART 3 EXECUTION

3.1 HANDLING, INSTALLING, RESTRAINING AND BRACING

- A. Trusses shall be handled during manufacturing, delivery and by the CONTRACTOR at the job site so as not to be subjected to excessive bending.
- B. Trusses shall be unloaded in a manner so as to minimize lateral strain. Trusses shall be protected from damage that might result from on-site activities and environmental conditions. Trusses shall be handled in such a way so as to prevent toppling when banding is removed.
- C. CONTRACTOR shall be responsible for the handling, installation, and temporary restraint/ bracing of the Trusses in a good workmanlike manner and in accordance with the recommendations set forth in the latest edition of BCSI.
- D. Apparent damage to Trusses, if any, shall be reported to Truss Manufacturer prior to erection.
- E. Trusses shall be set and secured level and plumb, and in correct location. Each Truss shall be held in correct alignment until specified permanent restraint and bracing is installed.
- F. Cutting and altering of Trusses is not permitted. If any Truss should become broken, damaged, or altered, written concurrence and approval by a Registered Design Professional is required.
- G. Concentrated loads shall not be placed on top of Trusses until all specified restraint and bracing has been installed and decking is permanently nailed in place. Specifically avoid stacking full bundles of plywood or other concentrated loads on top of Trusses.
- H. Truss Submittals and any supplementary information provided by the Truss Manufacturer shall be provided by the CONTRACTOR to the individual or organization responsible for the installation of the Trusses.

- I. Trusses shall be permanently restrained and braced in a manner consistent with good building practices as outlined in BCSI and in accordance with the requirements of the Construction Documents. Trusses shall furthermore be anchored or restrained to prevent out-of-plane movement so as to keep all Truss members from simultaneously buckling together in the same direction. Such permanent lateral restraint shall be accomplished by: (a) anchorage to solid end walls; (b) permanent diagonal bracing in the plane of the web members; or (c) other suitable means.
- J. Materials used in temporary and permanent restraint and bracing shall be furnished by CONTRACTOR.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation over roof deck.
- B. Batt insulation and vapor retarder in exterior wall and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Supporting construction for batt insulation.
- B. Section 072119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
- C. Section 072500 - Weather Barriers: Separate air barrier and vapor retarder materials.
- D. Section 092116 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.3 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- F. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C 2019a.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.5 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Insulation Over Roof Deck: Polyisocyanurate board.
- B. Insulation Under Roof Deck: Batt insulation.

2.2 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Type and Compressive Resistance: Type VI, 40 psi (276 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
 - 5. Manufacturers:
 - a. Dow Chemical Company; STYROFOAM HIGHLOAD 40:
www.dowbuildingsolutions.com/#sle.
 - b. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi:
www.kingspan.com/#sle.
 - c. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation:
www.ocbuildingspec.com/#sle.

d. Or Approved. Equal.

2.3 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 - 1. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 2. Thermal Resistance: R-value (RSI-value) as shown on drawings.
 - 3. Manufacturers:
 - a. CertainTeed Corporation
 - b. Johns Manville
 - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation
 - d. Or Approved Equal.
- C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 - 1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 - 2. Thermal Resistance: R-value (RSI-value) as shown on Drawings.
 - 3. Manufacturers:
 - a. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle.
 - b. Or Approved Equal.

2.4 ACCESSORIES

- A. Banded liner consisting of fabric facing and metal strapping.
 - 1. White high density polyethylene fabric for installation on interior face of under-roof-deck batt insulation.
 - a. Class A fire rated.
 - 2. Strapping
 - a. 1" x .020. metal strapping

- b. 100,000#/square inch tensile strength.
- 3. Basis of Design: Johns Mansville UVMAX Simple Saver or approved equal.
- B. Insulation Fasteners: Appropriate for purpose intended and per insulations manufacturer's written instructions..

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

- A. Installation of board insulation over low slope roof deck as specified in Section 074113 Metal Roof Panels.
- B. Board Installation Over Roof Deck, General:
 - 1. See applicable roofing specification section for specific board installation requirements.
 - 2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.
 - 3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
 - 4. Do not apply more insulation than can be covered with roofing on the same day.

3.3 BATT INSTALLATION

- A. Install insulation and banded liner in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

E. Tape seal tears or cuts in banded liner.

3.4 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

3.5 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 21 19

FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. Post-installed in open cells of CMU walls.

1.2 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- C. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials 2013.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- C. Certificates: Certify that products of this section meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.
- E. Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- F. Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.

1.5 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Foamed-In-Place Insulation:
 - 1. Tailored Chemical Products; Core-Fill 500: www.core-fill500.com
 - 2. Or Approved Equal.

2.2 MATERIALS

- A. Foamed-In-Place Insulation: Flexible foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
 - 1. Thermal Resistance: R-value (RSI-value) of 4.9 minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature when tested in accordance with ASTM C518.
 - 2. Air Permeance: 0.04 cfm per square foot (0.2 L/(s/sq m)), maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf (75 Pa).
 - 3. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.3 ACCESSORIES

- A. As required by insulation manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify work within construction spaces or crevices is complete prior to insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.2 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.3 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.

3.4 PROTECTION

- A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

SECTION 07 41 13

METAL ROOF PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Architectural roofing system of preformed steel panels.
- B. Metal soffit panels.
- C. Miscellaneous accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Roof sheathing.
- B. Section 07 21 00 - Thermal Insulation: Rigid roof insulation.
- C. Section 07 92 00 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.
- D. Section 08 62 00 – Skylights. Aluminum framed curb mounted skylights.

1.3 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2019.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- D. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems 2018.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Summary of test results, indicating compliance with specified requirements.

2. Storage and handling requirements and recommendations.
 3. Installation methods.
 4. Specimen warranty.
- C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
1. Show work to be field-fabricated or field-assembled.
- D. Manufacturer Qualification Statement: Provide documentation showing metal roof panel fabricator is accredited under IAS AC472.
- E. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
1. Accredited by IAS in accordance with IAS AC472.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.
- B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of five years from Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design:

1. Metal Roof Panels:

- a. Slim-Lok, manufactured by Taylor Metal Products.
- b. Medallion-Lok manufactured by McElroy Metal.
- c. Or Approved Equal.

2.2 METAL PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

1. Metal Panels: Factory-formed panels with factory-applied finish.

2. Steel Panels:

- a. Steel Thickness: Minimum 24 gauge (0.024 inch) (0.61 mm).

3. Profile: Standing seam, with minimum 1" seam height; concealed fastener system lapped seam in standing seam profile.

4. Texture: Smooth, with intermediate ribs for added stiffness.

5. Length: Full length of roof slope, without lapped horizontal joints.

6. Width: Maximum panel coverage of 16 inches (406 mm).

B. Metal Soffit Panels:

1. Profile: Style as indicated.

2. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.

3. Color: To match roof panel.

2.3 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.4 FINISHES

- A. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss Kynar "Sandstone" or approved equal.

2.5 ACCESSORIES

- A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.
 - 1. Downspouts: Open face, rectangular profile.
- B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.
- C. Coverboard: Gypsum coverboard per roofing panel manufacturer.
- D. Sealants:
 - 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
 - 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
- E. Underlayment: Synthetic non-asphaltic sheet, intended by manufacturer for mechanically fastened roofing underlayment without sealed seams.
 - 1. Self Sealability: Passing nail sealability test specified in ASTM D1970/D1970M.
 - 2. Low Temperature Flexibility: Passing test specified in ASTM D1970/D1970M.
 - 3. Fasteners: As specified by manufacturer and building code qualification report or approval.
 - 4. Manufacturers:
 - a. System Components Corporation, Inc; ProTex:
www.systemcomponents.net/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Broom clean wood sheathing prior to installation of roofing system.
- B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.
- C. Remove protective film from surface of roof panels immediately prior to installation. Strip film carefully, to avoid damage to prefinished surfaces.
- D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roof panel manufacturer.
- E. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 INSTALLATION

- A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.
 - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
 - 2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.
- B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

- C. Install roofing underlayment system before installing preformed metal roof panels. Secure by methods acceptable to roof panel manufacturer, minimizing use of metal fasteners. Apply from eaves to ridge in shingle fashion, overlapping horizontal joints a minimum of 2 inches (50 mm) and side and end laps a minimum of 3 inches (75 mm). Offset seams in building paper and seams in roofing felt.
- D. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.
 - 1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by the panel manufacturer.

3.4 CLEANING

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.5 PROTECTION

- A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
- B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 07 42 13

METAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured metal panels for exterior wall panels, with related flashings and accessory components.

1.2 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wall panel substrate.
- B. Section 072100 - Thermal Insulation.
- C. Section 072500 - Weather Barriers: Weather barrier under wall panels.
- D. Section 079200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.3 REFERENCE STANDARDS

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2019a.

1.4 SUBMITTALS

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

PART 2 PRODUCTS

2.1 MANUFACTURED METAL PANELS

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
1. Provide exterior wall panels.
 2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
 3. Maximum Allowable Deflection of Panel: $L/180$ for length(L) of span.
 4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
 6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
 7. Corners: Factory-fabricated in one continuous piece with minimum 2 inch (51 mm) returns.
 8. Provide continuity of air barrier and vapor retarder seal at building enclosure elements in accordance with materials specified in Section 072500.
- B. Exterior Wall Panels:
1. Basis of Design:
 - a. Bridger Steel; Shiplap Wall
 - b. Or Approved Equal.
 2. Profile: Vertical; shiplap style.
 3. Side Seams: Double-interlocked, tight-fitting, sealed per manufacturer's written instructions..
 4. Material: Precoated steel sheet, 24 gage.
 5. Panel Width: 12 inches.
 6. Color: Chosen by Owner.

- C. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- D. Expansion Joints: Same material, thickness and finish as exterior sheets; 24 gage; manufacturer's standard brake formed type, of profile to suit system.
- E. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- F. Anchors: Per manufacturer's written instructions..

2.2 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.3 FINISHES

- A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.

2.4 ACCESSORIES

- A. Cladding Support Clips: Manufacturer's standard panel support clip.
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 galvanized coating.
- B. Fasteners: Manufacturer's standard type to suit application; [].
- C. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that building framing members are ready to receive panels.
- B. Verify that weather barrier has been installed over substrate completely and correctly.

3.2 PREPARATION

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

3.3 INSTALLATION

- A. Install panels on walls in accordance with manufacturer's instructions.
- B. Use concealed fasteners unless otherwise approved by Architect.

3.4 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.
- C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.
- D. Upon completion of installation, thoroughly clean prefinished aluminum surfaces in accordance with AAMA 609 & 610.

END OF SECTION

SECTION 07 46 46
FIBER CEMENT SIDING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish all necessary labor, material and equipment for complete installation of fiber cement siding, fascia, molding and related work as shown on Drawings or specified herein.

- B. Section includes:
 - 1. Lap siding.
 - 2. Trim.
 - 3. Soffit panels.
 - 4. Fasteners.
 - 5. Finishes.

1.2 RELATED SECTIONS:

- A. Section 06 05 30 - Wood, Plastic, and Composite Fasteners.

- B. Section 06 10 00 - Rough Carpentry.

1.3 REFERENCE STANDARDS

- A. Building Officials and Code Administrators International, Inc. (BOCA):
 - 1. National Building Code.
 - 2. National Fire Prevention Code.

- B. International Code Council (ICC):
 - 1. International Building Code (IBC).
 - 2. SBCCI.
 - 3. ICC-ES Legacy Report, NER-405.

- C. ASTM International:
 - 1. ASTM C1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards.

 - 2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

3. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Samples of siding design, size and color for approval.
 2. Preparation instructions and recommendations.
 3. Storage and handling requirements and recommendations.
 4. Installation methods.
- C. Shop Drawings: Provide detailed drawings of atypical non-standard applications of cementitious siding materials which are outside the scope of the standard details and specifications provided by the manufacturer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum of 2 years' experience with installation of similar products.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store siding on edge or lay flat on a smooth level surface.
- C. Protect edges and corners from chipping.
- D. Store sheets under cover and keep dry prior to installing.
- E. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.8 WARRANTY

- A. Product Warranty: Limited product warranty against manufacturing defects.
 1. Lap vertical siding: 50 years.
 2. Trim: 10 years.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fiber Cement Siding, Fascia and Molding:

1. General:

- a. Flexural strength in accordance with ASTM C1185.
 - 1) Along direction of sheet: 1,850 psi.
 - 2) Across direction of sheet: 2000 psi.
- b. Non-combustible, in accordance with ASTM E136.
- c. Surface burning characteristics in accordance with ASTM E84.
 - 1) Flame Spread = 0.
 - 2) Fuel Contribution = 0.
 - 3) Smoke developed = 5

2. Lap Siding:

- a. Type: Cedarmill Select 7-1/4 inches (191mm) with 6 inches (152 mm) exposure or approved equal
- b. Hardieplank as manufactured by James Hardie Building Products, Inc. or approved equal.

3. Trim:

- a. Type: Trim to be 1-inch thickness and width as shown on Drawings.
- b. Hardietrim Fascia and Molding as manufactured by James Hardie Building Products, Inc. or approved equal.

4. Soffit Panels:

- a. Type: ¼-inch Vented Cedarmill panels or approved equal.
- b. HardieSoffit as manufactured by James Hardie Building Products, Inc. or approved equal.

2.2 FASTENERS

- #### A. Wood Framing Fasteners: All fasteners shall be stainless steel. Select in accordance with local codes and manufacturers installation recommendations.

2.3 FINISHES

- A. Factory Primer: Provide factory applied universal primer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If framing preparation is the responsibility of another installer, notify Owner's Representative of unsatisfactory preparation before proceeding.
- C. Nominal minimum of 2-inch by 4-inch (51 mm by 102 mm) wood framing selected for minimal shrinkage and complying with local building codes, including the use of water-resistant barriers or vapor barriers where required. Minimum 1-1/2 inches (38 mm) face and straight, true, of uniform dimensions and properly aligned.
 - 1. Install water-resistant barriers and claddings to dry surfaces.
 - 2. Repair any punctures or tears in the water-resistant barrier prior to the installation of the siding.
 - 3. Protect siding from other trades.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION, FIBER CEMENT LAP SIDING

- A. Install materials in strict accordance with manufacturer's installation instructions.
- B. Starting: Install a minimum ¼-inch (6 mm) thick lath starter strip at the bottom course of the wall. Apply planks horizontally with minimum 1-1/4 inches (32 mm) wide laps at the top. The bottom edge of the first plank overlaps the starter strip.
- C. Allow minimum vertical clearance between the edge of siding and any other material in strict accordance with the manufacturer's installation instructions.
- D. Align vertical joints of the planks over framing members.
- E. Maintain clearance between siding and adjacent finished grade.

- F. Locate splices at least one stud cavity away from window and door openings.
- G. Wind Resistance: Where a specified level of wind resistance is required, lap siding is installed to framing members and secured with fasteners described in Table No. 2 in National Evaluation Service Report No. NER-405.

3.4 INSTALLATION, FIBER CEMENT TRIM & SOFFIT

- A. Install materials in strict accordance with manufacturer's installation instructions. Install flashing around all wall openings.
- B. Fasten through trim into structural framing or code complying sheathing. Fasteners must penetrate minimum 3/4 inch (19 mm) or full thickness of sheathing. Additional fasteners may be required to ensure adequate security.
- C. Place fasteners no closer than 3/4 inch (19 mm) and no further than 2 inches (51 mm) from side edge of trim board and no closer than 1 inch (25 mm) from end. Fasten maximum 16 inches (406 mm) on center.
- D. Maintain clearance between trim and adjacent finished grade.
- E. Trim inside corner with single board.
- F. Outside Corner Board: For 3/4-inch (19 mm) trim only. Install single board of outside corner board then align second corner board to outside edge of first corner board. Do not fasten trim board to trim board.
- G. Allow 1/8-inch gap (+/- 1/32 inch) between trim and siding.
- H. Seal gap with high quality, paint-able caulk.
- I. Shim frieze board as required to align with corner trim.
- J. Install trim fascia over structural subfascia.

3.5 FINISHING

- A. Finish factory primed siding in accordance with specifications Section 09 80 00, Painting and Coating.

3.6 PROTECTION

- A. Protect installed products until completion of Project.
- B. Touch-up, repair or replace damaged products before Final Completion.

END OF SECTION

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish and install flashing and sheet metal work, including gutters and downspouts, as indicated on the Drawings and by provisions of this Section.
- B. Section includes:
 - 1. Galvanized metal flashings.
 - 2. Prefinished galvanized downspout and gutter.

1.2 RELATED SECTIONS:

- A. Section 06 05 30 - Wood, Plastic, and Composite Fasteners.
- B. Section 07 41 13 - Metal Panel Roofs

1.3 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM G90 - Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Samples of flashing design, size and color for approval.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Per manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pre-finished Galvanized Steel Sheet:

1. Steel Sheet: 24 gage, commercial quality.
2. Finish: Complying with ASTM A653, ASTM G90 for hot-dip galvanizing.
 - a. Pre-finished with baked-on polyester coating, not less than 1.0 mil thick.
3. Color: Provide material in color selected by Owner.

B. Galvanized Steel Sheet:

1. Steel Sheet: 24 gage minimum, commercial quality.
2. Finishing: Galvanized, with minimum of 0.20 percent copper content. Complying with ASTM A653, G90 for hot-dip galvanizing, mill phosphatized, unless otherwise indicated.

C. Miscellaneous Materials and Accessories

1. Solder: Except as otherwise indicated or recommended by metal manufacturer, provide 100 percent lead free solder for tinning and soldering galvanized metal joints.
2. Visually Exposed Fasteners: Stainless steel pop rivets with heads finished to match color of pre-finished metal material.
3. Concealed Fasteners: Zinc coated, type as required and recommended by manufacturer for materials and substrates involved.
4. Mastic Sealant -- Polyisobutylene, non-hardening, non-skinning, non-migrating sealant typical for flashing lap joint applications.

2.2 FABRICATED UNITS

A. General

1. Shop fabricate metal counter flashings, cap and sill flashings, and similar items to comply with profiles and sizes shown, and to comply with standard industry details as shown by SMACNA in the "Architectural Sheet Metal Manual."

2. Comply with metal producers' recommendations for tinning, soldering, and cleaning flux from galvanized metal fabrications. Provide stainless steel rivets at exposed fastenings in pre-finished metal fabrications.
 3. Form exposed sheet metal work without oil-canning, buckling and tool marks, true to line and level with exposed edges folded back to form hems.
 4. Where movable joints are required for proper installation of mastic sealant, in compliance with SMACNA standards.
- B. Pipe Jack Sleeve Fastenings
1. Fabricate pipe, roof penetration sleeves from galvanized material fully tinned and soldered at seams. Provide stack sleeve of diameter ½-inch greater than penetrating pipe and same height above with 3-inch high conical base and embedment flange 12-inch greater than diameter of base. Furnish flanges at top of stack sleeve for attachment of counter flashing cap.
 2. Fabricate counter flashing cap with interior pipe sleeve and conical cap to fit over pipe and stack sleeve. Size interior sleeve to tightly fit pipe diameter and to into pipe not less than 3 inches. Size conical cap to extend not less than 3 inches below top of stack sleeve with space above to permit not less than 1-inch pipe movement. Rivet counter flashing cap to flanges of stack sleeve.
- C. Counter Flashings
1. Fabricate counter flashings from galvanized material to size and profiles shown in 10-foot minimum lengths with continuous 20 gage galvanized cleat at hemmed lower drip edge.
 2. Where top leg of counter flashing is not covered by other applied materials or otherwise supported, provide with integral hemmed sealant dam and anchor to wall substrates with 1/8 inch by 1-1/2 inch galvanized float bar, prepared with fastener holes drilled or punched at 8-inch o.c. Coordinate size of holes with anchors to be used. Form sealant dam with 3/4-inch minimum outward-turned hemmed leg.
 3. At inside and outside corners, provide double lapped, tinned and fully soldered assemblies, shop assembled prior to installation. Do not solder flashing corners after installation other than to render remedial surface repairs. If joint separation should occur, remove flashings and resolder as required.
- D. Cap Flashings
1. Fabricate lap seamed cap flashings from galvanized material with hemmed drips on both sides and continuous 20 gage galvanized cleat at front edge.

2. Shop assemble cap end-to wall closure flashings with double lapped, riveted and mastic sealed construction. Provide vertical legs with sealant dam as required for counter flashings.

E. Wall Flashings

1. Fabricate wall flashings from galvanized material with flat locked, mastic filled vertical seams spaced not greater than 4 feet on-center.
2. Form as required to closely follow substrate profile and interlock with counter and cap flashing assemblies without exposed fasteners. Secure to walls with 20 gage galvanized cleat concealed by edge hems.

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with manufacturer's instructions and recommendation for handling and installation of flashing and sheet metal work.
- B. Coordination:
 1. Coordinate Work with other work for the correct sequencing of items which make up the entire membrane or system of weatherproofing and rain drainage.
 2. Coordinate Work of this Section with interfacing and adjoining work for proper sequence of each installation.
- C. It is required that the flashing and sheet metal work be permanently water-tight, and not deteriorate in excess of manufacturer's published limitations.
- D. Provide flashing and sheet metal work which is fully compatible with interfacing or adjoining work to ensure the best total assembly performance for weather resistance and durability.

3.2 INSTALLATION OF METAL WORK

- A. Comply with details and profiles as shown and comply with SMACNA "Architectural Sheet Metal Manual" recommendations for installation of the work.
- B. Non-Moving Seams: Provide sealed flat-lock seams, except as otherwise indicated. Comply with metal producers' recommendations for tinning, soldering and cleaning the joints of soldered work.
- C. Provide for thermal expansion of all exposed sheet metal work exceeding 20-foot running length, except as otherwise indicated.

- D. Conceal fasteners and expansion provisions wherever possible. Fold back edges on concealed side of exposed edges, to form a hem and stiffen material.
- E. Provide flashing reglets as shown or as required to seal work to existing substrates. Seal assembled joint with sealant as indicated.
- F. Do not proceed with the installation of flashing and sheet metal work until curb and substrate construction, blocking, and other construction to receive the work is completed.
- G. Examine the substrate and the conditions under which flashing and sheet metal work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.3 CLEANING AND PROTECTION

- A. Clean visually exposed metal surfaces and other surfaces indicated to be painted. Remove corrosive substances, including soldering flux, which might cause deterioration of metal surfaces or final finish.
- B. Provide surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration at time of acceptance by Owner.

END OF SECTION

SECTION 07 92 00

SEALANTS AND CAULKING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish and install sealing or caulking joints between dissimilar materials for watertight seal.
- B. Section includes:
 - 1. Sealants.
 - 2. Filler gaskets.
 - 3. Primers and bond breakers.

1.2 DEFINITIONS

- A. Sealants: Where the words “sealants” or “caulking” are used in this text, they shall be synonymous and shall mean sealant or caulking compounds as specified under Part 2 of this specification.

1.3 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product data and materials list of items proposed to be provided under this Section.
- C. Sufficient technical data to demonstrate compliance with the specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Type A Sealant
 - 1. Application: General building sealant.
 - 2. Material: One component polyurethane sealant.
 - a. Vulkem 116, as manufactured by Tremco.
 - b. Sonolastic NP1, as manufactured by BASF.
 - c. Or approved equal

- B. Type B Sealant
 - 1. Application -- General building sealant for wide joints.
 - 2. Materials -- Self-leveling one component polyurethane.
 - a. Vulkem 45, as manufactured by Tremco.
 - b. Or approved equal
- C. Filler Gasket (Backer Rod) Cord Strip
 - 1. Ethafoam, as manufactured by Dow Chemical.
 - 2. Sonolastic Closed-cell Backer Rod, as manufactured by Sonneborn.
 - 3. Or approved equal

PART 3 EXECUTION

3.1 PREPARATION

- A. Surfaces to receive caulking materials shall be thoroughly clean and free of any non-compatible primers or protective coatings, including lacquers, form coatings, clear sealers, etc.
- B. Brush out all foreign matter and loose particles.
- C. Clean metal surfaces with solvents and wipe dry while the surface is still wet with solvent.

3.2 INSTALLATION

- A. Primers and Bond Breakers
 - 1. Apply to surfaces as required; verify with manufacturer.
 - 2. In general, prime all concrete and Portland cement-based plaster or grout surfaces.
 - 3. Prime wood surfaces where specifically required.
 - 4. Use proper type primers and bond breakers, apply per sealant manufacturer's printed instructions.
- B. Sealants
 - 1. Provide watertight caulked joints at all building exterior locations where possible water penetration through joint may occur.

2. If caulking systems for such joints are not shown, provide as specifically approved.

C. Gaskets or Fillers

1. Compress all gaskets to tight fit. Where required as backing for caulking system, roll or stretch in gasket sections to depth from sealant face or as shown (in general, to 3/8-inch).
2. Install gun grade material with gun nozzle of similar size as joint width as shown. Tool all beads, after application to assume full firm contact. Strike off excess material.
3. Maintain edge surfaces adjacent to joints clean and free of caulking stain and excess material. Trim joints as required per manufacturer's printed instructions.
4. Do not apply caulking materials to a "bleeding" type of surface, such as asphaltic or other oil-emitting types. Where such material occurs at caulking joint (roofing, etc.), isolate from caulking with gasket filler.
5. Avoid mixing any water in caulking mixture before and during application. Do not thin material.

3.3 CORRECTIONS AND CLEANUP

- A. Remove all damaged, defective or improperly installed sealant and/or caulking and replace.
- B. Clean and remove all sealant and caulking from adjacent surfaces.
- C. Upon completion of the work, remove all disused implements, rubbish, and debris, and leave premises neat and clean.

END OF SECTION

SECTION 07 92 25

SEALANTS AND CAULKING FOR STEEL RESERVOIRS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish and install sealing or caulking joints between dissimilar materials for watertight seal. Work includes sealing the joint between the exterior floor the tank and the top of the existing reinforced concrete foundation.
- B. Section includes:
 - 1. Sealants.
 - 2. Filler gaskets.
 - 3. Primers and bond breakers.

1.2 RELATED SECTIONS:

- A. Section 09 97 14 – Steel Water Storage Tank Painting
- B. Section 33 16 13.13 – Steel Aboveground Water Utility Storage Tanks

1.3 DEFINITIONS

- A. Sealants: Where the words “sealants” or “caulking” are used in this text, they shall be synonymous and shall mean sealant or caulking compounds as specified under Part 2 of this specification.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product data and materials list of items proposed to be provided under this Section.
- C. Sufficient technical data to demonstrate compliance with the specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Type A Sealant
 - 1. Application: Joint between steel reservoir reinforced concrete ring wall foundation and exterior steel floor and wall connection.

2. Material: One component polyurethane sealant.
 - a. Dymonic 100, as manufactured by Tremco Commercial Sealants & Waterproofing.
 - b. Approved equal.
- B. Filler Gasket (Backer Rod) Cord Strip
 1. Sonolastic Closed-cell Backer Rod, as manufactured by Sonneborn.
 2. Equal, as approved by Owner's Representative.

PART 3 EXECUTION

3.1 PREPARATION

- A. Surfaces to receive caulking materials shall be thoroughly clean and free of any non-compatible primers or protective coatings, including lacquers, form coatings, clear sealers, etc.
- B. Brush out all foreign matter and loose particles.
- C. Clean metal surfaces with solvents and wipe dry while the surface is still wet with solvent.

3.2 INSTALLATION

- A. Primers and Bond Breakers
 1. Apply to surfaces as required; verify with manufacturer.
 2. In general, prime all concrete and Portland cement-based plaster or grout surfaces.
 3. Use proper type primers and bond breakers, apply per sealant manufacturer's printed instructions.
- B. Sealants
 1. Provide watertight caulked joints at all building exterior locations where possible water penetration through joint may occur.
 2. If caulking systems for such joints are not shown, provide as specifically approved.

C. Gaskets or Fillers

1. Compress all gaskets to tight fit. Where required as backing for caulking system, roll or stretch in gasket sections to depth from sealant face or as shown (in general, to 3/8-inch).
2. Install gun grade material with gun nozzle of similar size as joint width as shown. Tool all beads, after application to assume full firm contact. Strike off excess material.
3. Maintain edge surfaces adjacent to joints clean and free of caulking stain and excess material. Trim joints as required per manufacturer's printed instructions.
4. Do not apply caulking materials to a "bleeding" type of surface, such as asphaltic or other oil-emitting types. Where such material occurs at caulking joint (roofing, etc.), isolate from caulking with gasket filler.
5. Avoid mixing any water in caulking mixture before and during application. Do not thin material.

3.3 CORRECTIONS AND CLEANUP

- A. Remove all damaged, defective or improperly installed sealant and/or caulking and replace.
- B. Clean and remove all sealant and caulking from adjacent surfaces.
- C. Upon completion of the work, remove all disused implements, rubbish, and debris, and leave premises neat and clean.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

1.2 RELATED SECTIONS:

- ###### A. Section 08 71 00 - Door Hardware.

1.3 DEFINITIONS

- ###### A. Minimum Thickness: Minimum thickness of base metal without coatings.

- ###### B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.4 SUBMITTALS

- ###### A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

- ###### B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings and removable stops.

- C. Other Action Submittals:
 - 1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.
- E. Provide (2) material Samples for each color of Kynar Finish.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.
 - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements:
1. Ceco Door Products; an Assa Abloy Group company.
 2. Fleming Door Products Ltd.; an Assa Abloy Group company.
 3. Steelcraft; an Ingersoll-Rand company.
 4. Approved equal.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 metallic coating.
- D. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

- A. Provide 1 3/4" thick doors of materials and ANSI/SDI-100 grades and models specified below, or as indicated on drawings or schedules:
1. Exterior Doors: Level 3, Model 3 – Seamless (with center rail)
 - a. Exterior doors shall be minimum 16-gauge galvanized or galvanealed steel with both lock and hinge rail edge of door intermittently welded, filled and ground smooth the full height of door. Exterior doors shall be insulated with a solid slab of expanded polystyrene or polyurethane foam permanently bonded to the inside of each face skin. The top of all doors shall be closed flush by the addition of a 16-gauge screwed-in top cap and sealed to prevent water infiltration. The bottom channel shall include weep-holes.

- B. All doors shall be reinforced for hardware as shown below where necessary to preclude the use of thru-bolts.
 - 1. Exit Devices: 14-gauge
 - 2. Door Closers: 12-gauge
- C. All doors shall be beveled 1/8 inch in 2 inch and shall have top and bottom channels of not less than 16-gauge, flush or inverted, welded to the face sheets. Doors shall have a full height 14-gauge hinge rail reinforcement channel, or individual 10-gauge hinge reinforcements.
- D. All doors to conform to ANSI-A250.4 Level "A" criteria and shall be tested to 1,000,000 operating cycles and 23 twist tests. Certification of Level "A" doors is to be submitted with approval drawings by supplier upon request. Do not bid or supply any type or gauge of door not having been tested and passed these criteria.

2.4 STANDARD HOLLOW METAL FRAMES

- A. Provide hollow metal frames for doors of types and styles as shown on the drawings and schedules. Conceal fastenings unless otherwise indicated.
 - 1. Exterior Frames: Level 2, 16-gauge, galvanized or galvanealed
 - 2. Security Grade Frames: 14-gauge
 - a. Ceco: SU Series
 - b. Curries: M Series
 - c. Steelcraft: F Series
- B. All frames over 36" in width shall be 14 gauge.
- C. Fabricate frames with mitered and faces only welded corners, re-prime at the welded areas. All welds to be flush with neatly mitered or butted material cuts.
- D. All frames shall have minimum 7 gauge hinge reinforcements, 14-gauge lock strike reinforcing, and 12-gauge closer reinforcing.
- E. All frames shall have minimum 7 gauge hinge reinforcements with an additional high frequency 12-gauge hinge reinforcement welded to the top hinge, 14-gauge lock strike reinforcing, and 12-gauge closer reinforcing.
- F. Provide temporary shipping bars to be removed before setting frames.
- G. Except on weather-stripped frames, drill stops to receive three silencers on strike jambs of single frames and two silencers on heads of double frames.

- H. Provide minimum 0.0179-inch-thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.5 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Astragals: Provide overlapping astragal on one leaf of pairs of doors where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Post installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 - 4. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping

according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
- G. Stops and Moldings: Provide stops and moldings around steel panel where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 2. Provide loose stops and moldings on inside of hollow metal work.

2.6 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
 2. Finish Coat:
 - a. As indicated on plans, Material Finish Schedule

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - b. Install frames with removable glazing stops located on secure side of opening.

- c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that are filled with grout containing anti-freezing agents.
2. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
- a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Standard Steel Doors:
- a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
- D. Steel Panel: Comply with installation requirements in hollow metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service doors.

1.2 REFERENCED STANDARDS

A. American Architectural Manufacturers Association

1. AAMA 611-1998: Voluntary Specification for Anodized Architectural Aluminum
2. AAMA 2603-2002: Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels

B. American Society of Civil Engineers/Structural Engineering Institute

1. ASCE/SEI 7-2010: Minimum Design Loads for Buildings and Other Structures

C. ASTM International

1. ASTM A 653/A 653M-10: Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209-07: Specification for Aluminum and Aluminum-Alloy Sheet and Plate
2. ASTM B 209M-07: Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]
3. ASTM B 221-08: Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
4. ASTM B 221M-07: Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]
5. ASTM E 84-10b: Test Method for Surface Burning Characteristics of Building Materials

6. ASTM E 90-09: Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 7. ASTM E 283-04: Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
 8. ASTM E 330-02 (Reapproved 2010): Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
 9. ASTM E 413-10: Classification for Rating Sound Insulation
 10. ASTM E 1996-09: Specification for Performance of Exterior Windows, Glazed Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes
- D. Door and Access Systems Manufacturers Association
1. DASMA 105-1992 (Revised 2004): Test Method for Thermal Transmittance and Air Infiltration of Garage Doors (ANSI)
 2. DASMA 108-2005: Method for Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance under Uniform Static Air Pressure Difference (ANSI)
- E. International Code Council
1. ICC A117.1-2009: Accessible and Usable Buildings and Facilities (ANSI)
- F. National Association of Architectural Metal Manufacturers/National Ornamental & Miscellaneous Metals Association
1. Metal Finishes Manual for Architectural and Metal Products (AMP 500-06). 2006.
- G. National Electrical Manufacturers Association
1. NEMA ICS 1-2000 (Reaffirmed 2008): Industrial Control and Systems General Requirements
- H. NFPA
1. NFPA 70-2011: National Electrical Code
 2. NFPA 80-2010: Fire Doors and Fire Windows
 3. NFPA 105-2010: Installation of Smoke-Control Door Assemblies
 4. NFPA 252-2008: Fire Tests of Door Assemblies

- I. Underwriters Laboratories Inc.
 - 1. UL 10B-2008: Fire Tests of Door Assemblies
 - 2. UL 325-2002 (Rev. 2010): Door, Drapery, Gate, Louver, and Window Operators and Systems
 - 3. UL 723-2008: Test for Surface Burning Characteristics of Building Materials
 - 4. UL 1784-2001 (Rev. 2004): Air Leakage Tests of Door Assemblies
- J. U.S. Architectural & Transportation Barriers Compliance Board
 - 1. Americans with Disabilities Act (ADA) and Architectural

1.3 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
 - 1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
 - a. Anchorage calculations as required by Section 018815, Anchorage and Bracing.
 - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
 - 3. For fire-rated doors, description of fire-release system including testing and resetting instructions.
- B. Seismic Qualification Certificates: For overhead coiling doors, accessories, and components, from manufacturer.
- C. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- D. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- E. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance, Exterior Doors: See structural drawings "Design Criteria"

- B. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Curtain Slats: Galvanized steel flat profile slats.
 - 2. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.
- B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.
- C. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.
- D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent over travel of curtain, and a continuous bar for holding windlocks.

2.3 LOCKING DEVICES

- A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from interior side.

2.4 CURTAIN ACCESSORIES

- A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on interior side of door, finished to match door.
 - 1. Provide pull-down straps or pole hooks for doors more than 84 inches high.

2.5 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.6 MANUAL DOOR OPERATORS

- A. Equip door with manufacturer's recommended manual door operator unless another type of door operator is indicated.
- B. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25 lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.

2.7 DOOR ASSEMBLY

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Cookson Company.
 - b. Cornell Iron Works, Inc.
 - c. Lawrence Roll-Up Doors, Inc.
 - d. Overhead Door Corporation.
 - e. Wayne-Dalton Corp.
 - f. Or Equal.

- B. Operation Cycles: Not less than 20,000.
 - 1. Include tamperproof cycle counter.
- C. Door Curtain Material: Insulated galvanized steel. Provide thermal efficiency to meet or exceed code requirement for the project.
- D. Door Curtain Slats: Flat profile slats of 3-1/4-inch center-to-center height.
- E. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational
- F. Locking Devices: Equip door with slide bolt for padlock.
- G. Manual Door Operator: Chain-hoist operator.
 - 1. Provide operator with through-wall shaft operation.

2.8 GENERAL FINISH REQUIREMENTS

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal

- A. Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Color: As indicated in the architectural drawings "Material Finish Schedule".

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide weathertight fit around entire perimeter.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train OWNER's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical Door Hardware for the following:
 - a. Swinging doors: Contractor / Hardware Door Supplier to provide "Schlage" locksets as scheduled in the Hardware Schedule. OWNER shall key all new hardware under this project.
 2. Cylinders for all door hardware is specified in this Section.
 - a. "Schlage" interchangeable (IC) core cylinders for Keying to be provided and installed by the OWNER in Contractor / Hardware Door Supplier furnished locksets as shown in Hardware Schedule.

1.2 RELATED SECTIONS:

1. Section 08 11 13 - "Hollow Metal Doors and Frames" for astragals (if any) provided as part of labeled fire-rated assemblies and for door silencers provided as part of hollow-metal frames. Coordinate with Door Schedule.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Other Action Submittals:
 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

- b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Fastenings and other pertinent information.
 - 5) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 6) Mounting locations for door hardware.
 - 7) List of related door devices specified in other Sections for each door and frame.
- 2. Keying Schedule: All cylinders and keying of cores is by the OWNER. OWNER is to provide "Schlage" interchangeable (IC) cores and install.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware schedule.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Lock and Passage Sets: Five years from date of "Substantial Completion".
 - b. Exit Devices (if any): Two years from date of "Substantial Completion".
 - c. Manual Closers: 10 years from date of "Substantial Completion".

1.9 MAINTENANCE SERVICE

- A. Maintenance Instructions: Furnish a maintenance instructions manual for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article and as Scheduled on Drawings to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door

Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.2 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on solid core wood doors and hollow-metal frames.
 1. Manufacturer: Subject to compliance with requirements, provide products by the following:
 - a. McKinney; an ASSA ABLOY Group company.

2.3 MANUAL FLUSH BOLTS

- A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.
 1. Manufacturer: Subject to compliance with requirements, provide products by the following:
 - a. Rockwood Manufacturing Company; an ASSA ABLOY Group Company.

2.4 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated on door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
- E. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
 1. Manufacturer: Subject to compliance with requirements, provide products by the following:

- a. Schlage "D Series"; Allegion plc.

2.5 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.

- 1. Manufacturer: Subject to compliance with requirements, provide products by the following:

- a. Von Duprin 98 Series; Allegion plc.

2.6 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

- 1. Manufacturer: Subject to compliance with requirements, provide products by the following:

- a. Schlage; Allegion plc.

- B. Lock Cylinders: full size interchangeable (IC) cores provided and installed by Owner; face finished to match lockset.

2.7 ACCESSORIES FOR PAIRS OF DOORS

- A. Astragals: BHMA A156.22. (unless shown as welded to hollow metal door)

- 1. Manufacturer: Subject to compliance with requirements, provide products by the following:

- a. Pemko Manufacturing Company; an ASSA ABLOY Group Company.

2.8 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4, Grade 1: rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

- 1. Manufacturer: Subject to compliance with requirements, provide products by the following:

- a. LCN; Allegion plc.

2.9 MECHANICAL STOPS AND HOLDERS

A. Wall and Floor Mounted Stops: BHMA A156.16.

1. Manufacturer: Subject to compliance with requirements, provide products by the following:
 - a. Not required.

2.10 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturer: Subject to compliance with requirements, provide products by the following:
 - a. Pemko Manufacturing Company; an ASSA ABLOY Group Company.

2.11 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturer: Subject to compliance with requirements, provide products by the following:
 - a. Pemko Manufacturing Company; an ASSA ABLOY Group Company.

2.12 FABRICATION

A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through

bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications (if applicable):

a. Machine Screws: For the following:

- 1) Hinges mortised to doors or frames.
- 2) Strike plates to frames.
- 3) Closers to doors and frames.

b. Steel Through Bolts: For the following unless door blocking is provided:

- 1) Surface hinges to doors.
- 2) Closers to doors and frames.
- 3) Surface-mounted exit devices.

3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.13 FINISHES

A. Provide finishes complying with BHMA A156.18.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings and / or to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
- E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07 9200 "Joint Sealants."
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- I. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: OWNER may engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately six months after date of “Substantial Completion”, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of “Substantial Completion”.

3.7 DOOR HARDWARE SCHEDULE

Door Hardware **Group No. 1: Door No. 3** (non-active to have flush bolts)

Entrance				
<u>Qty.</u>	<u>Item</u>	<u>Basis-of-Design Product</u>		<u>Finish</u>
12 ea	Hinges	McKinney	T4A3786 x NRP 4-1/2 x 4-1/2	626
2 ea	Lockset	Schlage	D53PD (Plymouth); IC core by Owner	626
2 ea	Surf. Closure	LCN	4040XP – CUSH Arm with 110 hold open arm	626
2 sets	Flush Bolts	Rockwood	557 x 19BFB – Lever Extension with Bottom Fire Bolt	626
4 sets	Gasketing	Pemco	303AV by door sizes	626
4 ea	Sweep	Pemco	315CN by door sizes	626
2 ea	Threshold	Pemco	272A by door size (see drawing details)	626

Door Hardware **Group No. 2: Door No. 2, 4, 5**

Exit Device (with rim cylinder)

<u>Qty.</u>	<u>Item</u>	<u>Basis-of-Design Product</u>		<u>Finish</u>
3 ea	Hinges	McKinney	TA2714 x 4-1/2 x 4-1/2	626
1 ea	Rim Exit Device	Von Duprin	98E0	626
1 ea	Core	Best	Rim Cylinder – Provide new 1C core to Owner	626
1 ea	Surf. Closure	LCN	4040XP – CUSH Arm with 110 hold open arm	626
1 set	Gasketing	Pemco	303AV by door sizes	626
1 ea	Sweep	Pemco	315CN by door sizes	626
1 ea	Threshold	Pemco	272A by door size (see drawing details)	626

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Glass for hollow metal door vision panels and windows.
 - 2. Glazing sealants and accessories.
 - 3. Glazing Schedule

1.3 RELATED REQUIREMENTS:

- A. Section 08 11 13 - Hollow Metal Doors and Frames

1.4 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: Current edition of the International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.5 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Coated Insulating glass units.
 - 2. Safety (Tempered) glass.

- B. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer manufacturers of insulating-glass units with sputter-coated, low-E coatings glass testing agency and sealant testing agency.
- B. Product Certificates: For glass.
- C. Product Test Reports: For coated glass, insulating glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Sample Warranties: For special warranties.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers

and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 degrees Fahrenheit.

1.11 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: **5 years** from date of Substantial Completion.

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: **5 years** from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products by the following:

1. PPG Industries, Inc – 1-inch Solarban 67 Glass (2) Clear + Clear.
2. Guardian SunGuard – 1-inch SuperNeutral SN68 Glass (2) Clear + Clear
3. See PERFORMANCE REQUIREMENTS for single glaze exterior and interior door lites for Safety Glazing. Exterior and interior door lites to be ¼-inch Tempered / Safety Glazing Units.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Structural Performance: Glazing shall withstand Basic Wind Speed, Importance Factor of 1.0, Exposure C Category within limits and under conditions indicated as determined according to the current edition of the International Building Code (IBC) and ASTM E 1300.
- C. Safety Glazing: Where safety glazing (tempered glass) is indicated, provide glazing that complies with CPSC 16 CFR 1201, Category I & II.
 - 1. Where single glaze is scheduled for lites in exterior and interior doors, use 1/4-inch heat-treated clear safety glass (tempered glass).
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 - 1. For monolithic-glass lites, properties are based on units with lites 1/4 inch.
 - 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite; 1-inch Insulating Units
 - 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu / sq. ft. x h x deg Fahrenheit.
 - 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 - 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 - 1. Minimum Glass Thickness for all Lites: 1/4 inch.
- E. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.4 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 2. Spacer: Aluminum with mill or clear anodic finish.
 - 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.5 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Field-applied sealants shall have a VOC content of not more than 250 g/L.

4. Colors of Exposed Glazing Sealants: As selected by from manufacturer's full range during the submittal process.
- B. Glazing Sealant: High-Performance Silicone Sealant, medium-modulus, one-part, neutral-curing silicone glazing sealant for a variety of perimeter caulking and glazing applications complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT, M, G, A and O.
 1. Manufacturer: Subject to compliance with requirements, provide products by the following:
 - a. Tremco – Spectrem 2

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg Fahrenheit, ambient; 180 deg Fahrenheit, material surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

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

gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

- E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

- A. Glass Type: Clear annealed heat-strengthened fully tempered float glass.
 - 1. Minimum Thickness: 1/4 inch.
 - 2. Safety glazing required at single interior door lites.

- B. Glass Type: Low-E-coated, clear 1-inch insulating glass.
1. Basis-of-Design Product: Guardian SunGuard – 1-inch SN68 Glass (2) Clear + Clear.
 2. Overall Unit Thickness: 1 inch.
 3. Minimum Thickness of Each Glass Lite: 1 /4 inch (6 mm).
 4. Outdoor Lite: Annealed Heat-strengthened Fully tempered float glass.
 5. Interspace Content: Air.
 6. Indoor Lite: Annealed Heat-strengthened Fully tempered float glass.
 7. Low-E Coating: Sputtered on second surface.
 8. Winter Nighttime U-Factor: .29 maximum.
 9. Summer Daytime U-Factor: .27 maximum.
 10. Shading Co-efficient: .43 percent minimum.
 11. Visible Light Transmittance: 19 percent minimum.
 12. Solar Heat Gain Coefficient: .38 maximum.
 13. Light to Solar Gain: 1.80
 14. Safety glazing required at exterior full glass door lites (if any).

END OF SECTION

SECTION 08 91 19

LOUVERS

PART 1 GENERAL

1.1 DESCRIPTION

A. SCOPE:

1. This Section includes intake and exhaust stationary air louvers and accessories.

B. Section Includes:

1. Louvers.
2. Screens.

1.2 RELATED SECTIONS

- A. Section 05 50 00 - Metal Fabrications.
- B. Section 09 90 00 - Painting and Coatings.

1.3 SUBMITTALS

- A. Manufacturer's catalog and/or other data confirming conformance to specified design, material and equipment requirements.
- B. Equipment List: Identify each louver with an equipment number corresponding to the Drawings and indicate the room or structure in which it is located.
- C. Certified results of pressure drop test data and water penetration data.
- D. Louvers shall bear the AMCA certified ratings seal for both air performance and water penetration.

1.4 REFERENCE STANDARDS

- A. Aluminum Association (AA):
 1. AA 45 - Designation System for Aluminum Finishes.
- B. Air Movement and Control Association (AMCA) International:
 1. AMCA Standard 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. ASTM International:
 1. ASTM B221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

PART 2 PRODUCTS

2.1 MANUFACTURERS

Manufacturers include Airlite, Construction Specialties, Greenheck, and Ruskin, or equal.

2.2 MATERIALS

- A. Frame: ASTM B221, 6063-T52 extruded aluminum alloy.
- B. Fasteners: Aluminum.
- C. Bird Screen.

2.3 EQUIPMENT

- A. Blades:
 - 1. Material: ASTM B221, 6063-T52 extruded aluminum alloy.
 - 2. Blades shall be of the combination of fixed and adjustable, drainable type with interlocking blade braces to provide an uninterrupted horizontal line.
 - 3. Blades for all louvers shall be minimum 0.081 inch thick.
 - 4. Slideable interlocked mullions shall have provisions for expansion and contraction.
- B. Frame:
 - 1. Material: ASTM B221, 6063-T52 extruded aluminum alloy.
 - 2. The frame shall be minimum 0.081-inch thick by 6 inches deep.
 - 3. The louver frame shall be assembled by welding.
 - 4. The head, sill, and jamb shall be one-piece structural members and shall have an integral calking slot and retaining bead.
- C. Screen:
 - 1. Material: Aluminum wire mesh.
 - 2. The louver shall be furnished with a removable bird screen constructed of 1/2-inch mesh, 16-gage wire and secured within a 10-gage extruded aluminum frame.
 - 3. The screen shall be mounted on the interior louver face but independent of the louver.
- D. Fasteners: Aluminum.

- E. Finish:
 - 1. Unless otherwise specified, all louvers shall receive an AAMA 2605, 70 percent fluoropolymer paint finish after assembly.
 - 2. Minimum coating thickness shall be 0.7 mil.
 - 3. Color to match door.

2.4 FABRICATION

- A. General: Fabricate louvers to comply with requirements indicated for design, dimensions, materials, joinery, and performance.
- B. Assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Maintain equal louver blade spacing to produce uniform appearance.
- E. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances of louvers, adjoining construction and perimeter sealant joints.
- F. Include supports, anchorages and accessories required for complete assembly.
- G. Provide vertical mullions of type and at spacing's indicated but not more than recommended by manufacturer, or 72 inches on center, whichever is less. At horizontal joints between louver units, provide horizontal mullions except where continuous vertical assemblies are indicated.
- H. Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.
- I. Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary:
 - 1. With fillet welds, concealed from view.
 - 2. With fillet welds, concealed from view; or mechanical fasteners; or a combination of these methods; as standard with louver manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Locate and place louver units plumb, level and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items that cannot be refinished in the field to the shop, make required alterations and refinish entire unit, or provide new units.
- F. Protect nonferrous metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that are in contact with concrete, masonry or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers and insulation, as louver installation progresses, where required to make louver joints weathertight. Comply with Section 07900 for sealants applied during installation of louver.

3.2 FINISHING

- A. Adjusting and Protection
 - 1. Protect louvers from damage of any kind during construction period including use of temporary protective coverings where needed and approved by louver manufacturer. Remove protective covering at time of Substantial Completion.
 - 2. Restore louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by the OWNER'S Representative, remove damaged units and replace with new units.
 - a. Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

B. Cleaning

1. Periodically clean exposed surfaces of louvers that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
2. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Rinse surfaces thoroughly and dry.

END OF SECTION

SECTION 09 20 10 - GYPSUM WALLBOARD

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish and install gypsum drywall and accessories where shown on the Drawings, as specified herein and as needed for a complete and proper installation.
- B. Section includes:
 - 1. Gypsum wallboard
 - 2. Metal trim
 - 3. Jointing systems
 - 4. Fastening devices
 - 5. Access doors
- C. Related Work:
 - 1. Section 06 10 00 - Rough Carpentry.

1.2 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board.
 - 2. ASTM C1396 - Standard Specification for Gypsum Board.

1.3 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product Data: Manufacturer's data sheets on each product to be used.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Per manufacturer's recommendations.

PART 2 PRODUCTS

2.1 GYPSUM WALLBOARD

- A. General: Provide gypsum wallboard complying with ASTM C1396, in 48-inch widths and in such lengths as will result in a minimum of joints.
- B. Regular wallboard: Provide 5/8-inch thick, except as may be shown otherwise on the Drawings.
- C. Fire-retardant wallboard: Provide Type X, 5/8-inch thick.
- D. Fire-resistant wallboard: Provide Type C, 5/8-inch thick, except as may be shown otherwise on the Drawings.
- E. Foil-backed wallboard -- Provide as shown on the Drawings.

2.2 METAL TRIM

- A. Form from zinc-coated steel not lighter than 26-gauge, complying with Fed Spec QQ-S0775, Type I, class D or E.
- B. Casing beads
 - 1. Provide channel shapes with an exposed wing and with a concealed wing not less than 7/8-inch wide.
 - 2. The exposed wing may be covered with paper cemented to the metal but shall be suitable for joint treatment.
- C. Corner beads
 - 1. Provide angle shapes with wings not less than 7/8-inch wide and perforated for nailing and joint treatment or with combination metal and paper wings bonded for joint treatment.
- D. Edge beads for use at perimeter of ceilings
 - 1. Provide angle shapes with wings not less than 3/4-inch wide.
 - 2. Provide concealed wing perforated for nailing and exposed wing edge folded flat.
 - 3. Exposed wing may be factory-finished in white color.

2.3 JOINTING SYSTEM

- A. Provide a jointing system, including reinforcing tape and compound, designed as a system to be used together and as recommended for this use by the manufacturer of the gypsum wallboard approved for use on this Work.

- B. Jointing compound may be used for finishing if so recommended by its manufacturer.

2.4 FASTENING DEVICES

- A. For fastening gypsum wallboard in place on metal studs and metal channels, use flat-head screws, shouldered, specially designed for use with power-driven tools, not less than 1-inch long, with self-tapping threads and self-drilling points.
- B. For fastening gypsum wallboard in place on wood, use 1-1/4-inch type W bugle-head screws or annular ring type nails complying with ASTM C514 and of the length required by governmental agencies having jurisdiction.

2.5 ACCESS DOORS

- A. In partitions and ceilings installed under this Section, provide doors where required for access to mechanical installations, electrical installations, and attic spaces.
- B. Types:
 - 1. Unless otherwise required, provide 22-inch by 30-inch metal access doors with concealed hinges to metal frame and with Allen key lock.
 - 2. For piercing fire-rated surfaces, provide access doors having the same fire rating as the surface being pierced.
 - 3. Provide prime-coated steel access doors and frames for finish painting to be performed at the job site under Section 09 90 00, Painting and Coating.

2.6 OTHER MATERIALS

- A. Provide other materials not specifically described but required for a complete and proper installation, as selected by the CONTRACTOR subject to the approval of the ENGINEER.

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

A. General:

1. Install gypsum wallboard in accordance with the Drawings and with the separate boards in moderate contact but not forced into place.
2. At internal and external corners, conceal the cut edges of the boards by the overlapping covered edges of the abutting boards.
3. Stagger the boards so that corners of any four boards will not meet at a common point except in vertical corners.

B. Ceilings:

1. Install gypsum wallboard to ceilings with the long dimension of the wallboard at right angles to the supporting members.
2. Wallboard may be installed with the long dimension parallel to supporting members that are spaced 16-inch on centers when attachment members are provided at end joints.

C. Walls:

1. Install the gypsum wallboard to studs at right angles to the furring or framing members.
2. Make end joints, where required, over framing or furring members.

D. Attaching:

1. Drive the specified screws with clutch-controlled power screwdrivers, spacing the screws 12 inches on centers at ceilings and 16 inches on centers at walls.
2. Where framing members are spaced 24 inches apart on walls, space screws 12 inches on centers.
3. Attach double layers in accordance with the pertinent codes and the manufacturer's recommendations as approved by the ENGINEER.
4. Attach to wood as required by governmental agencies having jurisdiction.

E. Access Doors:

1. By careful coordination with the Drawings and with the trades involved, install the specified access doors where required.

2. Anchor firmly into position and align properly to achieve an installation flush with the finished surface.

3.3 JOINT TREATMENT

A. General:

1. Inspect areas to be joint treated, verifying that the gypsum wallboard fits snugly against supporting framework.
2. In areas where joint treatment and compound finishing will be performed, maintain a temperature of not less than 55 degrees Fahrenheit (F) for 24 hours prior to commencing the treatment and until joint and finishing compounds have dried.
3. Apply the joint treatment and finishing compound by machine or hand tool.
4. Provide a minimum drying time of 24 hours between coats with additional drying time in poorly ventilated areas.

B. Embedding Compounds:

1. Apply to gypsum wallboard joints and fastener heads in a thin uniform layer.
2. Spread the compound not less than 3-inch wide at joints, center the reinforcing tape in the joint, and embed the tape in the compound. Then spread a thin layer of compound over the tape.
3. After this treatment has dried, apply a second coat of embedding compound to joints and fastener heads, spreading in a thin uniform coat to not less than 6-inch wide at joints, and feather edged.
4. Sandpaper between coats as required.
5. When thoroughly dry, sandpaper to eliminate ridges and high points.

C. Finishing Compounds:

1. After embedding compound is thoroughly dry and has been completely sanded, apply a coat of finishing compound to joints and fastener heads.
2. Feather the finishing compound to not less than 12-inch wide.
3. When thoroughly dry, sandpaper to obtain a uniformly smooth surface, taking care to not scuff the paper surface of the wallboard.

3.4 CORNER TREATMENT

A. Internal Corners:

1. Treat as specified for joints, except fold the reinforcing tape lengthwise through the middle and fit neatly into the corner.

B. External Corners:

1. Install the specified corner bead, fitting neatly over the corner and securing with the same type fasteners used for installing the wallboard.
2. Space the fasteners approximately 6-inch on centers and drive through the wallboard into the framing or furring member.
3. After the corner bead has been secured into position, thread the corner with joint compound and reinforcing tape as specified for joints, feathering the joint compound out from 8-inch to 10-inch on each side of the corner.

3.5 OTHER METAL TRIM, GENERAL

A. The Drawings do not purport to show all locations and requirements for metal trim.

B. Carefully study the Drawings and the installation and provide all metal trim normally recommended by the manufacturer of the gypsum wallboard approved for use in this Work.

3.6 CLEANING UP

A. In addition to other requirements for cleaning, use necessary care to prevent scattering gypsum wallboard scraps and dust, and to prevent tracking gypsum and joint finishing compound onto floor surfaces.

B. At completion of each segment of installation in a room or space, promptly pick up and remove from the working area all scrap, debris, and surplus material of this Section.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATINGS

PART 1 GENERAL

1.1 THE REQUIREMENT

- A. Work under this Section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.
- B. This specification is applicable to coated pipe, steel, concrete and other surfaces listed in the coating schedule at the end of this section. Reservoir painting, pipe corrosion protection systems, galvanizing and anodizing are specified elsewhere within the contract documents.
- C. The Coating System Schedules summarize the surfaces to be coated, the required surface preparation and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.
- D. Related Work Specified in Other Sections -- Shop coatings and/or factory finishes on fabricated or manufactured equipment may be specified in other divisions. Some items with factory finishes, or corrosion resistant finishes may be scheduled or directed to be painted by the Owner's Representative to unify a wall finish or color scheme, at the Owner's Representative's discretion.
- E. Exclusions -- Do not coat the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze and other corrosion-resistant material (except for valve bodies and piping); Electrical switch-gear and motor control centers having factory finish; Fencing; Multiple coated factory finished baked enamel or porcelain products; Concealed areas such as ducts, piping, conduits and items specified elsewhere for special linings and coatings.
- F. Damaged Factory Finish -- If directed by the Owner's Representative, refinish the entire exposed surfaces of equipment chipped, scratched or otherwise damaged in shipment or installation.
- G. All coating in contact with potable water shall be NSF approved.

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified.
1. "Architectural Specification Manual" by the Painting and Decorating Contractors of America (PDCA), 333 Taylor Avenue North, Seattle, Washington 98109.
 2. "Systems and Specifications" - Volume 2 of Steel Structures Painting Council (SSPC).
 3. National Sanitation Foundation (NSF) Standard No. 61.
- B. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Owner's Representatives, P.O. Box 986, Katy, TX 77450.
- C. Pipe Coating Commercial Standards
- | | |
|----------------|---|
| ANSI/AWWA C105 | Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids. |
| ANSI/AWWA C203 | Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied. |
| ANSI/AWWA C205 | Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inch and Larger - Shop Applied |
| ANSI/AWWA C209 | Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Pipelines. |
| ANSI/AWWA C210 | Liquid Epoxy Coating for Exterior and Interior of Steel Pipe. |
| ANSI/AWWA C213 | Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines. |
| ANSI/AWWA C214 | Tape Coating systems for the Exterior of Steel Water Pipelines. |
- D. Federal Specifications
- | | |
|------------------|--|
| DOD-P-23236A(SH) | Military Specification, Paint Coating Systems, Steel Ship Tank, Fuel and Salt Water Ballast. |
|------------------|--|

1.3 CONTRACTOR SUBMITTALS

- A. Coating Materials List -- The Contractor shall provide a coating materials list which indicates the manufacturer and the coating number, keyed to the coating systems herein.

- B. Coating Manufacturer's and Applicator Information -- For each coating system to be used the Contractor shall submit, the following listed data.
1. Manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.
 2. Manufacturer's instructions and recommendations on surface preparation and application.
 3. Colors available for each product and each coat.
 4. Compatibility of shop and field applied coatings (where applicable).
 5. Material safety data sheet (MSDS) for each product used.
 6. The manufacturer's recommended products and procedures for field coating repairs and field preparation of field cut pipe ends.
 7. The name of the proposed coating applicator shop along with certification that the applicator shop is qualified and equipped to apply the coatings systems as specified.
 8. Certificate -- Submit manufacturer's certificate of compliance with the specifications and standards signed by a representative in the manufacturer's employ.
 9. Samples -- Provide painted surface areas at the job for approval of main color selections or submit sample on 12-inch sample of substrate using required finish system at OWNER'S REPRESENTATIVE's discretion.

1.4 QUALITY ASSURANCE

- A. Painter Qualifications -- The Painting/Coating Contractor must be capable of performing the various items of work as specified. The Painting/Coating Contractor shall furnish a statement covering experience on similar work, a list of machinery, plant and other equipment available for the proposed work, and a financial statement, including a complete statement of the Painter/Coating Contractor's financial ability and experience in performing similar painting and coating work. The Painting/Coating Contractor shall have a minimum of five (5) years practical experience and a successful history in the application of the specified products to concrete/steel surfaces. Upon request, the Painting/Coating Contractor shall substantiate this requirement by furnishing a list of references, which shall include jobs of similar nature.
- B. The Contractor shall give the Owner's Representative a minimum of 3 days advance notice of the start of any field surface preparation work of coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

- C. All such work shall be performed only in the presence of the Owner's Representative, unless the Owner's Representative has granted prior approval to perform such work in its absence.
- D. Inspection by the Owner's Representative, or the waiver of inspection of any particular portion of the work, shall not relieve the Contractor of its responsibility to perform the work in accordance with these Specifications.
- E. Surface Preparation -- Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.
- F. Scaffolding shall be erected and moved to locations where requested by the Owner's Representative to facilitate inspection. Additional illumination shall be provided by the Contractor to cover all areas to be inspected.
- G. Paint Products -- No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified. Painting shall be done at such times as the Contractor and Owner's Representative may agree upon in order that dust-free and neat work be obtained. All painting shall be in strict accordance with the manufacturer's instructions and shall be performed in a manner satisfactory to the Owner's Representative.
- H. Manufacturer's Representative -- Require coating manufacturer's representative to be at job site when the first day's coating application is in progress and periodically during progress of the work.
- I. Labels -- Deliver to the job site in the original sealed containers with manufacturer's name, product name, type of product, manufacturer's specification or catalog number or federal specification number, and instructions for reducing where applicable.
- J. Colors -- Colors will be selected from manufacturer's standard colors as reviewed by Owner's Representative and approved by the Owner. Colors for special coatings that are limited in their availability and color selection will be chosen on the basis of manufacturer's standard colors, provided that the manufacturer's product line represents a color range comparable to similar products of other manufacturers.
- K. Flame Spread -- Provide paint materials which will result in a Class II finish for all coated surfaces in exit corridors, and a Class III finish for all other interior rooms or areas.
- L. Film Thickness Testing -- On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gage such as Mikrotest model FM, Elcometer model 111/1EZ, or approved equal. Each coat shall be tested for the correct thickness. No

measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using wet film gage readings and destructive film thickness tests.

- M. Inspection Device -- The Contractor shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gages shall be made available for the Owner's Representative's use at all times while coating is being done, until final acceptance of such coatings. The Contractor shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.
- N. Holiday Testing -- The Contractor shall holiday test all coated ferrous surfaces. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.
 - 1. Coatings with Thickness Exceeding 20 Mils -- For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or approved equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - 2. Coatings with Thickness of 20 Mils or Less -- For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Razor Model M1 nondestructive type holiday detector, K-D Bird Dog, or approved equal shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

1.5 DELIVERY, HANDLING AND STORAGE

- A. Deliver in labeled containers as specified above and store in a locked room accessible for inspection. Comply with fire and health regulations.
- B. Provide adequate heat and forced mechanical ventilation for health, safety and drying requirements. Use explosion proof equipment. Provide face masks.
- C. Protect adjacent surfaces with suitable masking and drop cloths as required. Remove cloths or waste from the project daily.
- D. Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Do not apply coating in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces, unless otherwise permitted by the coating manufacturer's printed

instructions. Coating application may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

1.6 PROTECTION

- A. Follow all safety recommendations of manufacturer regarding ventilation and danger from explosion or breathing paint fumes or skin exposure, and all applicable O.S.H.A. and other regulations.
- B. Protect surface adjacent to work being coated from overspray, drips or other damage.

1.7 EXTRA STOCK

Provide one gallon of each type and color, fully labeled, at completion of job.

PART 2 PRODUCTS

2.1 GENERAL

- A. Definitions -- The terms "paint," "coatings" or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.
- B. General -- Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.
- C. Use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.
- D. Compatibility -- In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the approval of the Owner's Representative, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- E. Colors -- All colors and shades of colors of all coatings shall be as selected or specified by the Owner's Representative. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the Owner's Representative. Color pigments shall be lead free.

- F. Protective Coating Materials -- Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the Contractor shall provide the Owner's Representative with the names of not less than 10 successful applications of the proposed manufacturer's products demonstrating compliance with this specification requirement.
- G. Substitute or "Or-Equal" Submittals -- Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The Contractor shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that said material meets the specified requirements and is equivalent or better than the listed materials.
- H. The cost of all testing and analyzing of the proposed substitute materials that may be required by the Owner's Representative shall be paid by the Contractor. If the proposed substitution requires changes in the contract work, the Contractor shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 INDUSTRIAL COATING SYSTEMS

A. General

Provide and apply the industrial coatings systems which follow as listed in the coating schedule, as required by these specifications and as directed by the Owner's Representative. Coat all existing and new exposed interior or exterior surfaces and submerged and intermittently submerged surfaces as indicated, except as specifically excluded in Part 1 of this section or on the drawings or finish schedules. Coating System Numbers listed below shall be used as the Coating System code letter, and shall be used on any coating submittals or correspondence.

B. Industrial coating systems shall be as follows

1. Coating System 100

- a. Location -- Exposed, unprimed, non-galvanized, non-submerged metal surfaces, both interior and exterior including piping and structural steel.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply prime coat and topcoat, 4.0-6.0 mils each coat of Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by Owner.

2. Coating System 101

- a. Location -- Exposed metal surfaces, shop primed, both interior and exterior including piping, railings, ladders, steel doors, and any other metal items not otherwise specified.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply shop prime coat 3.0 mils DFT Tnemec Series 90-97 Tneme-Zinc, one coat 4.0 - 6.0 mils DFT Tnemec Series 66 Hi-Build Epoxoline, and 3.0 - 4.0 mils DFT of Tnemec Series 175 Endura Shield, or approved equal. Color as selected by Owner.

3. Coating System 102

- a. Location -- Unprimed or non-galvanized, continuously or intermittently submerged metal items, both interior and exterior including piping, structural steel and all other metal items not otherwise specified.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Prime, intermediate and topcoat, 4.0-6.0 mils each coat of Tnemec Series 20 Pota-Pox, or approved equal. Color as selected by Owner.

4. Coating System 103

- a. Location -- Vertical concrete walls, exterior, below finish grade, not exposed to view.
- b. Surface Preparation -- As specified herein.
- c. Paint System -- Apply two coats 9.0-10.0 mils each, Carboline Bitumastic 50, or approved equal.

5. Coating System 104

- a. Location - Nonsubmerged, exposed to view, PVC piping.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply one coat, 4.0-6.0 mils Tnemec Series 66-2 Hi-Build Epoxoline, or approved equal. Color as selected by Owner.

2.3 SPECIAL PIPE AND SEVERE SERVICE COATING SYSTEMS

A. General

The following coatings are for buried pipe and surfaces used in severe service conditions. The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated within the paragraph entitled " 'Or-Equal' Clause" in Section 01 33 00, Submittal Procedures.

B. Special pipe and severe service coating systems shall be as follows

1. Coating System 200 -- Cement Mortar Coating

- a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
- b. Surface Preparation - As specified herein.
- c. Coating System -- A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than one part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C 309-81, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped by at least 6 inches. At the Owner's Representative's discretion, the hot applied coal tar epoxy coating may be used as the curing membrane for the mortar coating.

2. Coating System 201 -- Hot Applied Coal Tar Epoxy Coating

- a. Location -- Exterior surface of concrete pipe and cement-mortar coated pipe and fittings.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- The hot applied coal tar epoxy shall be a solvent free 100 percent solids coal tar epoxy chemically compatible with hydrating cement and suitable for application on moist surfaces of freshly placed cement mortar or concrete and properly prepared cured surfaces. The coal tar epoxy coating material shall be Amercoat 1972B or approved equal. The finish coal tar epoxy coating shall have a minimum DFT of 26 mils.

3. Coating System 202 -- Coal-Tar Epoxy Coating System

- a. Location -- Exterior surface of buried steel pipe, fittings and other ferrous surfaces.

- b. Surface Preparation -- As specified herein.
 - c. Coating System -- High build, 2-component amine or polyamide cured coal-tar epoxy shall have a solids content of at least 68 percent by volume, suitable as a long term coating of buried surfaces, and conforming to AWWA C210. Prime coats are for use as a shop primer only. Prime coat shall be omitted when both surface preparation and coating are to be performed in the field. The coal-tar epoxy coating system shall include:
 - 1) Prime coat (DFT = 1.5 mils), Amercoat 83HS, Tnemec P66, or equal.
 - 2) Finish coats (2 or more, DFT = 18 mils), Amercoat 78 HB, Tnemec 46 H-413, or equal.
 - 3) Total system DFT = 19.5 mils.
4. Coating System 203 -- Fusion Bonded Epoxy
- a. Location -- Ferrous surfaces of sleeve couplings, steel pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines". The coating shall be applied using the fluidized bed process.
 - 1) Liquid Epoxy -- For field repairs, the use of a liquid epoxy will be permitted, applied in not less than 3 coats to provide a DFT 16 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the powder epoxy manufacturer.
 - 2) Coating (DFT = 16 mils), Scotchkote 203, or equal.
 - 3) Total system DFT = 16 mils.
5. Coating System 204 -- Hot, Coal-Tar Enamel
- a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation - As specified herein
 - c. Coating System -- Coal-Tar Enamel materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a primer layer, coal-tar enamel layer, coal-tar saturated nonasbestos felt outerwrap and a finish coat. Total system DFT = 188 mils.

6. Coating System 205 -- Hot Applied Tape
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a cold-applied liquid primer and heated coal-tar base tape. Total system DFT = 50 mils.
7. Coating System 206 -- Cold Applied Tape
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. Prefabricated tape shall be Type II. The system shall consist of a primer layer, inner layer tape of 35 mils, and an outer layer tape of 35 mils. Total system DFT = 70 mils.
8. Coating System 207 -- PVC Tape
 - a. Location -- Small galvanized steel pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Prior to wrapping pipe with PVC tape, the pipe and fittings shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half lapped for a total thickness of 40 mils.
9. Coating System 208 -- Mastic
 - a. Location -- Pipe and fitting joints, and general buried surface coating repair and touch up.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- Mastic shall be a one-part solvent drying heavy bodied thixotropic synthetic elastomeric coating with chemically inert resins and fillers and an average viscosity of 650,000 CPS at 77 degrees Fahrenheit, thereby requiring generous applications by hand or trowel. Total coat thickness shall be 30 mils, minimum. Mastic shall be Protecto Wrap 160 H or approved equal and be fully compatible with pipeline coating systems.

10. Coating System 209 -- Polyethylene Encasement

- a. Location -- Ductile iron, steel and concrete cylinder pipe and fittings
- b. Surface Preparation -- None required.
- c. Coating System -- Except as otherwise specified, application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

2.4 ARCHITECTURAL COATING SYSTEMS

A. General

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or topcoat.

Fungus Control: Submit evidence for all paints attesting the passing of Federal Test Method Standard No. 141, Method 6271.1 showing no fungus growth or other approved test results.

Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Acrylics require 60 degrees Fahrenheit (°F) and above temperature and below 50 percent relative humidity. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50°F and 90°F unless otherwise permitted by the paint manufacturer's printed instructions.

B. Architectural coating systems shall be as follows

1. Coating System 300

- a. Location -- Vertical, exterior concrete masonry unit walls exposed to view.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply prime, intermediate and top coat, 75 ft²/gal, 100 ft²/gal and 100 ft²/gal respectively for each coat of Tnemec Series 156 Envirocrete or approved equal. Color as selected by Owner.

2. Paint System 301

- a. Location -- Vertical concrete exterior walls and flat concrete exterior roofs and slabs exposed to view.
- b. Surface Preparation -- As specified herein.

- c. Coating System -- Apply two coats 6.0-9.0 mils (100 ft²/gal) each coat, Tnemec Series 156 Envirocrete, or approved equal. Color as selected by Owner.
- 3. Paint System 302
 - a. Location -- Interior concrete masonry unit walls and interior and exterior wood walls, ceilings and other wood surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Prime as specified by coating manufacturer. Apply two coats 6.0 - 9.0 mils (100 ft²/gal) each coat, Tnemec Series 156 Envirocrete, or approved equal. Color as selected by Owner.
- 4. Paint System 303
 - a. Location -- Wood surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply an alkyd primer as recommended by the manufacturer, 2 mils. Apply finish coats (two or more coats 6 mils total) of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Total DFT = 8 mils. Color as selected by Owner.
- 5. Paint System 304
 - a. Location -- Interior drywall surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- Apply two coats 2.0 - 3.0 mils each coat of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Color as selected by Owner.
- 6. Paint System 305
 - a. Location -- Exterior brick surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation -- Surfaces shall be cleaned with a manufacturers approved chemical cleaner and power washed. Surfaces shall be completely dry, free from efflorescence, oils, paint and other contaminants before the coating system is applied. Coating system shall be applied according to the manufacturers published recommendations. A manufacturer's representative

shall be present during application of the coating system, if required by the manufacturer's warranty.

- c. Coating System -- Apply two coats of masonry water retardant material. The system shall be clear, non-staining, silane-modified-siloxane, Fabrishield 161, Rainstopper 1500, or equal. The selected coating system shall provide a minimum of a five-year manufacturer's warranty.

PART 3 EXECUTION

3.1 STORAGE, MIXING AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations -- Unless otherwise specified herein, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the manufacturer's recommended shelf life.
- C. Storage and Mixing -- Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification.
 - 1. Solvent Cleaning (SSPC-SP1) -- Removal of oil, grease, soil, salts and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion or steam.
 - 2. Hand Tool Cleaning (SSPC-SP2) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
 - 3. Power Tool Cleaning (SSPC-SP3) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing and grinding.
 - 4. White Metal Blast Cleaning (SSPC-SP5) -- Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC-SP6) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
6. Brush-Off Blast Cleaning (SSPC-SP7) -- Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust and loose paint.
7. Near-White Blast Cleaning (SSPC-SP10) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
8. High- and Ultra High- Pressure Water Jetting (SSPC-SP12): Water jetting at high- or ultra high-pressure to prepare a surface for recoating using pressure above 10,000 psi.
9. Surface Preparation of Concrete (SSPC-SP-13) - Surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.
10. Industrial Blast Cleaning (SSPC-SP14): Blast cleaning to remove all visible oil, grease, dust and dirt, when viewed without magnification.

3.3 CORRECTIONS AND CLEANUP

At completion any damaged, de-laminated or defaced coated surfaces shall be touched up, restored and left in first class condition. Any coated or finished surfaces damaged in fitting or erection shall be restored. If necessary, an entire wall shall be refinished rather than spot finished. Upon completion and prior to final acceptance, all equipment and unused materials accumulated in the coating process shall be removed from the site and any spillage, spatter spots or other misplaced coating material shall be removed in a manner which will not damage surfaces. Perform required patching, repair and cleaning to the satisfaction of the Owner's Representative. Cooperate and coordinate work with the work of other trades in the removal and replacement of hardware, fixtures, covers, switch plates, etc., as required for coating.

3.4 SURFACE PREPARATION

A. General

Prepare all surfaces scheduled to receive new coating systems, as required to provide for adequate bonding of the specified coating system to the substrate material. Request review of prepared surfaces by the Owner's Representative prior to proceeding. For existing coated surfaces, hand wash with cleaner or product recommended by coating manufacturer to properly prepare existing surface and

provide for bonding of coating specified to follow. Remove any loose, peeling or flaking coating, or mildewed areas. Surface preparation minimums shall be as follows:

1. Exposed metal items, nonsubmerged, unprimed, non-galvanized both interior and exterior, including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP6, "Commercial Blast Cleaning".
2. Exposed metal items, shop primed, both interior and exterior including: piping, steel doors, steel ladders to be painted, and railings, and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning"; SSPC-SP2, "Hand Tool Cleaning"; and SSPC-SP3, "Power Tool Cleaning" as may be required to remove grease, loose or peeling or chipped paint.
3. Metal items, unprimed or non-galvanized, continuously or intermittently submerged, both interior and exterior including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in conformance with SSPC-SP10, "Near-White Blast Cleaning".
4. Stainless Steel - Nonsubmerged and submerged, exposed piping and fittings, both interior and exterior shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning".
5. Polyvinyl Chloride (PVC) - Nonsubmerged, both interior and exterior, process piping and plumbing, shall be lightly sanded prior to application of the specified coating system to follow.
6. Nonsubmerged Concrete - Clean all concrete surfaces of dust, form oil, curing compounds or other incompatible matter. Etch and prime if required by manufacturer for specified coating products to follow. Allow minimum 28-day cure of concrete prior to application of coating systems.
7. Concrete Masonry Units -- Repair all breaks, cracks and holes with concrete grout. The surface must be free of dirt, dust, loose sand and other foreign matter. Brush clean. Allow minimum 28-day cure of concrete joint mortar and repair grout prior to application of coatings system.
8. Wood -- Wood surfaces shall be thoroughly cleaned and free of all foreign matter with cracks, nail holes and other defects properly filled, smoothed and sandpapered to fine finish. Wipe clean of dust.
9. Preparation of All Existing Coated Surfaces -- Removed rough and defective coating film from material surfaces to be painted. Touch up with approved primer. Clean all greasy or oily surfaces, to be painted, with benzine or mineral spirits or Rodda's

Gresof before coating, or as recommended by manufacturer. For walls, patch existing nicks and gouges, sand to match wall finish.

3.5 PRIME COATING

- A. Exposed Steel -- Prime coat all exposed steel in accordance with SSPC PS 13.01 for epoxy-polyamide coating systems. Prime coats shall be applied following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above.
- B. Galvanized Metal -- After surface preparation specified above, prime galvanized metal items receiving paints as specified with Tnemec Series 66 Hi-Build Epoxaline or equal, verifying with manufacturer before application the compatibility with coatings specified to follow.
- C. Shop Primed Metal -- Where indicated on the plans or coating schedule and following the surface preparation procedures specified in paragraph 3.4.A.2 above, the Contractor shall apply intermediate and topcoats of the specified paint system to shop primed metal. The Contractor shall verify with the manufacturer(s) representative of the item(s) to be painted, before application, the compatibility of shop primers with the specified intermediate and topcoat coating systems.
- D. Non-Shop Primed Metal and Piping -- Prime coat all exposed metal and piping, except stainless steel, received at job site following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above. Prime paint in accordance with SSPC PS No. 13.01 for epoxy-polyamide primers. Epoxy-polyamide primers shall conform to the standards set forth in SSPC Paint Specification No. 22.
- E. Cast-In-Place Reinforced Concrete -- After surface preparation specified above, prime coat concrete as specified in the coating schedule found elsewhere in the specifications.
- F. Concrete Masonry Units -- After surface preparation specified above, prime coat as specified in the coating schedule found elsewhere in the specifications.
- G. Wood Surfaces -- Following surface preparation specified above, prime coat exterior exposed wood surfaces with appropriate coating system as specified in the painting schedule.

3.6 FIELD PRIME

Wherever shop priming has been damaged in transit or during construction, the damaged area shall be cleaned and touched up with field primer specified herein or returned to the shop for resurfacing and repriming, at the Owner's Representative's discretion. Metal items delivered to the job site unprimed shall be cleaned and primed as specified herein.

3.7 APPLICATION

- A. Thickness -- Apply coatings in strict conformance with the manufacturer's application instructions. Apply each coat at the rate specified by the manufacturer to achieve the dry mil thickness specified. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material. Correct apparent deficiency of film thickness by the application of an additional coat.
- B. Porous Surfaces -- Apply paint to porous surfaces as required by increasing the number of coats or decreasing the coverage as may be necessary to achieve a durable protective and decorative finish.
- C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.
- D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe coating for these areas.
- F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- G. Ventilation -- Adequately ventilate enclosed rooms and spaces during painting and drying periods.
- H. Drying Time -- Do not apply next coat of coat until each coat is dry. Test non-metallic surfaces with moisture meter. The manufacturer's recommended drying time shall mean an interval under normal condition to be increased to allow for adverse weather or drying conditions. Coating manufacturer's representative shall verify by cure testing, complete cure of coatings systems used for immersion service.

3.8 COATING SCHEDULE

- A. Provided with Drawings.

END OF SECTION

SECTION 09 97 14

STEEL WATER STORAGE TANK PAINTING

PART 1 GENERAL

1.1 SUMMARY

A. General:

1. This Section includes preparing, priming, and installing protective paint systems for a new welded steel potable water storage tank, accessories and associated interior piping.
2. The intent of the interior coating system specified herein is to provide a long-lasting coating system with the least concentration of volatile organic compounds (VOCs) as possible. The 100% solids epoxies specified shall not be thinned with any solvent or thinners. Special consideration shall be given to limiting as much use of any solvent on the project site as possible. The interior coating shall meet the anticipated extractables standards of NSF 61/600, which is to be effective in January 2023.

B. Section Includes:

1. Surface preparation.
2. Painting tank interior and exterior.

C. The new reservoir is described as follows:

1. Owner: City of Pendleton, Oregon.
2. Location: Airport Road. See Sheet GEN-C-1, Site Mapping and General Project Overview of the Drawings.
3. Function: Potable water reservoir
4. Reservoir Name: New Airport Reservoir.
5. Nominal Volume: 2.0 million gallons
6. Dimensions (approximate): 107 feet interior diameter; 32 feet in shell height.
7. Roof Style: Self-supported dome.

D. Extent of Work:

1. Surface preparation and application of a protective paint system to the new steel reservoir interior surfaces.
 - a. Abrasive blasting to the specified surface preparation cleanliness standard in an approved Shop per the requirements of this Specification and in the field following erection as required.
 - b. Humidity and temperature control for the interior coating work.
2. Surface preparation and application of a protective paint system to the new steel exterior surface.
 - a. Abrasive blasting to the specified surface preparation cleanliness standard in an approved Shop per the requirements of this Specification.
 - b. For field surface preparation after tank erection, if required due to local air quality regulations, wind patterns or site proximity to adjacent properties or other structures, utilize wet-abrasive blasting with an approved flash rust prohibitor additive to eliminate airborne dust and coatings release.
3. Installation of a non-skid surface on portions of the reservoir roof.
4. Installation of sealant as required between the exterior foundation and steel bottom plate. See Specification Section 07 92 25, Sealants and Caulking for Steel Reservoirs.
5. Reservoir disinfection upon completion of construction.

E. Related Work Specified in Other Sections:

1. Surface preparation and application of specified coatings systems in this Section are in addition to shop-priming and surface treatment that may be specified under other sections of the Work or furnished with manufactured equipment and tank accessories.
2. Some items with factory finish or corrosion-resistant finishes may be scheduled or directed to be painted by the Owner's Representative to unify a finish or color scheme at the Owner's Representative's discretion.
3. Paint all exposed surfaces whether or not colors are designated in "Schedules", except where the natural finish of the material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas. If color or finish is not designated,

the OWNER'S REPRESENTATIVE will select these from standard colors available for the materials systems specified.

F. Exclusions:

1. Do not paint the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze and other corrosion-resistant materials (except for valve bodies and piping); multiple-coated factory-finished baked enamel or porcelain products; concealed areas such as ducts, piping, conduits and items specified elsewhere for special linings and coatings.
2. Do not paint any surfaces scheduled for special coating or waterproofing systems in other sections of the specifications.

1.2 RELATED SECTIONS

- A. Instructions to Bidders: Approved Tank Painting Contractor List
- B. Section 00 20 20 - Tank Painting Contractor SoQ Form
- C. Section 05 50 00 - Metal Fabrications
- D. Section 07 92 10 - Sealants and Caulking for Steel Reservoirs
- E. Section 33 13 13 - Water Storage Tank Disinfection
- F. Section 33 16 19 - Steel Aboveground Water Utility Storage Tanks

1.3 REFERENCE STANDARDS

A. General:

1. Without limiting the general aspects or other requirements of this Section, Work and equipment shall conform to any applicable requirements of municipal, state and federal codes, laws and ordinances governing the Work, standard specifications, and the paint manufacturer's printed instructions and guidance documentation.
2. The decision of the Owner's Representative shall be final as to the interpretation of any codes, laws, ordinances, instructions, guidance documentation, specifications and standards referenced or contained herein and the resolution of any conflicts between any documents.

B. American Water Works Association:

1. AWWA D102 - Coating Steel Water Storage Tanks.

C. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.

2. NSF/ANSI/CAN 600 - Health Effects Evaluation and Criteria for Chemicals in Drinking Water.
- D. SSPC: The Society for Protective Coatings:
1. Good Painting Practice, SSPC Painting Manual, Volume 1.
 2. Specifications and Systems, SSPC Painting Manual, Volume 2.
- E. Published standards of National Association of Corrosion Owner's Representatives (NACE) pertaining to coating and coating inspections.
- F. Code of Federal Regulations (CFR)
1. 29 CFR 1910 Occupational Safety and Health Standards (General Industry Standards)
 2. 29 CFR 1926.62, Lead in Construction

1.4 DEFINITIONS

- A. Coating Systems: Protective paint systems consisting of primer, intermediate coat(s) and finish-top coats.
- B. Exterior Surfaces: All outside surfaces of the reservoir. Exterior surfaces include the reservoir roof; the reservoir exterior shell; all exterior ladders, ladder cages, landings, platforms, and guardrails; vents; piping; roof hatches; sidewall manway access hatches; and any other exterior appurtenances and surfaces not specifically excluded by this Section or elsewhere in these Specifications to receive the specified paint system.
- C. Interior Surfaces: All surfaces contained within the inside of the reservoir which have contact with the stored fluid or the humid atmosphere above the stored fluid. Interior surfaces include the reservoir ceiling; reservoir interior shell; reservoir floor; interior ladders; overflow piping (where metal) and associated supports; the exterior of all metal piping located within the reservoir and associated supports; and any other interior surfaces not specifically excluded by this Section or elsewhere in these Specifications to receive the specified paint system.
- D. Paints: All coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or topcoat.

1.5 QUALIFICATION OF TANK PAINTING CONTRACTOR

The Contractor's attention is directed to Section 00 20 20, Tank Painting Contractor Statement of Qualifications Form of these Specifications for instructions for submitting a

Statement of Qualifications during bidding in order to become prequalified to perform steel tank painting work for this Project.

The Tank Painting Contractor shall be one of the Contractors listed in Paragraph 1.05 of Section 00 10 00 Instructions to Bidders of these Specifications. The Tank Painting Contractor shall be a company normally involved in the coating of the type of reservoir structure painting specified.

1.6 PREINSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing Work of this Section.
 - 1. To be held with the Owner, Contractor, Owner's Representative, and paint manufacturers' representative present.
 - 2. Review minimum acceptable atmospheric conditions under which the specified paint systems can be applied.
 - 3. Low and high temperature limits for application work shall be determined at the sole discretion of the Owner's Representative at this time.

1.7 PAINT AND COATING SYSTEMS MANUFACTURER

- A. Provide the paints and coatings specified herein. Paint application shall be in strict accordance with the manufacturer's printed instructions.
- B. Paint Products:
 - 1. All paint products shall be from a single manufacturer.
 - 2. No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified.
 - 3. Painting shall be done at such times as the CONTRACTOR and OWNER'S REPRESENTATIVE may agree upon in order that dust-free and neat work is achieved.
 - 4. All painting shall be in strict accordance with the manufacturer's instructions and shall be performed in a manner satisfactory to the OWNER'S REPRESENTATIVE.
- C. Manufacturer's Representative:
 - 1. Provide a paint manufacturer's representative and require paint manufacturer's representative to be at job site for a pre-job conference, when surface preparation

is underway, when the first day's painting is in progress and periodically during progress of the work.

D. Paint Labels:

1. Deliver paint to Site in the original sealed containers with manufacturer's name, product name, type of product, manufacturer's specification or catalog number or federal specification number, and instructions for reducing where applicable.

E. Paint Colors:

1. Colors will be selected from manufacturer's standard colors as reviewed by OWNER'S REPRESENTATIVE and approved by the OWNER.
2. Colors for special coatings that are limited in their availability and color selection will be chosen on the basis of manufacturer's standard colors, provided that the manufacturer's product line represents a color range comparable to similar products of other manufacturers.

1.8 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Materials List: Submit a list of materials and manufacturer's standard color chart and manufacturer's technical information including analysis and application information for each material proposed for use, federal specification number, and cross references to the specifications. Clearly identify and label each paint system with designated specification number and, within each system, identify and label the product designated for first coat and each additional coat. Submit product data/information sheets for all products proposed for use.

C. Manufacturer's Application Instructions and Surface Preparation Recommendations: Submit manufacturer's application instructions and surface preparation recommendations for use and reference at the project site.

D. Safety Data Sheets (SDS): Submit SDS's for all products proposed for use, including paint systems, solvents, thinners and mineral spirits to be used for degreasing, surface preparation and thinning of paint systems for review by the OWNER'S REPRESENTATIVE and approval by the paint manufacturer's representative. Applicable SDS's shall be kept on the Site for the entire time such products are present on the Site.

E. Certificate: Submit manufacturer's certificate of compliance with the specifications and standards signed by a representative in the manufacturer's employ who is authorized by the manufacturer to execute the certificate.

- F. Samples:
 - 1. Provide painted surface areas at the Site for approval of main color selections.
 - 2. Provide a representative sample of sand to be used for any required non-skid surfaces.
- G. Submittal Documents: Submit the above-specified materials in a single project submittal with all materials loose-leaf in 3-ring binders and an electronic copy.
- H. Field Quality-Control Submittals:
 - 1. Indicate results of Contractor-furnished tests and inspections including, but not limited to, ambient environmental conditions, surface profile measurements, DFT measurements, etc.
 - 2. Provide letters of coating application acceptance from paint and coating systems manufacturer representative.
 - 3. Provide certification letters from NACE Certified Level 2 Coating Inspector and surface preparation conformance with Specifications for any shop-coating procedures performed as may be applicable to the project.

1.9 QUALITY ASSURANCE

- A. Comply with AWWA D102.
- B. Materials in Contact with Potable Water: Certified to NSF 61.
- C. Obtain paint products from single source for Work specified in this Section.
- D. Provide all testing equipment and conduct Field Quality Control procedures as specified in Part 3 of this Section.

1.10 PAINT DELIVERY, HANDLING AND STORAGE

- A. Container Labeling: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- B. Inspection:
 - 1. Accept materials on Site in manufacturer's sealed and labeled containers.
 - 2. Inspect for damage and to verify acceptability.
- C. Store materials in ventilated area and otherwise according to manufacturer instructions.

- D. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Provide additional protection according to manufacturer instructions.

1.11 SAFETY AND HEALTH REQUIREMENTS

- A. Comply with all applicable Oregon OSHA, EPA, and DEQ regulations relating to painting/coating preparation, application and all associated activities.
- B. Conform to all applicable safety requirements set forth by manufacturer's printed instructions and applicable technical bulletins and manuals.
- C. Provide and require the use of personal protective life-saving equipment for persons working within or about the Site.
- D. Ladders, Scaffolding and Rigging:
 - 1. All ladders, scaffolding and rigging shall be designed for their intended uses.
 - 2. Ladders and scaffolding shall be erected where requested by OWNER'S REPRESENTATIVE to facilitate inspection and be moved by the CONTRACTOR to locations requested by the OWNER'S REPRESENTATIVE.
- E. Ventilation:
 - 1. Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof.
 - 2. Ventilation accomplished by educting air, vapors, and other hazardous material from the confined space shall be conducted to reduce the concentration of air contaminants to the degree a hazard does not exist.
 - 3. Forced air eduction during blast cleaning and coating application operations is mandatory.
 - 4. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- F. Protective Equipment:
 - 1. Provide for the duration of the coating/painting operations suitable personal breathing apparatus, protective clothing and safety gear for the use of the OWNER'S REPRESENTATIVE's on-site representative.

2. All such equipment shall be provided and maintained in excellent working order and shall be available at all times during painting and coating operations.
- G. Grounding: Blasting, spray and air hoses shall be grounded to prevent accumulation of charges of static electricity.
- H. Illumination:
1. Spark-proof artificial lighting shall be provided for all work in confined spaces. Light bulbs shall be guarded to prevent breakage.
 2. Lighting fixtures and flexible cords shall comply with the requirements of NFPA 70: National Electric Code for the atmosphere in which they will be used.
 3. Whenever required by the OWNER'S REPRESENTATIVE, the CONTRACTOR shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the OWNER'S REPRESENTATIVE.
- I. Solvents:
1. The solvents used with specified protective coatings may be explosive at low concentrations and may be highly toxic. Because of toxicity, the maximum allowable concentration of vapor shall be kept below the maximum safe concentration for eight-hour exposure and the lower explosive limit (LEL) must be strictly adhered to.
 2. If existing coatings or paints to be removed contain lead or other hazardous materials, all regulations related to safety of personnel and handling of such materials shall be strictly adhered to.
- J. Mixing and Application of Coatings and Paints:
1. During mixing and application of coatings and paints, all flames, welding and smoking shall be prohibited in the vicinity.
 2. When handling and mixing coatings and paints, workers shall wear gloves and eye shields.
 3. Fire extinguishers of the appropriate type shall be provided by CONTRACTOR and kept at the project site during all operations.
- K. Noise: Whenever the occupational noise exposure exceeds the maximum allowable sound levels, the CONTRACTOR shall provide and require the use of approved ear protective devices.

- L. Notification to Public: Notify all adjoining property owners within twenty-four (24) hours of any and all on-site surface preparation and/or painting activities.
- M. Dust Prevention and Control: Applicable environmental regulations for dust prevention shall be strictly enforced. Emissions from reservoir construction activities including abrasive blasting and painting shall be controlled to be within applicable environmental regulations.
 - 1. Where a reservoir may be in close proximity to existing residential, commercial, or industrial development, conduct all operations so as to confine abrasive blasting debris and paint overspray to within the bounds of the Site. Take all precautions necessary to prevent adverse off-site consequences of painting operations.
 - 2. Any complaints received by the Owner or Owner's Representative shall be delivered to the Contractor for resolution. The Contractor shall immediately halt the work and shall take whatever corrective action is required to mitigate any such problems.
 - 3. All costs associated with protection of off-site properties and/or correction of damage to property as a result of painting operations shall be borne directly by the Contractor at no additional expense to the Owner.

1.12 AMBIENT CONDITIONS

- A. Do not apply paint in rain, snow, fog or mist, or when steel surface temperature is below dew point as specified by coating manufacturer which will result in condensation.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges indicated by paint product manufacturer.
- C. Prevent rapid changes in temperature during curing and thermal shock cracks in finish material.

1.13 WARRANTY

- A. A warranty inspection will be conducted between the tenth and twelfth months following completion and acceptance of all coating and painting work. The Owner, the Owner's Representative, and the Contractor shall be present at this inspection.
- B. All defective work found in the warranty inspection shall be repaired at the sole cost of the Contractor in strict accordance with this Section and to the satisfaction of the Owner's Representative.

- C. The warranty inspection shall consist of the following:
1. The Owner shall establish the date for the inspection and shall notify the Contractor at least 30 days in advance.
 2. Interior Coating Systems:
 - a. The entire interior coating systems, as installed under this Project, shall be visually inspected.
 - b. If additional inspection is deemed necessary by the OWNER'S REPRESENTATIVE, such inspection shall be accomplished as directed in accordance with the applicable provisions of this Section.
 - c. All defective coating, as well as damaged or rusting spots of the reservoir, shall be satisfactorily repaired by and at the sole expense of the CONTRACTOR.
 - d. All repaired areas shall then be electrically tested as specified in the Field Quality Control procedures within Part 3 of this Section.
 3. Exterior Coating Systems:
 - a. The entire exterior paint system, as installed under this Project, shall be visually inspected.
 - b. If additional inspection if deemed necessary by the OWNER'S REPRESENTATIVE, such inspection shall be accomplished as directed in accordance with the application provisions of this Section.
 - c. All defective, damaged or rusting areas shall be satisfactorily repaired by and at the sole expense of the CONTRACTOR.
 4. The OWNER'S REPRESENTATIVE will prepare and deliver to the CONTRACTOR an inspection report covering the first anniversary inspection, setting forth the number and type of failures observed, the percentage of the surface area where failure has occurred, and the names of the persons making the inspection.
 5. Upon completion of inspection and receipt of the inspection report as noted herein, the OWNER shall establish a date for the CONTRACTOR to proceed with remedial work. Any delay on part of the CONTRACTOR to meet schedule established by the OWNER shall constitute breach of this Contract and OWNER may proceed to have defects remedied as outlined under the Contract.
 6. Any location where the coating or paint has peeled, bubbled, or cracked and any location where rusting is evident shall be considered to be a failure of the system. The CONTRACTOR shall make repairs at all points where failures are observed by

removing the deteriorated coating or paint, cleaning the surface, and recoating or repainting with the same system. If the area of failure exceeds 25 percent of the total coated or painted surface, the entire coating or paint system may be required to be removed and recoated or repainted in accordance with the original specification.

7. All costs for the warranty inspection and all costs for repair shall be borne by the CONTRACTOR. The CONTRACTOR shall reserve an appropriate amount for the following activities. No additional allowance will be paid by the Owner for the warranty inspection and repair.
 - a. Tank Inspection.
 - b. Coating Testing.
 - c. Coating Repair.
 - d. Tank Disinfection.
 - e. Replacement of manway gasketing.

PART 2 PRODUCTS

2.1 MATERIALS, GENERAL

A. Schedules:

1. Paint systems, surface treatments, and finishes are indicated in the "Schedules" of the contract documents or as described in this Section.
2. Prior to beginning work, the Owner's Representative will furnish color schedule for surfaces to be painted.
3. Vary undercoats slightly from color of next coat.
4. The color schedule will consist of colors as selected by the Owner and approved by the Owner's Representative and from approved submittals, at the Owner's Representative's discretion.

B. Quality:

1. Provide the best quality grade of the various types of coatings as regularly manufactured by acceptable paint materials manufacturers.
2. Materials not displaying the manufacturer's identification as a standard, best-grade product will not be acceptable.

- C. Paint Coordination:
 - 1. Provide topcoats which are compatible with prime coats used on the Project or which are compatible with existing topcoats on existing facilities.
 - 2. Review other sections of these Specifications in which prime coats are to be provided to ensure compatibility of total coatings system for various substrates.
 - 3. Upon requests from other trades, furnish information on the characteristics of finish materials proposed for use, to ensure compatible prime coats are used.
 - 4. Provide barrier coats over incompatible primers or remove the primer and re-prime as required.
 - 5. Notify the Owner's Representative in writing of any anticipated problems using specified coating systems with substrates primed by others or on existing finishes.
- D. Proprietary names used to designate colors, materials, or equipment are not intended to imply that products of the named manufacturers are required to the exclusion of equivalent products, materials, equipment and equal color ranges of other manufacturers.
- E. Federal Specifications, where used, establish the minimum acceptable quality for paint materials. Provide a written certification from the paint manufacturer that materials provided meet or exceed these minimums.
- F. Color Pigments:
 - 1. Color pigments shall be pure, non-fading, and applicable and suitable to the substrates and services indicated.
 - 2. Pigments shall be lead free.
- G. Use only thinners approved by the paint manufacturer and only within recommended limits.

2.2 SURFACE PREPARATION MATERIALS

- A. Abrasives
 - 1. Abrasives used in blast cleaning operations shall be clean, well graded, non-metallic and free of contaminants which would interfere with adhesion of the coatings to the substrate material.

2. Selection of abrasive size and type shall be based upon the type, grade and surface condition of the steel to be cleaned and on the finished surface to be produced for the subsequent paint system.
3. Blast cleaning abrasives shall meet or exceed the following minimum criteria:

<u>Description</u>	<u>Criteria</u>
Shape	Angular
Hardness (Mohr Scale)	8
Specific Gravity	3.3
Bulk Density (1lbs/cu. ft.)	110
Free Silica (% by wt.)	0

4. Blast cleaning abrasive particle size shall be that which will produce a 2.0 mil (.002 inch) anchor profile on the substrate metal or in accordance with recommendations of the manufacturers of the specified coating system to be applied, subject to approval by the OWNER'S REPRESENTATIVE.
5. Blast cleaning abrasive manufacturer:
 - a. Kleen Blast Abrasive as manufactured by Kleen Blast;
 - b. Green Diamond Abrasive as manufactured by Green Diamond Sand Products;
 - c. Or approved equal.
- B. Tool Cleaning: Hand and power tools shall be used to adequately prepare surface areas per surface preparation specifications methods specified herein.
- C. If wet-abrasive blasting is utilized for exterior field surface preparation, HoldTight 102 flash rust preventer as manufactured by HoldTight Solutions shall be utilized.

2.3 INTERIOR PAINT SYSTEMS

- A. General:
 1. Interior paint systems for wet surfaces of tanks must have been approved by the National Sanitation Foundation (NSF) under Standard 61 for indirect additives and Standard 600 for extractables.
 2. The paint systems shall conform to regulations and applicable requirements of local, State and Federal air pollution regulatory agencies.
 3. Products containing perchloroethylene will not be permitted.

- B. Interior paint system shall consist of a zinc / 100% solids epoxy (two-coat) system, as well as an intermediate stripe coat for all welds and irregular areas.
 - 1. Generally, in accordance with AWWA Standard D102, Inside Coating System No. 3 for all surfaces.
 - 2. The intent of the interior coating system specified herein is to provide a long-lasting coating system with the least amount of VOCs possible. The 100% solids epoxies specified shall not be thinned with any solvent or thinners. Special consideration shall be given to limiting as much use of any solvent on the project site as possible.
- C. Coatings and sequence of their application shall be as described below:
 - 1. Prime coat for all interior surfaces including associated appurtenances and piping:
 - a. Material: Zinc-rich urethane.
 - 1) Tnemec Series 94-H2O, Hydro Zinc.
 - 2) Approved equal.
 - b. Dry Film Thickness: 2.5 to 3.5 mils.
 - 2. Stripe coat for all interior welds and irregular surfaces:
 - a. Must be brushed or rolled, shall not be spray applied unless back brushing or rolling is to occur.
 - b. Material: Epoxy.
 - 1) Tnemec Series N140 Epoxoline
 - 2) Approved equal.
 - c. Dry Film Thickness: 3 to 5 mils.
 - 3. Finish coat for all interior surfaces:
 - a. Material: 100% solids modified polyamine epoxy.
 - 1) Tnemec Series 22 or FC22 Epoxoline
 - 2) Approved equal.
 - b. Dry Film Thickness: 20 to 30 mils.
 - c. Color shall be "White".

4. The completed finished coating system for all interior non-irregular surfaces shall be 22.5 to 33.5 mils DFT minimum. The completed finished coating system for all interior welds and irregular surfaces shall be 25.5 to 38.5 mils DFT minimum.
- D. Fast-cure versions of the paint products specified above may be substituted upon approval from the ENGINEER.
- E. The use of adding solvents or other products including VOCs for thinning interior coatings outside of the manufacturer's standard levels is expressly forbidden on this project.

2.4 EXTERIOR PAINT SYSTEMS

- A. General:
 1. Conform to the regulations and applicable requirements of local, State and Federal air pollution regulatory agencies.
- B. AWWA OCS-6 Exterior paint systems shall consist of an organic zinc /epoxy / urethane system.
- C. Coatings and sequence of their application shall be as described below:
 1. Prime Coat:
 - a. Material: Zinc-rich urethane.
 - 1) Tnemec Series 94-H₂O, Hydro Zinc, Zinc-rich urethane primer.
 - 2) Approved equal.
 - b. Dry Film Thickness: 2.5 to 3.5 mils.
 2. Intermediate Coat:
 - a. Material: Epoxy.
 - 1) Tnemec Series 27 F.C. Typoxy.
 - 2) Approved equal.
 - b. Dry Film Thickness: 3.0 to 5.0 mils.
 - c. Color: Same color as the top coat, tinted slightly for discerning between coats following application.
 3. Finish coat
 - a. Material: Polyurethane.

- 1) Tnemec Series 1095 Endura-Shield..
 - 2) Approved equal.
- b. Dry Film Thickness: 3.0 to 5.0 mils.
- c. Color: As selected by the OWNER. Confirm color with OWNER prior to ordering.
4. Finished coating system on exterior surface and appurtenances shall be between 8.5 and 13.5 mils dry film thickness.
- D. Compatible accelerators may be used as recommended by manufacturer and as approved by OWNER'S REPRESENTATIVE. All such accelerators must be produced by the same manufacturers as the paint products.
- E. Non-Skid Surface
1. Material: Natural, clean sand, free of soil, and other deleterious material, having hard, durable grains with 100 percent passing the No. 4 sieve.

2.5 MOISTURE CONTROL EQUIPMENT

- A. Moisture control equipment shall be used on Project to complete the specified interior surface preparation and coating as specified herein.
- B. Dehumidifier:
1. Design: Solid desiccant design having a single rotary desiccant bed capable of continuous operation with fully automatic operation. No liquid desiccant, granular or loose lithium chloride drying systems shall be accepted.
 2. Performance Criteria:
 - a. Continuously deliver air with a maximum relative humidity of 11%.
 - b. Supply the space with two complete air changes per hour.
 - c. Supply sufficient dry air to assure that the air adjacent to the surfaces to be abrasive blasted or coated shall not exceed 35% relative humidity at any time during the blasting, coating or curing cycle.
 - d. Capable of depressing the dew point in the space 10 degrees F below ambient air temperature within twenty minutes.

2.6 HEATING EQUIPMENT

- A. Auxiliary heaters or chillers may be necessary to maintain the surface temperature at a level acceptable to the coating manufacturer's application parameters.

- B. Coordination with Dehumidification Equipment:
 - 1. Heating equipment must be coordinated with and approved for use by the manufacturer of the dehumidification equipment.
 - 2. If is necessary to filter the air escaping the space, the filtration system must be designed to match the air volume of the dehumidification equipment in such a way that it will not interfere with the dehumidification equipment's capacity to control the space as described herein.
- C. Heating Equipment:
 - 1. Design: Only electric or indirect gas fired auxiliary heaters shall be used. No direct fired space heaters will be allowed during the blasting, coating or curing phases.
 - 2. Performance Criteria:
 - a. Equipped with controls that automatically turn the heater off if the airflow is interrupted or the internal temperature of the heater exceeds its design temperature or that of the supply duct.
 - b. Air heaters or refrigeration equipment are not acceptable as a substitute for dehumidification.

2.7 ELECTRICAL POWER AND GENERATOR REQUIREMENTS

- A. If the operating equipment is to be electrically powered by connection to the local electrical utility, the CONTRACTOR shall be responsible for all utility arrangements. The CONTRACTOR's attention is directed to the General Requirement Sections regarding temporary utilities for construction purposes.
- B. If portable electric generators are used for operating equipment, including moisture control equipment, they shall include acoustic attenuation shrouds and be strategically located on site to minimize noise impact to nearby residents.
- C. Noise Limitations:
 - 1. Maximum decibel (dB) limit: Comply with City of Pendleton ordinances for the location of the Reservoir.
 - 2. The CONTRACTOR's attention is directed to Section 01 10 00, Summary of Work, regarding noise limitations.

2.8 ACCESS MANWAY GASKETS AND HARDWARE

- A. Furnish gaskets and hardware for access manways into reservoir.

- B. Replace gaskets (and hardware if required) for access manways into reservoir which are opened during anniversary inspections.
- C. Furnish and install galvanized steel bolts, nuts, and washers. Regular hexagon-head bolts per ASTM A307, Grade A.
- D. Gaskets shall be full-face gaskets which are NSF-61 approved, molded fluoroelastomer, 1/8-inch thickness, Garlock Stress Saver XP or approved equal.
- E. Contractor to field verify all dimensions before ordering materials.

PART 3 EXECUTION

3.1 INSPECTION

- A. The CONTRACTOR, OWNER'S REPRESENTATIVE and local painting manufacturer representative shall jointly inspect surfaces to receive finishes.
 - 1. Examine surfaces scheduled to be finished prior to commencement of Work, and report conditions capable of affecting proper application.
 - 2. At the OWNER'S REPRESENTATIVE's direction, correct defects prior to application of coatings systems specified herein.
 - 3. Painting over the work of other trades does not constitute acceptance of previous work and surfaces by OWNER'S REPRESENTATIVE.

3.2 PROTECTION

- A. Cover miscellaneous tank openings, except as required for ventilation, to avoid accumulation of cleaning residue and paint material in overflows, drains, inlet and outlet piping.
- B. Exterior Tank:
 - 1. Cover tank vents without sealing tight to prevent contamination of tank interior.
 - 2. Maintain ventilation of tank interior.
- C. Protect equipment from abrasion and paint damage.
- D. Cleaning and painting tank exterior after tank is filled is not permitted.

3.3 POST-FABRICATION AND ERECTION CUT-OUTS

- A. One cut-out of the reservoir shell will be allowed for the temporary purpose of moving equipment into or out of the steel tank structure.
 - 1. Cut-outs shall be accommodated by cutting out and re-welding an entire full-height fabricated steel shell panel section at the shell pattern layout seams.
 - 2. Special cut-outs within a fabricated steel panel will not be allowed.
 - 3. The Contractor shall provide design and installation of temporary bracing or stiffening as may be required to accommodate the cut-out.
- B. The intent of this specification is to preserve the aesthetic appearance of existing symmetrical and uniform fabricated panel layouts and weld seams. It is not the intent of this specification to restrict the CONTRACTOR installing or removing equipment into or from the structure.
- C. The cut-out shall be located in a location approved by the OWNER.

3.4 SURFACE PREPARATION

- A. General:
 - 1. Unless specified otherwise herein, all surface preparation, coating and paint application shall conform to applicable standards:
 - a. The Society for Protective Coatings (SSPC).
 - 1) All painting work shall be conducted in accordance with SSPC Painting Manual, Volume 1 - Good Painting Practices.
 - b. American Water Works Association (AWWA).
 - c. Manufacturer's printed instruction.
 - 2. Skilled Craftsmen:
 - a. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice.
 - b. Continuity of personnel shall be maintained, and transfers of key personnel shall be coordinated with the Owner's Representative.

3. Supervisor:
 - a. Provide a supervisor to be at the Site during surface preparation, paint coatings application and disinfection operations.
 - b. Supervisor shall have the authority to sign change orders, coordinate work and make other decisions pertaining to the fulfillment of the work requirements.
4. Rolling Scaffolds:
 - a. Blast cleaning from rolling scaffolds shall only be performed within the confines of the interior perimeter of scaffolds.
 - b. Reaching beyond the limits of the perimeter will be allowed only if the blast nozzle is maintained in a position which will produce a profile acceptable to Owner's Representative.
5. Slag and weld metal accumulation and spatters not previously removed by others including the fabricator, erector or installer shall be removed by chipping and grinding. All sharp edges shall be peened, ground or otherwise blunted.
6. Evaluation:
 - a. Surface evaluated before and after preparation will be based upon comparison with:
 - 1) SSPC-VIS 1, Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
 - 2) SSPC-VIS 2, Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces.
 - 3) SSPC-VIS 3, Guide and Reference Photographs for Steel Surfaces Prepared by Power- and Hand-Tool Cleaning.
 - 4) SSPC-VIS 4, Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting.
 - 5) SSPC-VIS 5, Guide and Reference Photographs for Steel Surfaces Prepared by Wet Abrasive Blast Cleaning.
 - 6) ASTM D610, Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces.
 - 7) ASTM D2200, Standard Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces.

- b. Anchor Profile: Anchor profile for prepared surfaces shall be measured by using a non-destructive testing instrument such as a Keane-Tator Surface Profile Comparator or Testex Press-O-Film System to be provided by the CONTRACTOR.
7. The latest revision of the following surface preparation specifications of The Society for Protective Coatings (SSPC) shall form a part of this Specification:
- a. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, dirt, soil, salts and contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
 - b. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mill scale, and loose paint to degree specified, by hand chipping, scraping, sanding, and wire brushing.
 - c. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mill scale, and loose paint to degree specified, by power tool chipping, descaling, sanding, wire brushing or wire impact tools, and grinding.
 - d. White Metal Blast Cleaning (SSPC-SP5): Removal of all visible rust, mill scale, paint and foreign matter by blast cleaning by wheel or nozzle (dry or wet) using sand, grit, or shot.
 - e. Commercial Blast Cleaning (SSPC-SP6): Removal of all visible rust, mill scale, paint and foreign matter by blast cleaning. Staining is permitted on no more than 33% of each 9 in² area of the cleaned surface.
 - f. Brush-off Blast Cleaning (SSPC-SP7): Blast cleaning of all except tightly adhering residues of mill scale, rust, and coatings, while uniformly roughening the surface.
 - g. Pickling (SSPC-SP8): Complete removal of rust and mill scale by acid pickling, duplex pickling, or electrolytic pickling.
 - h. Near-White Blast Cleaning (SSPC-SP10): Removal of all visible rust, mill scale, paint and foreign matter by blast cleaning. Staining is permitted on no more than 5% of each 9 in² area of the cleaned surface.
 - i. Power Tool Cleaning to Bare Metal (SSPC-SP11): Complete removal of all rust, scale, and paint by power tools, with resultant minimum surface profile of 25 μ m (1 mil).
 - j. Industrial Blast Cleaning (SSPC-SP14): Between SP 7 (brush-off blast cleaning) and SP 6 (commercial blast cleaning). The intent is to remove as much coating as possible, but tightly adherent rust, mill scale, and coating can remain on 10% of each 9 in² area of the cleaned surface.

- k. Commercial Grade Power Tool Cleaning (SSPC-SP15): Between SP 3 (power tool cleaning) and SP 11 (power tool cleaning to bare metal). Removes all rust and paint but allows for random staining on up to 33% of each 9 in² area of the cleaned surface; requires a minimum surface profile of 25 µm (1 mil).
 - l. Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals (SSPC-SP16): Requirements for removing loose contaminants and coating from coated and uncoated galvanized steel, stainless steels, and non-ferrous metals. Requires a minimum 19 µm (0.75 mil) surface profile on bare metal substrate.
 - m. Waterjet Cleaning of Metals – Clean to Bare Substrate (SP WJ-1): Cleanest waterjetting level, requires the cleaned metal to be free of all visible oil, grease, dirt, rust and other corrosion products, previous coatings, mill scale, and foreign matter.
 - n. Waterjet Cleaning of Metals – Very Thorough Cleaning (SP WJ-2): Requires the cleaned metal surface to be free of all visible oil, grease, dirt, rust and other corrosion products, except for randomly dispersed stains of rust and other corrosion products, tightly adherent thin coatings, and other tightly adherent foreign matter previous coatings, mill scale, and foreign matter over no more than 5% of each 9 in² area of the cleaned surface.
 - o. Waterjet Cleaning of Metals – Thorough Cleaning (SP WJ-3): Requires removal of all visible contaminants as in WJ-2 above. Randomly dispersed staining as described in WJ-2 is limited to no more than 33% of each 9 in² area of the cleaned surface.
 - p. Waterjet Cleaning of Metals – Light Cleaning (SP WJ-4): Requires removal of all visible oil, grease, dirt, dust, loose mill scale, loose rust and other corrosion products, and loose coating. Any residual material shall be tightly adhered to the metal substrate.
8. All welds, when required, shall be neutralized with a suitable chemical compatible with the specified coating or paint materials.
9. Keep the area of Work in a clean condition.
- a. Do not permit blasting materials to accumulate so as to constitute a nuisance or hazard to the prosecution of Work or the operation of the existing facilities.
 - b. Spent abrasives and other debris shall be removed at the CONTRACTOR's expense as directed by the OWNER'S REPRESENTATIVE.

- c. If waste is determined to be hazardous, disposal by the CONTRACTOR shall meet requirements of all regulatory agencies for handling and disposing of such wastes as noted elsewhere in this Section.

10. Remove residue from surface preparation before paint application is begun.

- a. Blast-cleaned surfaces shall be cleaned prior to application of specified coatings or paints through a combination of blowing with clean dry air, brushing/brooming and/or vacuuming as directed by the OWNER'S REPRESENTATIVE.
- b. Air hoses for blowing shall be at least ½-inch in diameter and shall be equipped with a shut-off device.

11. Any surfaces not coated/painted the same day they are prepared to receive the specified paint systems shall be re-prepared prior to coating/painting, unless the OWNER'S REPRESENTATIVE-approved moisture control equipment is used by the CONTRACTOR to maintain conditions that allow extended blasting schedules prior to application of prime coats.

B. Surface Preparation, Interior Surfaces

- 1. Prepare all interior surfaces of the reservoir and associated interior structures according to SSPC-SP 5, White Metal Blast Cleaning.
- 2. Anchor profile shall be measured as described elsewhere in this Section.
- 3. Following blast cleaning and prior to painting, the following additional operations shall be performed:
 - a. Material Removal: Remove spent abrasives and existing coating waste material from all blasted surfaces. This shall be accomplished by blowing off all blasted surfaces with clean, dry air and vacuum cleaning or brooming/sweeping of all waste material.
 - b. Remove or cause to be removed all traces of rust bloom or deposits of oil, grease, or other contaminants which become visible prior to application of the prime coat.
- 4. Humidity and Temperature Control
 - a. General: Humidity and temperature control, when specified and required elsewhere in this Section for interior spaces, shall be provided using appropriate specialized equipment.
 - b. Dehumidification: Dehumidification equipment shall be used to control the environment in the space on a continuous basis 24 hours a day during blast

cleaning, coating and coating curing unless otherwise approved by OWNER'S REPRESENTATIVE.

- c. Heating Equipment: Auxiliary heaters or chillers may be necessary to maintain the surface temperature at a level acceptable to the coating manufacturer's application parameters.
 - 1) Heaters and coolers shall be installed in the process air supply duct between the dehumidifier and the space as close to the space as possible.
 - 2) The space to be controlled shall be sealed off as well as possible allowing air to escape at the bottom of the space away from the point where the dehumidified air is being introduced.
 - 3) Maintain a slight positive pressure in the space unless the dust from the blasting operation is hazardous.
 - 4) Do not recirculate the air from the space or from filtration equipment back through the dehumidifier when coating or solvent vapors are present.

C. Surface Preparation, Exterior Surfaces

- 1. Prepare all exterior surfaces of the reservoir and associated exterior structures according to SSPC-SP 10, Near-White Metal Blast.
- 2. Utilize wet-abrasive blasting for exterior field surface preparation to contain blast residue without erection of containment if project site and local air quality regulations require.

3.5 APPLICATION

A. General:

- 1. According to SSPC Paint Application Specification PA 1 – Shop, Field and Maintenance Painting, latest revision.
- 2. Printed literature of the manufacturer of the coating and paint materials.
- 3. As further specified within this Section.

B. Ventilation: Provide for adequately ventilated enclosed rooms and spaces during painting and curing periods.

C. Thickness:

- 1. Apply coatings in strict conformance with the manufacturer's application instructions.

2. Apply each coat at the rate specified by the manufacturer to achieve the dry mil thickness specified.
 3. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material.
 4. Correct any apparent deficiencies of film thickness by the application of an additional coat.
- D. Thinning:
1. Do not thin pain unless approved by the OWNER'S REPRESENTATIVE.
 2. Only use thinner recommended by paint manufacturer which has been determined to be compatible with specified coating system.
 3. Thin paint in accordance with the manufacturer's directions.
- E. Application:
1. Each application of coatings shall be applied evenly, free of brush marks, sags, runs and no evidence of poor workmanship.
 2. Care shall be exercised to avoid lapping on glass or hardware.
 3. Coatings shall be sharply cut to lines.
 4. Finished surfaces shall be free from defects or blemishes.
- F. Interior Coatings: By airless spray application, except where back rolling or striping is performed.
- G. Exterior Paint Application: By roller only.
1. Brushing may be used to repair paint in areas of steel modifications.
 2. Spray application will not be allowed.
- H. Brush Coats:
1. All welds, laps, edges, inside angles, and irregular surfaces shall receive a brush coat of the specified product prior to application of each complete coat.
 2. Paint may be applied as a spray stripe coat and back brushed by hand.
 3. Coatings shall be brushed in multiple directions to insure penetration and coverage, as directed by the OWNER'S REPRESENTATIVE.

- I. Non-Skid Surfaces: Applied after the full prime coat has cured.
 - 1. A non-skid surface shall be applied to a 3-foot-wide strip around the roof vent at the tank center.
 - 2. Application:
 - a. Broadcast over a wet coat of the finish topcoat specified herein.
 - b. Following curing of coating/sand mixture, non-skid surface area shall be top coated with the same finish coating.
- J. At conclusion of each day's cleaning and coating operations, a 6-inch wide strip of cleaned substrate shall remain uncoated to facilitate locating the point of origin for each successive day's cleaning operations.
- K. Curing Time:
 - 1. Do not apply the next coat of paint until each coat is dry.
 - 2. Test non-metallic surfaces with a moisture meter.
 - 3. The manufacturer's recommended curing time shall mean an interval under normal conditions that is to be increased to allow for adverse weather or curing conditions.
 - 4. Paint manufacturer's representative shall verify by cure testing the complete cure of coatings systems used for immersion service.
- L. Attachments, Accessories and Appurtenance: All attachments, accessories, and appurtenances shall be prepared and coated in the same manner as specified for adjacent structures, unless otherwise specified elsewhere in this Section or other sections of the Specifications.
- M. Protection of Coated Surfaces:
 - 1. Protective coverings or drop cloths shall be used to protect floors, fixtures, equipment, prepared surface and applied coatings.
 - 2. Personnel entering the reservoir or walking on the exterior roof of the reservoir shall take precautions to prevent damage or contamination of coated surfaces.
 - 3. Care shall be exercised to prevent coatings from being spattered onto surfaces which are not to be coated.
 - 4. Surfaces from which such material cannot be removed satisfactorily shall be repainted as required to produce a finish satisfactory to the OWNER'S REPRESENTATIVE.

- N. Atmospheric Conditions: No coatings shall be applied under the following limitations:
1. Temperature: If temperatures are anticipated to be as noted below within eight hours after application of the coating.
 - a. Epoxy Coatings: Surface to be coated is below 55 degrees F. Exceptions may be approved by OWNER'S REPRESENTATIVE with concurrence from manufacturer if material is "low temperature" type.
 - b. Inorganic Zinc or Urethane Finishes: Surface to be coated is below 40 degrees F.
 - c. When the temperature is less than 5 degrees F above the dew point.
 - 1) The dew point shall be measured by use of an instrument such as a sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables or other instrument acceptable to the OWNER'S REPRESENTATIVE.
 - d. When the temperature of the surface to be coated is above 125 degrees F for all coating types.
 2. Surfaces: When the surfaces to be coated are wet or damp or there is the presence of rain, snow, fog or mist.
 3. If any of the above adverse conditions are present, the coating or paint application shall be postponed until conditions are favorable. The day's coating or paint application shall be completed in time to permit the film sufficient drying time prior to the onset of adverse atmospheric conditions.

3.6 SHOP QUALITY CONTROL

- A. Quality assurance procedures and practices shall be used to monitor all phases of surface preparation, application and inspection of all shop coating performed as part of this project. A NACE Certified Level 2 Coating Inspector shall oversee all shop coating performed and provide the OWNER'S REPRESENTATIVE with written reports on a form approved by the OWNER'S REPRESENTATIVE prior to work being performed.
- B. For new reservoir construction, the application of permanent shop-applied primers will be allowed for exterior surfaces of the reservoir provided that a NACE Certified Level 2 Coating Inspector observes the procedures and provides written reports certifying all work to be in conformance with these Specifications.
- C. Unless approved by the Owner's Representative at the request of the Contractor, the application of permanent shop-applied primers will not be allowed for interior surfaces of the reservoir.

- D. Procedures or practices not specifically defined herein may be used provided they meet recognized and acceptable professional standards and are approved by the OWNER'S REPRESENTATIVE.
- E. All materials furnished and all work performed shall be subject to inspection by the Owner's Representative. The Contractor shall be held strictly to the true intent of the Specifications in regard to quality of materials, workmanship, and diligent execution of the work.
- F. The following procedures shall be followed by the Contractor in the handling of shop-primed steel:
 - 1. Curing: Upon completion of blasting and priming operations, primer on fabricated steel shall be cured sufficiently to minimize damage during handling.
 - 2. Separation of Steel: When fabricated steel is transported, spacers and other protection shall be used to separate members to eliminate primer from being pulled off during unloading operations. If wood spacers are used, no splinters or wood particles shall remain in primed surfaces after separation.
 - 3. Cover of Steel during Transit: Shop-primed fabricated steel shall be covered 100% to prevent deposition of road salts, fuel residue and other contaminants which may be present along the route of shipment to jobsite.
 - 4. Load Binders: Loaded steel must be bound with padded chains or ribbon binders to minimize damage to coatings during shipment.
 - 5. Handling: Care shall be used during loading, unloading, storage and erection operations to minimize damage to primed steel. Sliding of steel across another member shall not be permitted, except for fitting members into position during assembly.
 - 6. Storage: Primed fabricated steel at jobsite shall not be placed on ground or on top of other steel work unless ground or steel work is covered with an approved covering. Approved spacers shall be used to elevate steel above ground level or other steel members.

3.7 FIELD QUALITY CONTROL

- A. Quality assurance procedures and practices shall be used to monitor all phases of surface preparation, application and inspection throughout the duration of the Project. Procedures or practices not specifically defined herein may be used provided they meet recognized and acceptable professional standards and are approved by the OWNER'S REPRESENTATIVE.

- B. All materials furnished and all work performed shall be subject to inspection by the Owner's Representative. The Contractor shall be held strictly to the true intent of the Specifications in regard to quality of materials, workmanship, and diligent execution of the work.
- C. Field Inspection: Contractor shall notify Owner's Representative when painting work is to be in progress in time for Owner's Representative to check atmospheric conditions, surface preparation, mixing and thinning procedures, materials and thicknesses with wet film thickness gauge at frequent intervals and varied locations during the course of painting work.
- D. The Owner's Representative will make, or arrange to have made by others, such tests as may be deemed necessary to assure the Work is being accomplished in accordance with the requirements of the specifications.
 - 1. Unless otherwise specified, the cost of such testing will be borne by the Owner.
 - 2. In the event such tests reveal non-compliance, the Contractor shall bear the cost of such corrective measures deemed necessary by the Owner's Representative, as well as the cost of retesting.
 - 3. It is understood and agreed that the performance of tests by the Owner's Representative shall not constitute an acceptance of any portion of the Work, nor relieve the Contractor from compliance with the project requirements.
- E. Testing Instruments:
 - 1. Provide all inspection devices in good working condition.
 - 2. Inspection devices shall be operated by, or in the presence of the OWNER'S REPRESENTATIVE with the location and the frequency basis of testing as determined by the OWNER'S REPRESENTATIVE.
 - 3. Provide all instruments required for testing atmospheric conditions and shall, during painting/coating operations, perform all measurements in the presence of the OWNER'S REPRESENTATIVE.
 - a. As a minimum, measure and record temperature, relative humidity and dew point daily prior to beginning any painting/coating operations and again at mid-day.
 - b. Measurement records shall be maintained by the CONTRACTOR on forms approved by the OWNER'S REPRESENTATIVE.

4. Provide all instruments required for detection of holidays and measurement of dry-film thickness of coatings and paints.
 - a. Holiday detectors and dry film thickness gauges shall be available at all times until final acceptance of painting/coating application.
 - b. Inspection devices shall be operated in accordance with the manufacturer's instructions.
 - c. Holiday Detectors: Acceptable devices for ferrous metal surfaces include, but are not limited to, Tinker & Razor Models AP and AP/W holiday detectors or other units approved by the OWNER'S REPRESENTATIVE.
 - d. Dry Film Thickness Gauges: DeFelsko Positest (Type 1), DeFelsko Positector 6000 (Type 2), or other units approved by the OWNER'S REPRESENTATIVE.
 5. Provide U.S. Department of Commerce, National Bureau of Standards certified thickness calibration plates to test the accuracy of thickness gauges.
 6. The OWNER'S REPRESENTATIVE is not precluded from furnishing its own inspection devices and rendering decisions based solely upon its tests.
- F. Thickness of Coatings:
1. Thickness of coatings and paint shall be checked with a non-destructive, magnetic-type thickness gauge.
 2. Destructive Testing: An instrument such as a Tooke Gage shall be used if a destructive tester is deemed necessary.
 3. The coating integrity of all coated surfaces shall be tested with an approved inspection device.
 4. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations, and retested.
 5. No pinholes or other irregularities will be permitted in the final coating.
- G. Wet Film Thickness: Use wet film thickness gauges to ensure proper application rates to prevent over-thick coatings and curing difficulties.
- H. Additional Coats: Provide additional coats of paint at no additional cost to the OWNER when mil thicknesses specified have not been obtained as determined by either dry or wet film thickness testing specified herein.

- I. Painting Equipment:
 - 1. Coating and painting equipment shall be designed for the proper application of the materials specified and shall be maintained in first class working condition.
 - 2. Compressors shall have suitable traps and filters to remove water and oils from the air.
 - 3. Blotter tests shall be performed at each start-up period and as deemed necessary by the OWNER'S REPRESENTATIVE.
 - 4. Equipment shall be subject to approval of the OWNER'S REPRESENTATIVE.
- J. Moisture Control Equipment: Employ to maintain conditions within the reservoir interior which allow extended blasting and painting schedules.
- K. Painting/Coating Manufacturer's Representative:
 - 1. Services of the paint/coating manufacturer's representative shall be provided at no additional expense to the OWNER.
 - 2. Reporting from the paint manufacturer's representative shall not preclude the OWNER'S REPRESENTATIVE from making independent assessments of the quality of Work. The OWNER'S REPRESENTATIVE will make the final decision as to the acceptability of the paint/coating systems.
 - 3. Responsibilities:
 - a. Make periodic site visits throughout the course of the surface preparation and the painting/coating application.
 - b. Schedule all site visits with the OWNER'S REPRESENTATIVE.
 - c. Minimum Site Visits:
 - 1) Inspect typical shop and field steel preparation prior to primer applications.
 - 2) Inspect finished primer applications prior to application of intermediate coats.
 - 3) Inspect each intermediate coat prior to application of subsequent finish coats.
 - 4) Inspect final coats and report to the OWNER'S REPRESENTATIVE the representative's assessment of the paint system's suitability and acceptability for the intended service.

- d. Prepare and submit written reports directly to the OWNER'S REPRESENTATIVE immediately following each site visit.
 - 1) Reports shall identify the representative's observations relative to the quality of the surface preparation and painting/coating work.
 - 2) Reports shall address any conditions observed which have the potential to adversely impact the finished painting/coating system's integrity and performance.
- e. Any such findings shall be immediately remedied by the CONTRACTOR.
- L. Damaged Factory Finishes: If directed by the OWNER'S REPRESENTATIVE, refinish the entire exposed surfaces of factory-finished equipment that is chipped, scratched or otherwise damaged in shipment or installation

3.8 CLEANUP

- A. Remove all staging, scaffolding, ladders and containers shall be removed from the Site.
- B. Remove temporary heating and ventilating facilities.
- C. Coating or paint spots upon adjacent surfaces shall be removed and the entire Site cleaned.
- D. All damage to surfaces resulting from the work of this Section shall be cleaned, repaired or refinished to the complete satisfaction of the OWNER'S REPRESENTATIVE at no cost to the OWNER.
- E. Allow a minimum of seven days at 70°F curing after application of the final coat to the tank interior before flushing, sterilizing or filling with water.
 - 1. Utilize a recording or high/low-indicating thermometer and paint manufacturer's reference charts to determine actual cure time of products.
 - 2. Prior to disinfection, demonstrate complete curing to OWNER'S REPRESENTATIVE and paint manufacturer's representative.
 - 3. Use forced ventilation during approved work days and hours identified elsewhere in this Section to assist curing.
- F. Disinfect the tank interior according to Section 33 13 13 Water Storage Tank Disinfection.

3.9 COLLECTION, MONITORING AND DISPOSAL OF REGULATED WASTES

- A. Unless otherwise indicated on the Plans or in the Specifications, all abrasive blasting material and byproducts, paints, solvents and containers and any other discarded materials or equipment shall remain the property of the CONTRACTOR and shall be disposed of in a manner compliant with applicable Federal, State and local laws and regulations governing disposal of all wastes generated by the CONTRACTOR in the prosecution of this work.

3.10 WATER SAMPLING VOC REQUIREMENTS FOLLOWING DISINFECTION AND FILLING

- A. Meet the health effects requirements of NSF/ANSI/CAN 600 according to the requirements of NSF/ANSI/CAN 61:

Compound	Criteria in ppb (TAC / SPAC)
Benzo(a)pyrene	0.04 / 0.004
Perfluorooctanoic acid (PFOA) & Perfluorooctanesulfonic acid (PFOS)	0.07 / 0.007 (Total)
Triphenylphosphine Oxide	1 / 0.1
Total Xylenes	90 / 9
Toluene	60 / 6
Ethylbenzene	140 / 14

END OF SECTION

SECTION 10 14 10
IDENTIFYING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers the work necessary to furnish and install, complete, identifying devices for the Project.
- B. Section includes:
 - 1. Process pipe color coding and labeling.
 - 2. Process equipment nameplates.
 - 3. Door and warning signs.

1.2 RELATED SECTIONS:

- A. Section 40 05 13 - Common Work Results for Process Piping.

1.3 STANDARDS, SPECIFICATIONS AND CODES

- A. All safety related signs, markers, labeling and symbols shall conform to the applicable provisions or codes of the Occupational Safety and Health Administration (OSHA), unless specifically modified hereinafter.
- B. All signage providing emergency information or general circulation directions, or identifies rooms for the physically handicapped, shall comply with the requirements of the latest edition of American National Standards Institute (ANSI A117.1).

1.4 SUBMITTALS

- A. In accordance with Section 01 33 00, Submittal Procedures.
- B. Manufacturer's Data - Specifications and installation instructions for each type of sign required.
- C. Samples - Submit three full size samples of each color and finish of pipe labeling, process equipment nameplates and warning signs with sample letters.
 - 1. Owner's Representative's review of samples will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

2. Submit samples of any other special identifying or signing provided for elsewhere in this specification.

PART 2 PRODUCTS

2.1 PIPE LABELING AND COLORS

- A. Unless noted otherwise on the Drawings or specified differently hereinafter, pipe labeling, and colors shall conform to the following schedule:

<u>Service</u>	<u>Symbol (label)</u>	<u>Symbol Color (label)</u>	<u>Pipe Color</u>
Plant Water/Potable Water/Well Water	PW	White	Blue
Domestic Water (Cold/Hot)	--	White	Blue
Chlorine Solution	CS	Black	Yellow
Drains	D	White	Gray
Vents	V	Black	Green
Misc. Piping	As directed by the Owner's Representative	As directed by the Owner's Representative	As directed by the Owner's Representative

- B. Pipe identification labels and flow direction arrows shall consist of lettering and symbols applied over the pipe base color.
- C. Coating systems and surface preparation requirements used in color coding piping and lettering and flow arrows shall be as specified in Section 09 90 00, Painting and Coating.

2.2 PROCESS EQUIPMENT NAMEPLATES

- A. Nameplates shall be used to identify all process equipment including but not limited to pumps, chlorinators, control panels and any other equipment requiring identification as directed by the Owner's Representative.
- B. Fabricated from 1/16-inch thick satin-surfaced Setonply, all edges beveled neatly.
- C. Furnish with drilled holes for mounting to the appropriate equipment or nearest adjacent surface. As an alternative, acceptable adhesive attachment methods may be used if approved by the Owner's Representative.
- D. Nameplate background color, lettering color and wording shall be as directed by the Owner's Representative and approved by the Owner.
- E. Minimum Size: 4-inch x 1 1/2-inch.

- F. Manufacturer: Seton Nameplate Company, New Haven, CT, Style 2060-40 or approved equal.

PART 3 EXECUTION

3.1 PIPE LABELS AND FLOW DIRECTION ARROWS

- A. Location: At all connections to equipment, valves, branching fittings, at wall boundaries and at intervals along the piping not greater than 5 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe. Exposed piping not normally in view, such as behind ceilings and in closets and cabinets, shall also be labeled.
- B. Labels shall not be applied to the pipe until all pipe painting is complete or as approved by the Owner's Representative.
- C. Application: By stencil over pipe base color. Base coat shall be cured, clean and dry, prior to application of lettering.
- D. Lettering sizes for pipe labels shall be in accordance with ANSI A13.1, Table 3, and based upon the outside diameter of the pipe to which they are applied.
- E. Stripes on solution pipe shall be applied at intervals along the piping not greater than 5 feet on center with at least one stripe applied to each exposed horizontal and vertical run of pipe.

3.2 PROCESS EQUIPMENT NAMEPLATES

- A. Location: As directed by the Owner's Representative.
- B. Mounting of process equipment nameplates shall be in accordance with the manufacturer's instructions, and as directed by the Owner's Representative.

END OF SECTION

SECTION 10 44 16
FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 SUMMARY

- A. Work under this Section includes requirements to furnish and install, complete, portable fire extinguishers.
- B. Section includes:
 - 1. Fire extinguishers.

1.2 SUBMITTALS

- A. Manufacturer, catalog data for each item including certifications and mounting information.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in manufacturer's original, unopened protective packaging.
- B. Store and handle products in accordance with manufacturer's instructions to protect them from damage.

PART 2 PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

- A. General
 - 1. All Extinguishers:
 - a. UL listing.
 - b. Charged and ready for service
 - 2. Provide heavy-duty brackets with clip-together strap for wall mounting.
 - 3. Manufacturers: Products of the following, or equal, meeting these Specifications, may be used on this Project:
 - a. Amerex Corp.
 - b. Ansul Co.
 - c. General Fire Extinguishing Corp.

- d. J.L. Manufacturing Co.
- e. Kiddle Belleville
- f. Larsen's Manufacturing Co.
- g. Modern Metal Products
- h. Potter-Roemer, Inc.
- i. W.D. Allen Manufacturing Co.

B. Multi-Purpose Hand Extinguisher (F. Ext-1)

- 1. Tri-class dry chemical extinguishing agent.
- 2. Pressurized, red enameled steel shell cylinder.
- 3. Activated by top squeeze handle.
- 4. Agent propelled through hose or opening at top of unit.
- 5. For use on A, B, and C class fires.
- 6. Minimum UL Rating: 4A-60B:C, 10-pound (4.5 kg) capacity.

PART 3 EXECUTION

3.1 INSTALLATION

A. Portable Fire Extinguishers

- 1. Provide at locations shown on Drawings.
- 2. Mount hangers securely in position, in accordance with manufacturer's recommendations.
- 3. Top of Extinguisher: No more than 5 feet (1.5 m) above the floor.

END OF SECTION

SECTION 11 81 29

FACILITY FALL PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work to furnish and install fall prevention systems at each fixed ladder as shown on the Drawings and as required to meet all safety and occupational code requirements.
- B. The requirements of the Drawings and all other sections and provisions of the specifications are applicable to the work to be performed under this Section.
- C. Section includes:
 - 1. Flexible cable ladder safety systems.

1.2 RELATED REQUIREMENTS:

- A. Section 33 16 13.13 - Steel Aboveground Water Utility Storage Tanks.

1.3 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI):
 - 1. ANSI ASC A14.3-2008 - American Nation Standards for Ladders - Fixed - Safety Requirements.

1.4 QUALITY ASSURANCE

- A. Comply with local, state and federal requirements of Occupational Safety and Health Administration (OSHA) regulations and all applicable codes and standards.
- B. Install according to manufacturer's instructions.
- C. Provide all system components from a single manufacturer that will assure compatibility of all components.

PART 2 PRODUCTS

2.1 FALL PREVENTION SYSTEM

- A. Fall prevention system shall be a flexible cable ladder system which includes cable, trolley, safety belt or harness, and all mounting, installation and alignment hardware

and other accessories as may be necessary to provide a complete and operational system.

- B. A pivot dismount section or removable extension shall be provided at locations shown on the Drawings.
 - 1. The pivot dismount section shall allow a person to step off the ladder and onto the adjacent surface prior to unclipping from the cable.
 - 2. Provide removable extensions where openings include access hatches.
- C. Fall prevention cables, mounting hardware and appurtenances shall be 304 stainless steel.
- D. Neoprene rubber bushing shall be provided at all ladder rung connections to prevent damage to coatings. NSF-61 approved rubber materials shall be installed at all connections inside of the potable water reservoirs.
- E. Manufacturer: Fall prevention system to be LAD-SAF by DBI-SALA (Capital Safety) or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fall prevention system according to manufacturer's instructions.
- B. Provide at least four safety belts or harness assemblies and trolley sleeves.
- C. Provide a copy of fall prevention system operation instructions.

END OF SECTION

SECTION 21 22 00 – CLEAN AGENT FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section addresses Clean Agent Fire Suppression Systems.
- B. The Fire Suppression System shall be arranged to adequately protect extents of each location specified in the event of fire.
- C. The Fire Suppression System arrangement shall take into consideration and provide for such adjustment as may be required to avoid interference with the separately specified piping, conduit, and equipment as indicated in the Contract Documents as amended herein.

1.2 REFERENCE STANDARDS

- A. Factory Mutual Global (FM)
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 30 Flammable and Combustible Liquids Code
 - 2. NFPA 72 National Fire Alarm and Signaling Code
 - 3. NFPA 497 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
 - 4. NFPA 499 Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas
 - 5. NFPA 820 Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- C. Underwriters Laboratories, Inc.

1.3 SUBMITTALS

- A. The following information shall be provided in accordance with Section 01 33 00:
 - 1. Provide design calculations for all systems, including hazard information, volumes and concentrations, configuration, model size, design and other items required by the referenced standards and local Fire Authority requirements.

2. Provide dimensions, weights and technical data for all assemblies, components, mounting, and bracing.
3. Provide an equipment list.
4. Installation drawings:
 - a. Submit the following prior to beginning installation:
 - 1) Installation drawings
 - 2) Calculation report
 - 3) Owner's manual
 - 4) Product data sheets
5. Upon completion of installation and testing acceptance, submit the following:
 - a. As-built installation drawings

1.4 REGULATORY SUBMITTALS

- A. Following the approval of the submittal but prior to commencement of the Work, the following shall be submitted to the Local Fire Authority and the OWNER's insurance agent:
 1. Fire Suppression System design drawings
 2. Materials and equipment lists, including manufacturer's data and cut sheets
- B. Upon completion of the WORK, the CONTRACTOR shall provide a letter of acceptance for the completed systems from the Local Fire Authority.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. An experienced installer with a minimum of 5 years fire protection system installation experience who is an authorized representative of the manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications:
 1. A firm with a minimum of five years' experience in manufacturing systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Drawings:
 1. The Contract Drawings do not depict the design location of fire suppression equipment. These locations should be identified to conform to the applicable

codes. There is no intent by the OWNER to provide design for any portion of the fire protection systems except for the location of the service entry.

2. Source Limitations:

- a. Obtain fire protection system components through one source from a single manufacturer.

1.6 MATERIAL DELIVERY, STORAGE, AND INSPECTION

A. Inspection

1. Accept materials on Site in manufacturer's original packaging and inspect for damage.
2. All materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition.

B. Storage:

1. Store materials according to manufacturer instructions.
2. Store materials off the ground, to provide protection against oxidation caused by ground contact.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
3. Provide additional protection according to manufacturer instructions.

D. All defective or damaged materials shall be replaced with new materials.

1.7 REGULATORY APPROVALS

A. The fire protection system shall have listing and/or approval from the following nationally recognized agencies:

1. UL - Underwriters Laboratories Inc.
2. FM - Factory Mutual

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. General:

1. This article covers the fire suppression systems to be designed, furnished, and installed under these specifications.
 - a. The CONTRACTOR shall furnish complete fire suppression systems, including all fire suppressing equipment, heat and smoke detecting devices, fittings, supports, alarms, controls, wiring, conduit, and instrumentation as required for complete systems. Each system shall be designed to provide the required protection for the room and area to be protected.
 - b. All material shall be suitable for a service life of not less than 20 years in the service environment.

- #### B. Supports shall be made of ferrous materials, unless otherwise approved, and shall be FM listed.

2.2 CLEAN AGENT FIRE SUPPRESSION SYSTEMS

A. General Requirements:

1. Design, install and test the system in accordance with relevant sections of NFPA 2001.
2. Systems shall be triggered by smoke, heat, or manual actuation.
3. As a minimum, the system design concentration shall be no greater than the No Observed Adverse Effect Level (NOAEL) as specified in NFPA 2001.
4. The systems shall be complete in every respect, including all mechanical and electrical installation, all detection and control equipment, agent storage containers, proper quantity of clean agent fluid, nozzles, fittings and supports, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, alarm interface, caution/advisory signs, functional checkout and testing, training and all other operations necessary for a functional, listed and approved system.
5. The systems shall be automatically actuated by a combination of ionization and/or photoelectric detectors installed at a maximum spacing of 125 ft² per detector in all spaces. Reference NFPA 72 – current edition.
6. System operation shall be fully automated.

7. Design the system with a minimum safety factor of 60% between the design concentration percentage and the agent's NOAEL for acute toxicity, including cardiac sensitization of 10%.
- B. Clean Agent Fire Suppressant:
 1. Suppressing Agent: FM-200 Clean Agent Gas (HFC-227ea)
 2. Temperature Rating: 32°F to 120°F
 3. Propellant: High Purity Compressed Dry Nitrogen
 - C. Sprinkler head with glass bulb thermometer
 1. System Activation Temperature: 155°F
 - D. Pressure Switch and Manual Actuator
 1. Each Clean Agent Fire Suppression System shall come equipped with a Pressure switch for alarming of low system pressure, and an actuator for manual/automatic actuation of the fire suppression system.
 - a. Alarm Set point: 95 psi
 - b. Set point Tolerance: +/- 1 psi or 5%
 - E. Manufacturers
 1. Cease Fire CFCA Series, or equal.

2.3 FIRE CONTROL PANEL

- A. General:
 1. The control panel for the extinguishing agent releasing system shall be a microprocessor-based control capable of protecting multiple hazards in one control panel. It shall be UL listed, be approved by FM, and comply with the requirements of NFPA-72 (Local: A, M, SS service types; DAC and NC signaling type) and NFPA12, NFPA12A, NFPA-13, NFPA-15, NFPA-16, NFPA-17, NFPA-17A, NFPA-750, and NFPA-2001.
 2. The control shall be housed in an 18-gauge steel cabinet that has a hinged, removable door with a key lock. The finish shall be baked enamel. The cabinet shall have adequate space to house two 18 Amp-Hour standby batteries.
 3. The control shall include a fully supervised integral power supply/battery charger capable of providing 200mA to the auxiliary power circuit. It shall also be capable of providing 2.5 Amps to all releasing and notification appliance circuits combined. All initiating, output and auxiliary power circuits shall be power limited.

4. The control shall have a 32 character (16 characters, 2 lines) backlit LCD display and a 34 LED supplemental display. All diagnostic and alarm event information shall be viewable in text form on this display. A field programmable custom banner message with the current date and time shall be displayed when no current alarm or diagnostic information exists.
5. All operational features of the control panel shall be field programmable using menu-driven selections on the alpha-numeric display and on-board controls. No special programmer, nor jumpers or switches shall be required to configure operational features. Alarm and trouble indications shall resound when required.
6. The control panel shall be equipped with 24 programs built into the panel memory, 15 for water-based extinguishing and 9 for agent extinguishing, with the ability to add custom programs. All programming functions shall be password protected.
7. The control shall have four fully supervised Class B (Style B) initiating circuits capable of supporting the operation of 25 compatible 2-wire smoke detectors on each circuit.
8. The individual circuits shall be selectable through the programming sequence to operate in one of the following modes: Conventional, Waterflow, Linear Heat Detection (up to 700 ohms per zone), Manual Release, Low Air Alarm, Supervisory, Tamper, Low Air or High Air.
9. The panel shall have a Low Air Zone that creates a supervisory condition and can be mapped to a release output.
10. The control shall have two fully supervised Class B (Style B) supervisory circuits. These circuits shall be selectable through the programming sequence to operate in one of the following modes: Supervisory, Tamper, Low Air or High Air.
11. The control shall have one fully supervised class B (style B) Abort circuit with 4 different operating modes, ULI, IRI, and NYC, and 30 second.
12. The control shall have four fully supervised Class B (Style Y) output circuits. These circuits shall be selectable through the programming sequence to operate as one of the following: Alarm Notification Appliance, Supervisory Notification Appliance, Trouble Notification Appliance or Releasing. The optional CAM module may be added to convert the outputs to Class A.
13. The releasing circuits shall be supervised for short circuit conditions and shall be programmable for cross zoning operation when required.
14. The discharge timer for these releasing circuits shall be programmable for times of 7, 8, 9, 10, 20 minutes or continuous. All initiating and output circuits shall be capable of being individually disabled or enabled. In addition, when in the agent

extinguishing mode there shall be a pre-discharge timer adjustable from 0-60 seconds from an alarm zone or 0-30 seconds from a manual release zone.

a. The pre-discharge timer shall be set to 30 seconds.

15. The control shall have a test mode that will automatically disable all releasing circuits. The test mode shall operate in such a manner as to automatically reset the initiating circuit and indicating circuits after detecting each alarm condition initiated by the test. All testing shall be recorded in the 40-event history buffer. The test mode will automatically terminate after twenty minutes of inactivity.

16. The control shall have four integral relay contacts rated 3 Amps at 30 VDC for connection to external auxiliary equipment. One relay shall operate when an alarm condition occurs, another when a trouble signal occurs, the third when a supervisory condition occurs, and the fourth during a waterflow condition.

17. UL and ULC Listed, FM Approved, NYMEA Accepted, CSFM Approved, CE Marked and RoHS Compliant.

B. Manufacturers:

1. Potter, PFC-4410RC, or equal.

2.4 BACK-UP BATTERIES

A. Constant voltage (at 20°C) Standby use: 13.5V~13.8V with initial current < 3.6A

B. Constant voltage (at 20°C) Cyclic use: 14.40V~15.0V with initial current <3.6A

C. 12 Amp-hour capacity

2.5 RELEASING ZONE CIRCUIT DISABLE SWITCH

A. The releasing zone circuit disable switch shall consist of a normally open key-operated switch rated for 1 amp 40 VDC. The switch shall be mounted to a stainless-steel faceplate with green and amber LED. The green LED shall be labeled Releasing Circuit System Normal and shall only light when the key is in the Normal position. The yellow LED shall be labeled System Disabled and shall only light when the switch is in the disabled position. The Key shall be removable in either position. The unit shall be designed to mount on a standard single gang enclosure indoors only. The switch shall create a supervisory condition on its associated release panel and replaces the software controlled disconnect.

B. Manufacturer:

1. Potter RCDS Series, or equal.

2.6 SMOKE DETECTORS

- A. Smoke detector shall be conventional photoelectric type. The base shall be appropriate twist-lock base.
- B. The smoke detector shall have one flashing status LED for visual supervision. When the detector is in standby condition the LED will flash Green. When the detector is outside the UL listed sensitivity window the LED will flash Red. When the detector is actuated, the flashing LED will latch on Red. The detector may be reset by actuating the control panel reset switch.
- C. The sensitivity of the detector shall be capable of being measured. The sensitivity of the detector shall be monitored automatically and continuously to verify that it is operating within the listed sensitivity range. To facilitate installation, the detector shall be non-polarized. Voltage and RF transient suppression techniques shall be employed to minimize false alarm potential. Auxiliary SPDT relays shall be installed where indicated.
- D. Manufacturer:
 - 1. Potter CPS-24 Series, or equal

2.7 MANUAL PULL STATION

- A. Switch Rating: 1 Amp @ 125 VAC
- B. Manufacturer: Potter RMS 1T-LP, or equal.

2.8 ALARM

- A. Alarm shall be horn and strobe combination. The horn shall produce a peak sound output of 100dBA or greater at 24VDC. The tone shall be selectable with 8 options. The Alarm shall have isolator switches for selection of strobe only, or horn only operation. Low and high dBA shall be selectable.
- B. The flash rate shall be 1Hz to 2Hz regardless of power input voltage with an operating current of 42mA or less at 24 VDC.
- C. The unit shall be back box mounted
- D. UL and FM listed
- E. Manufacturers: Potter HS-24WR, or equal.

PART 3 EXECUTION

3.1 EXTENTS:

- A. The clean agent Fire Suppression System shall be designed to protect the following in accordance with the requirements of the referenced standards:
 - 1. See Contract Drawings

3.2 INSTALLATION

- A. Install fire suppression systems in accordance with the approved plans and manufacturer recommendations.
- B. Install Clean Agent Fire Suppression System in accordance with the manufacturer's recommendations, codes, standards, regulation, listings and approvals.

3.3 TRAINING

- A. After completion of installation and testing, and prior to final acceptance; a minimum of 4 hours of training shall be provided.

END OF SECTION

SECTION 22 13 16

SANITARY DRAIN AND VENT PIPING

PART 1 GENERAL

1.1 SCOPE

This section covers the work necessary to furnish materials, labor equipment and services necessary to provide all drain and vent piping (DWV), equipment and specialties for the plumbing system as shown on the drawings and specified herein.

1.2 QUALITY ASSURANCE

Install plumbing to meet requirements of local and states codes and provide manufacturer's certification that materials meet or exceed minimum requirements as specified.

1.3 SUBMITTALS

Submittals shall include manufacturers certificate of conformance; certified copies of test reports; documentation on plumbing fixtures; fabrication drawings for roof flashing and counterflashing; layout showing type, spacing, maximum loads and materials for hangers and supports and manufacturer's warranty statements.

PART 2 PRODUCTS

2.1 PIPING

- A. For underground waste and vent piping larger than 4-inch diameter, refer to Section 40 05 13, Common Work Results for Process Piping.
- B. PVC Pipe:
 - 1. PVC pipe for non-pressurized sanitary drain systems shall be manufactured from rigid polyvinyl chloride compounds conforming to ASTM D-1784, Class 12454-B.
 - 2. Non-pressurized PVC pipe joints shall be integral bell push-on type meeting the requirements of ASTM D-3212. Gaskets shall be rubber ring type meeting the requirements of ASTM F477. Rubber gaskets shall be factory installed.
- C. Cleanouts
 - 1. All cleanouts shall be heavy plugs with tapered shoulders against caulked lead or heavy brass plugs. Where underground or concealed, cleanouts shall be brought to floor level and to accessible locations with access covers and frames.

2. Manufacturer's or Equal: The following cleanouts, or equal, shall be furnished:

	<u>Josam</u>	<u>J.R.Smith</u>	<u>Zurn</u>
Exposed locations	58500-20	4405	Z-1440-A
Underground	53010-30	4143	ZN-1400-2
Walls, concealed	58790-20	4535	ZN-1445-1-A
Traffic areas	56070	4240	Z-1420-27

PART 3 EXECUTION

3.1 INSTALLATION

- A. All sanitary drain and vent piping shall be installed in accordance with the applicable plumbing code.

3.2 PLUMBING SPECIALTIES INSTALLATION AND APPLICATION

- A. The CONTRACTOR shall coordinate the work of roughing-in, wall and floor sleeves, pipe inserts, cutting of roof and floor construction to receive drains and vents to required invert elevations. Pipes below ceilings shall be held as high as possible without interfering with other trades.
- B. The CONTRACTOR shall install all plumbing specialties in accordance with manufacturer's printed instructions to permit intended performance.
- C. Cleanouts shall be extended to finished floor or wall surface. Threaded cleanout plug shall be lubricated with mixture of graphite and linseed oil. The CONTRACTOR shall ensure sufficient clearance at cleanouts for rodding of drainage system.
- D. Exterior cleanouts shall be encased in concrete flush with pavement or they shall be extended to above finished grade in unpaved locations.

END OF SECTION

SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.1 SUBMITTALS

- A. Action Submittals: Manufacturer's product data, catalog cut sheets, installation instructions, and operations and maintenance information for specified products.

PART 2 PRODUCTS

2.1 PRODUCTS

- A. General:
 - 1. Specification applies to motorized control dampers and motorized control damper electric motor operators, except those furnished by fan manufacturer as packaged with fan equipment.
 - 2. Dampers shall be two-position, parallel-blade type for open-close service.

2.2 MOTORIZED CONTROL DAMPERS (MCD)

- A. Industrial Duty Motorized Dampers:
 - 1. Frame: Frame: 5 inches by 1 inch by minimum 0.125 inch (127 mm by 25 mm by minimum 3.2 mm) 6063-T5 extruded aluminum hat-shaped channel, mounting flanges on both sides of frame, reinforced at corners.
 - 2. Blades:
 - a. Style: Airfoil-shaped, single-piece.
 - b. Orientation: Horizontal or vertical with thrust washers, as indicated on Drawings.
 - c. Material: Heavy duty 6063-T5 extruded aluminum.
 - d. Width: Nominal 6 inches (152 mm).
 - 3. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.

4. Seals:
 - a. Blade Seals: Extruded neoprene type for ultra-low leakage from minus 72 to 275 degrees F (minus 58 to 135 degrees C). Mechanically attached to blade edge.
 - b. Jamb Seals: Flexible metal compression type.
5. Linkage: Concealed in frame.
6. Axles:
 - a. Minimum 1/2-inch (13 mm) diameter, hex-shaped, mechanically attached to blade.
 - b. Material: Galvanized steel.
 - c. Coordinate number of axles with the required number of actuators such that one axle is provided for each actuator. Multiple actuator on a single axle is not allowed.
7. Performance Data:
 - a. Temperature Rating: Withstand minus 72 to 275 degrees F (minus 58 to 135 degrees C).
 - b. Capacity: Demonstrate capacity of damper to withstand ventilation system operating conditions.
 - c. Closed Position: Maximum pressure of 13 inches w.g. (3.2 kPa) at 12-inch blade length (305).
 - d. Open Position: Maximum air velocity of 6,000 feet per minute (1,829 meter per minute).
 - e. Leakage: Maximum 5.2 cubic feet per minute per square foot (0.6 cubic meter per minute per square meter) at 4 inches w.g. (1 kPa) for size 48 inches by 48 inches (1219 by 1219 mm).
 - f. Pressure Drop: Maximum 0.03-inch w.g. (0.01 kPa) at 1,500 feet per minute (457 meters per minute) across 24-inch by 24-inch (610 by 610 mm) damper.
8. Accessories:
 - a. Actuator: Refer to Article Motorized Control Damper Electric Motor Operators, for requirements.

- b. Flange Frame: 1-1/2 inches (38 mm), roll formed as part of frame, double configuration.
 - c. Factory Sleeve: Minimum 20-gauge (1 mm) thickness, minimum 12 inch (305 mm) length.
 - d. Duct Transition Connection: Size and shape to mate with ductwork as shown on Contract Drawings.
9. Manufacturers and Products:
- a. Ruskin; Model CD-50.
 - b. American Warming and Ventilating.
 - c. TAMCO.

2.3 MOTORIZED CONTROL DAMPER ELECTRIC MOTOR OPERATORS

A. General:

1. Provide electric operators for motorized dampers.
2. Contract Drawings show only one motor per motorized damper. Select actual quantity of motors required to operate each damper in accordance with size of damper provided.
3. Coordinate exact quantity of damper motors with electrical work including sizing of electrical power supplies to ensure that necessary power, wiring and conduit is provided for complete installation.

B. Electric Damper Operators:

1. Performance:
 - a. Two-position.
 - b. Spring return.
 - c. Fail Position: Damper Open.
2. Mounting: External side plate.
3. Ample power to overcome friction of damper linkage and air pressure acting on damper blades.
4. Furnished with external adjustable stops to limit stroke.

5. Operating Torque:

- a. Provide multiple independent damper sections, each with separate actuator, as needed to provide minimum of 120 percent of operating torque required by damper(s).
- b. Required damper operating torque for actuator sizing calculations shall include friction of damper linkage and 1-inch WC air pressure on damper blades. Operating torque shall be minimum of 7 inch-pounds per square foot of damper area for parallel blade dampers.

6. Manufacturers:

- a. Belimo.
- b. Siemens Building Technologies.
- c. Johnson Controls.
- d. Honeywell.

2.4 ELECTRIC THERMOSTATS

A. Room Thermostat for Process Spaces:

1. Temperature Scale: 0 to 125 degrees F,
2. External adjustments.
3. Adjustable sensitivity.
4. Locking wire protective guard.
5. Voltage as indicated on electrical drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Motorized Control Dampers:

1. Install at motorized control damper locations indicated on Contract Drawings and in accordance with manufacturer's instructions.
2. Install square and free from racking with blades running horizontally.
3. Bracing:
 - a. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
 - b. Install at every horizontal and vertical mullion.

B. Motorized Control Damper Electric Motor Operators:

1. Install quantity of electric operators required for each motorized damper, whether or not all motors are shown on Contract Drawings.
2. Install operators in accordance with manufacturer's instructions.
3. Coordinate installation of operators with all trades to avoid interference with architectural features, structural members, and electrical lighting.
4. Electrical work shall include all wiring and conduit required for a complete installation of each motorized damper and shall be provided as part of the work of Division 26, Electrical.

END OF SECTION

SECTION 23 31 13

METAL DUCTS AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Air Movement and Control Association (AMCA): 500, Test Methods for Louvers, Dampers and Shutters.
 2. American Society of Heating, Refrigerating, and Air Conditioning Owner's Representatives (ASHRAE) Handbook.
 3. American Society of Mechanical Owner's Representatives (ASME): A13.1, Scheme for the Identification of Piping Systems.
 4. Association of the Nonwoven Fabrics Industry (INDA): IST 80.6, Water Resistance (Hydrostatic Pressure).
 5. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A90/A90M, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - c. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - d. A176, Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
 - e. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - f. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - g. A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

- h. A653/A653M, Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - i. A700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment.
 - j. A924/A924M, Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.
 - k. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - l. 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.
 - m. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - n. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - o. C916, Standard Specification for Adhesives for Duct Thermal Insulation.
 - p. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - q. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
 - r. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - s. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
6. National Air Duct Cleaners Association (NADCA): General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems.
 7. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - b. 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

- c. 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - d. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - e. 259, Standard Test Method for Potential Heat of Building Materials.
 - f. 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
- a. Duct Construction Standards.
 - b. Guidelines for Seismic Restraints of Mechanical Systems.
 - c. Fibrous Glass Duct Construction Standards.
 - d. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.
 - e. HVAC Air Duct Leakage Test Manual.
9. Underwriters Laboratories Inc.(UL):
- a. 181, Standard for Safety Factory-Made Air Ducts and Connectors.
 - b. 214, Standard for Tests for Flame-Propagation of Fabrics and Films.
 - c. 555, Standard for Safety Fire Dampers.
 - d. 555S, Standard for Safety Smoke Dampers.

1.2 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
- 1. CFM: cubic feet per minute.
 - 2. FPM: feet per minute.
 - 3. PCF: pounds per cubic foot.
 - 4. WC: water column.
- B. Sealing Requirements: For the purpose of duct systems sealing requirements specified in this section, the following definitions apply:
- 1. Seams: Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on perimeter are deemed to be joints.
 - 2. Joints, duct surface connections including:
 - a. Girth joints.
 - b. Branch and subbranch intersections.
 - c. Duct collar tap-ins.

- d. Fitting subsections.
- e. Louver and air terminal connections to ducts.
- f. Access door, and access panel frames and jambs.
- g. Duct, plenum, and casing abutments to building structures.

1.3 SUBMITTALS

A. Action Submittals:

1. Ductwork Product Data: Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, hangers and supports, seam and construction details, and finishes.

Ductwork Accessories: Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, and finishes.

PART 2 PRODUCTS

2.1 GENERAL

- A. Specified components of this ductwork system, including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.
- B. Ductwork material shall be aluminum or galvanized steel, minimum thickness 24 gauge.
- C. Duct Sealants: Adhesives, cements, and sealants shall be as recommended by duct manufacturer for industrial applications.
- D. Ductwork Interior Surfaces:
 1. Smooth.
 2. No sheet metal parts, tabs, angles, or other items may project into air ducts, unless otherwise specified.
 3. Seams and joints shall be external.

2.2 SHEET METAL MATERIALS

- A. Construct supply and exhaust duct systems from aluminum or galvanized steel construct odor control duct systems from stainless steel as specified herein.

- B. Galvanized Steel Ductwork:
 - 1. Comply with ASTM A653/A653M and ASTM A924/924M.
 - 2. Product Name: Steel Sheet, Zinc Coated (Galvanized Steel).
 - 3. Sheet Designation: CS Type B.
 - 4. Applicable Specification: ASTM A653/A653M.
 - 5. (Zinc) Coating Designation: G90.
 - 6. Coating designation in accordance with Test Method A, ASTM A90/A90M and ASTM A924/A924M.
 - 7. Provide mill-phosphatized finish for ducts exposed to view and for ducts scheduled to be painted.
 - 8. Provide sheet metal packaged and marked as specified in ASTM A700.
- C. Exposed Ductwork: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discoloration, and other imperfections, including those which would impair painting.
- D. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.3 DUCT SEALING MATERIALS

- A. General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
- B. Adhesives, Cements, Sealant, and Installation Accessories: As recommended by duct manufacturer for application.
- C. Solvent-Based Sealants:
 - 1. Ultraviolet light resistant.
 - 2. Mildew resistant.
 - 3. Flashpoint: Greater than 70 degrees F, SETACC.

4. Manufacturers and Products:
 - a. Hardcast, Inc.; Versagrip 102.
 - b. Rectorseal; AT-33.
 - c. Childers CP-140.
- D. Water-Based Sealants:
 1. Listed by manufacturer as nonflammable in wet and dry state.
 2. Manufacturers and Products:
 - a. Foster; Series 32.
 - b. Childers; CP-145A, 146.
 - c. Rectorseal; Airlok 181.
- E. Do not use silicone sealants at odor control ducting. Instead, utilize expanded Teflon (Gortex), or a Hypalon product.

2.4 DUCTWORK FASTENERS

- A. General:
 1. Rivets, bolts, or sheet metal screws.
 2. Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.
- B. Self-Drilling Screws:
 1. Galvanized Steel Ductwork System: Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish.
 2. Aluminum Ductwork System:
 - a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated Type 410 stainless steel, complete with bonded metal and fiber washer for dielectric separation.
 - b. Manufacturers:
 - 1) DB Building Fasteners Inc., Santa Fe Springs, CA.
 - 2) Clark Craft Fasteners, Tonawanda, NY.

3. Stainless Steel Ductwork System:

- a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated, Type 410 stainless steel.
- b. Manufacturers:
 - 1) DB Building Fasteners Inc., Santa Fe Springs, CA.
 - 2) Clark Craft Fasteners, Tonawanda, NY.

2.5 DUCTWORK PRESSURE CLASS

A. Construct duct systems to pressure classifications indicated as follows:

1. Supply Ducts: 3-inch WC.
2. Return Ducts: 2-inch WC, negative pressure.
3. Exhaust Ducts: 2-inch WC, negative pressure.

B. Where no specific duct pressure designations are indicated in Specifications or on Drawings, 2-inch WC pressure class shall be basis of Contract.

2.6 RECTANGULAR DUCTWORK

A. Fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise.

B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20-gauge or less, with more than 10 square feet of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

2.7 RECTANGULAR DUCTWORK FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.

B. Elbows:

1. Fit square-turn elbows with vane siderails.
2. Shop fabricate double-blade turning vanes of same material as ductwork.
3. Fabricate with equal inlet and outlet.
4. Rectangular radius elbows with inside radius of $\frac{3}{4}$ of duct width in direction of turn.

5. Manufacturers and Products:

- a. Elgen; All-Tight.
- b. Duro-Dyne; Type TR.

2.8 RECTANGULAR DUCTWORK BRANCH CONNECTIONS

- A. Branch duct connections to rectangular duct mains shall be made using factory fabricated fittings with spot welded tap to main duct connections or with factory fabricated, field installed taps, with spin-in or mechanical fastened tap to main duct connections.

2.9 RIGID ROUND DUCTWORK

- A. Construct rigid round ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise.
- B. Basic Round Diameter: As used in this Article, is inside diameter of size of round duct.
- C. Where space limitations prevent use of round duct or where shown on Drawings, provide ductwork of flat oval construction hydraulically equivalent to round ductwork.
- D. Fabricate round ducts with spiral seam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams.
- E. Ductwork seams of Snaplock type shall not be used.

2.10 RIGID ROUND DUCTWORK FITTINGS

- A. Construct rigid round ductwork fittings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless otherwise specified.
- B. 90-Degree Tees, Laterals, and Conical Tees: Fabricate to conform to SMACNA manual with metal thicknesses specified for longitudinal seam straight duct.
- C. Diverging Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- D. Elbows:
 - 1. Fabricate in stamped (die-formed), pleated, or segmented (gored) construction 1.5 times elbow diameter. Two-piece segment elbows are not allowed, except with turning vanes.
 - 2. Segmented Elbows: Fabricate with welded construction.

3. Round Elbows 8 Inches and Smaller:
 - a. Stamped elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees configuration.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 3-1/2 inches and 4-1/2 inches) elbows with segmented construction.
4. Round Elbows 9 Inches Through 14 Inches:
 - a. Segmented or pleated elbows for 30, 45, 60, and 90 degrees.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 9-1/2 inches and 10-1/2 inches) elbows with segmented construction.

2.11 DUCTWORK FLEXIBLE CONNECTIONS

A. General:

1. Factory fabricated metal-edged fabric flexible connectors for commercial or industrial applications.
2. Sheet metal permanently secured to fabric with double fabric fold, double metal crimp.
3. Comply with NFPA 90A and NFPA 90B requirements.
4. Airtight and waterproof.

B. Materials:

1. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
2. Metal Edges: Construct from same material as ductwork, unless otherwise noted.
3. Fabric:
 - a. Comply with NFPA 701 or UL 214 (except Tefloncoated).
 - b. Woven polyester or nylon.

C. Construction:

1. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.
2. Standard Metal Edged Connectors: Strip of fabric 3 inches wide attached to two strips of 3-inch-wide sheet metal.

3. Wide Metal Edged Connectors: Strip of fabric 4 inches wide attached to two strips of 4-inch-wide sheet metal.
4. Extra Wide Metal Edged Connectors: Strip of fabric 6 inches wide attached to two strips of 6-inch-wide sheet metal.

D. Manufacturers:

1. Ductmate; PROflex, Commercial.
2. Ventfabrics.
3. Duro-Dyne.

2.12 DUCTWORK HANGERS AND SUPPORTS

A. General:

1. Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed.
2. Duct hanging system shall be composed of three elements; upper attachment to building, hanger itself, and lower attachment to duct.
3. Wire hangers are not acceptable.
4. Hanger Spacing:
 - a. Ducts Up to 60 inches in Largest Dimension: 10 feet, maximum.
 - b. Ducts Over 61 inches in Largest Dimension: 8 feet, maximum.

B. Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:

1. Of same material as ductwork.

C. Building Attachments:

1. Concrete inserts, powder-actuated fasteners, or structural steel fasteners appropriate for building materials.
2. Do not use powder-actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
3. Upper Attachment (Concrete):
 - a. Drive pin fastener and expansion nail anchor may be used for ducts up to 18-inch maximum dimension.

- b. Threaded stud fastener may be used for ducts up to 36-inch maximum dimension.
- c. Concrete attachments shall be made of steel.
- D. Duct Fasteners: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials and conforming to requirements of Article Ductwork Fasteners.
- E. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36/A36M, hot-dipped galvanized after fabrication.

2.13 MANUAL DAMPERS

A. Aluminum, Counterbalanced, Standard Duty:

1. Fabrication:

- a. Frame: 3 inches by minimum 0.09 inch, 6063-T5 extruded aluminum channel with front flange and rear flange and mitered corners.
- b. Blades:
 - 1) Style: Single piece, overlap frame.
 - 2) Action: Parallel.
 - 3) Material: Minimum 0.025-inch (0.6 mm) 6063-T5 formed aluminum.
 - 4) Width: Maximum 6 inches (152 mm).
- c. Bearings: Corrosion-resistant, long-life, synthetic, formed as single piece with axles.
- d. Blade Seals: Extruded vinyl, mechanically attached to blade edge.
- e. Linkage: Concealed in frame.
- f. Axles: Corrosion-resistant, long-life, synthetic, locked to blade and formed as single piece with bearings.
- g. Finish: Mill aluminum.

2. Performance Data:

- a. Temperature Rating: Withstand minus 40 degrees to 200 degrees F (minus 40 degrees to 93 degrees C).
- b. Maximum Back Pressure: 1.5-inch WC or 55 MPH external wind.

- c. Maximum Spot Air Velocity: 1,000 fpm (5 mps).
 - d. Operation of Blades:
 - 1) Start to Open: 0.03-inch WC.
 - 2) Fully Open: 0.1-inch WC.
 - e. Pressure Drop: Maximum 0.04-inch WC (0.01 kPa) at 1,000 fpm (305 mpm) through 24-inch by 24-inch (610 mm by 610 mm) damper.
3. Accessories:
- a. Duct Transition Connection: Rectangular.
 - b. Factory Sleeve: Minimum 20-gauge (1.0 mm) thickness, minimum 12-inch (305 mm) length.
 - c. Screen:
 - 1) Type: Bird.
 - 2) Location: Rear with sleeve.
 - 3) Material: Aluminum.
4. Manufacturers and Products:
- a. Ruskin; Model BD2A1.
 - b. Or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Install sheet metal ductwork and flexible ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B.
2. Install ductwork using manufacturer's recommended adhesives, cement, sealant, and insulation accessories.
3. Joints and seams shall be sealed watertight.
4. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth.
5. Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be

installed, sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.

B. Ductwork Location:

1. Locate ductwork runs vertically and horizontally, unless otherwise indicated.
2. Avoid diagonal runs wherever possible.
3. As indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment.
4. In general, install as close to bottom of structure as possible.
5. For ductwork concealed above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.
6. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
7. Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to bottom of structure immediately adjacent to obstruction.

C. Penetrations:

1. Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls and ceilings.
2. Clearances:
 - a. For uninsulated ducts, allow 1-inch clearance between duct and sleeve, except at grilles, registers, and diffusers.
 - b. For insulated ducts, allow 1-inch clearance between insulation and sleeve, except at grilles, registers, and diffusers.
3. Closure Collars:
 - a. Minimum 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed.
 - b. Fit collars snugly around ducts and insulation.
 - c. Same gauge and material as duct.
 - d. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.

- e. Use fasteners with maximum 6-inch centers on collars.
- 4. Packing: Mineral fiber in spaces between sleeve or opening and duct or duct insulation.
- D. Coordination with Other Trades:
 - 1. Coordinate duct installation with installation of louvers, dampers, and ductwork accessories.
 - 2. Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on Drawings.
 - 3. Coordinate ductwork layout to avoid interference with lighting, bridge crane, suspended ceiling, tanks, generator, electrical panels and all process equipment.

3.2 RECTANGULAR DUCTWORK

- A. General:
 - 1. Where possible, install ductwork so seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.
 - 2. If cutting of seams or joints is unavoidable, reinforce cut portion to original strength.
- B. Low Pressure Taps:
 - 1. Use bell mouth or conical fittings with integral locking quadrant damper. Spin-in fitting shall be sealed at duct tap with a gasket or sealed with sealant as specified for medium pressure ductwork.
 - 2. Determine location of spin-in after outlet location is determined.
 - 3. Fitting shall be securely attached to shaft to prevent damper from rotating around shaft.
- C. Fittings:
 - 1. Use bell-mouth or conical tee fittings for round duct takeoffs from rectangular mains.
 - 2. Use 45-degree entry fittings conforming to SMACNA requirements for rectangular takeoffs from rectangular or round mains.
 - 3. Make offsets with maximum angle of 45 degrees.

4. Use fabricated fittings for changes in directions, changes in size and shape, and connections.
- D. Rectangular Ductwork Transverse Joints:
1. Install each run with a minimum of joints.
 2. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
 3. Mechanical Joint Option:
 - a. Construct transverse joints with Ductmate 25/35 duct connector systems, Ductmate W.D.C.I. Heavy/Lite duct connector systems, or Ductlok J/E duct connector system. Slip-on duct flange connectors shall have integral sealant pocket with permanently flexible sealant.
 - b. When using Ductmate W.D.C.I. Heavy/Lite system, construct ductwork in accordance to the Ductmate W.D.C.I. Heavy J and Light H Assembly Manual and Duct Construction Standards.
 - c. When using Ductlok J/E duct connector system, construct ductwork in accordance with Ductlok's Rectangular Duct Construction Manual for Low, Medium, and High Pressure.
 - d. For longitudinal seams, use Pittsburgh lock seam sealed internally with permanently elastic sealer such as Ductmate 5511M mastic.
 - e. Conform to SMACNA Class A sealing requirements.

3.3 RIGID ROUND OR OVAL DUCTWORK

- A. General:
1. Round ductwork may be substituted in place of rectangular ductwork at locations approved by the Owner. Obtain written approval from the Owner prior to substituting round for rectangular ductwork.
 2. Round ductwork shall be installed in lengths as long as possible to minimize joints.
- B. Rigid Round or Oval Ductwork Joints:
1. Rigid round ductwork joints shall be in accordance with SMACNA, unless otherwise specified.
 2. Single and Double Wall Supply and Return System Joints:
 - a. Less than 36 Inches: Slip coupling.

- b. 36 Inches and Larger: Flanged connector, Van Stone, or welded companion flange type.
- 3. Single and Double Wall Exhaust and Return System Joints:
 - a. Spiral Seam Duct: Welded flanged connector.
 - b. Longitudinal Seam Duct: Van Stone flangeconnector.

3.4 FLEXIBLE CONNECTIONS

- A. Flexible Collars and Connections:
 - 1. Use between fans and ducts.
 - 2. For round ducts, securely fasten flexible connections by zinc-coated steel clinch-type draw bands.
 - 3. For rectangular ducts, lock flexible connections to metal collars.

3.5 DUCTWORK HANGERS AND SUPPORTS

- A. Install ductwork with support systems in accordance with SMACNA Manual, unless otherwise noted.
- B. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.
- C. Install additional bracing on ductwork as required, to prevent ballooning or breathing.
- D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- E. Support vertical ducts at maximum interval of 16 feet and at each floor.
- F. Upper attachments to structures shall have allowable load not exceeding 1/4 of failure (proof test) load, but are not limited to specific methods indicated.
- G. In new construction, install concrete insert prior to placing concrete.

3.6 DUCT SEALING

- A. Seal duct seams and joints as follows:
 - 1. In accordance with SMACNA requirements.
- B. If no specific duct sealing requirements are specified, requirements of SMACNA manual shall govern.

- C. Provide additional duct sealing as required to comply with Article Ductwork Leakage Testing.
- D. Seal all audible leaks.

3.7 DUCTWORK LEAKAGE TESTING

A. General:

1. Tests shall be conducted on completed ductwork systems.
2. Testing of partial installations or limited sections of ductwork will not be acceptable.
3. All ductwork leakage test procedures and results shall be submitted to OWNER'S REPRESENTATIVE for review.
4. OWNER'S REPRESENTATIVE shall retain the right to witness some or all ductwork leakage testing procedures.
5. Subcontractor shall notify OWNER'S REPRESENTATIVE in writing at least 5 working days prior to ductwork testing.

B. Leakage Criteria:

1. Assemble and install ductwork with maximum leakage limited as follows:
2. Odor Control Systems:
 - a. Odor Control Ductwork:
 - 1) Operating Pressure: 0- to 2-inch WC.
 - a) Allowable Leakage: 2 percent of design airflow.
 - 2) Operating Pressure: 3-inch and over WC.
 - a) Allowable Leakage: 1 percent of design airflow.

C. Leakage Testing Method:

1. Subcontractor shall be responsible for providing all necessary test fans and calibrated measuring devices to accomplish ductwork leakage test and to demonstrate that ductwork systems leakage rate is less than maximum rate specified.
2. Pressure testing shall be accomplished using a pressure blower with a calibrated orifice and manometer.

3. Blower shall maintain SMACNA construction pressure classification during test.
4. Perform testing in accordance with procedures given in SMACNA HVAC Air Duct Leakage Test Manual.

3.8 CLEANING

- A. Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing in operation.
- B. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.
- C. If duct systems are found to contain construction debris at time of construction completion Subcontractor shall provide complete ductwork system cleaning in accordance with NADCA Standards.

END OF SECTION

SECTION 23 34 00

FANS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Acoustical Society of America (ASA).
2. Air Movement and Control Association International (AMCA).
3. American Bearing Manufacturers Association (ABMA).
4. ASTM International (ASTM).
5. National Electrical Manufacturers Association (NEMA).
6. Occupational Safety and Health Act (OSHA).
7. Underwriters Laboratories Inc. (UL).

1.2 SUBMITTALS

A. Action Submittals: Provide for all products specified, as follows:

1. Unit tag number or equipment identification as referenced in Contract Documents.
2. Manufacturer's name and model number.
3. Descriptive specifications, literature and drawings.
4. Dimensions and weights.
5. Fan sound power level data (reference 10 to power minus 12 Watts) at design operating point.
6. Fan Curves:
 - a. Performance Curves Indicating:
 - 1) Relationship of flow rate to static pressure for various fan speeds.
 - 2) Brake horsepower curves.
 - 3) Acceptable selection range (surge curves, maximum revolutions per minute, etc.).
7. Static pressure, capacity, horsepower demand and overall efficiency required at the duty point, including drive losses.
8. Capacities and ratings.

9. Construction materials.
 10. Fan type, size, class, drive arrangement, discharge, rotation, and bearings.
 11. Wheel type, diameter, revolutions per minute, and tip speed.
 12. Motor and Power Data: Refer to Section 262000, Low Voltage AC Induction Motors.
 13. Manufacturer's standard vibration isolation accessories.
 14. Factory finish system.
- B. Informational Submittals:
1. Recommended procedures for protection and handling of products prior to installation.
 2. Manufacturer's installation instructions, including seismic anchorage and bracing requirements.
 3. Factory test reports.
 4. Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 FAN DRIVES

- A. Drive assembly shall be sized for a minimum 140 percent of fan motor horsepower rating.
- B. Shaft Guard:
1. Provide shaft guard for each fan and drive not housed in its own fan enclosure.
 2. Shaft guards shall be easily removable and enclose entire drive assembly, meeting federal and OSHA requirements.
 3. Guard faces shall be constructed of expanded metal having minimum 60 percent free area for ventilation.
 4. Shaft Guard Color: Bright yellow finish.

2.2 FINISHES

- A. Carbon Steel Parts: Factory finish as follows, unless indicated otherwise.
1. Parts cleaned and chemically pretreated with a phosphatizing process.

2. Alkyd enamel primer.
 3. Air-dry enamel topcoat.
- B. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
- C. Stainless Steel Parts: Finished smooth and left unpainted.

2.3 SODIUM HYPOCHLORITE ROOM FAN (F-2)

- A. General:
1. Supply, exhaust or return air inline fans shall be of the centrifugal, direct driven type.
- B. Housing:
1. Fan housing shall be constructed of heavy gauge galvanized sheet metal.
 2. Externally mounted electrical terminal box with pre-wired terminal strip connection.
 3. Capacitor shall be located within electric terminal box.
- C. Motors:
- D. Motorized impeller shall be an external rotor type, class B insulation, enclosed with permanent split capacitor. Motor shall be a permanently sealed self lubricating ball bearing type. Motor shall be quipped with automatic reset thermal overload protection. Motor shall be acceptable for continuous duty. Wheel:
1. Fan wheel shall be of the backward inclined centrifugal type with a well designed inlet venturi for maximum performance.
 2. Motorized impeller shall be both statically and dynamically balanced as one integral unit to provide for vibration free performance.
- E. Impellers shall be molded of high impact polypropylene. Manufacturers and Products:
1. Fantech, FG 4.
 2. Or approved equal

2.4 DOWNBLAST CENTRIFUGAL EXHAUST FAN

- A. Wheel:
1. Constructed of aluminum.
 2. Non-overloading, backward inclined centrifugal

3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
 4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.
- B. Motors:
1. AC Induction Motor
 - a. Motor enclosures: Open drip-proof
 - b. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase for fan sizes 90 and larger. Fan sizes 60-80 use sleeve bearing.
 - c. Mounted on vibration isolators, out of the airstream
 - d. For motor cooling there shall be fresh air drawn into the motor compartment through an area free of discharge contaminants
 - e. Accessible for maintenance
- C. Shafts and Bearings:
1. Fan shaft shall be ground and polished solid steel with an anti-corrosive coating
 2. Permanently sealed bearings or pillow block ball bearings
 3. Bearing shall be selected for a minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
 4. Bearings are 100 percent factory tested.
 5. Fan Shaft first critical speed is at least 25 percent over maximum operating speed.
- D. Housing
1. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum
 2. Shroud shall have an integral rolled bead for extra strength
 3. Shroud shall be drawn from a disc and direct air downward
 4. Lower windband shall have a formed edge for added strength
 5. Motor cover shall be drawn from a disc

6. All housing components shall have final thicknesses equal to or greater than preformed thickness.
 7. Curb cap shall have pre-punched mounting holes to ensure correct attachment
 8. Rigid internal support structure
 9. Leak proof
- E. Housing Supports and Drive Frame:
1. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators
- F. Vibration Isolation:
1. Rubber isolators
 2. Sized to match the weight of each fan
- G. Disconnect Switches:
1. NEMA rated: 4X
 2. Positive electrical shut-off
 3. Wired from fan motor to junction box installed within motor compartment
- H. Drive Assembly
1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower
 2. Belts: Static free and oil resistant
 3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts
 4. The motor pulley shall be adjustable for final system balancing
 5. Readily accessible for maintenance
- I. Options/Accessories:
1. Auto Belt Tensioner:
 - a. Automatic tensioning device that adjusts for the correct belt tension, only for single drives

2. Bird screen:
 - a. Material Type: Aluminum
 - b. Protects fan discharge
 3. Roof Curbs:
 - a. Types: GPIIP
 - b. Mounted onto roof with fan
 - c. Material: Aluminum
 4. Curb Seal:
 - a. Rubber seal between the fan and the roof curb
 5. Dampers:
 - a. Type: Gravity
 - b. Prevents outside air from entering back into the building when fan is off
 - c. Balanced for minimal resistance to flow
 - d. Galvanized frames with pre-punched mounting holes
 6. Hinge Kit:
 - a. Aluminum hinges
 - b. Allows the fan to tilt away for access to wheel and ductwork for inspection and cleaning
- J. Manufacturers and Products:
1. Greenheck; GB Series.
 2. Or Equal

2.5 MOTORS

- A. General:
1. Provide integral self-resetting overload protection on single-phase motors.
 2. Motors shall not operate into service factor in any case.
- B. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:
1. Electrically commutated, permanent magnet type.
 2. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 3. Solid state electronics.

4. Screw adjustment type SPEEDselector.
5. Number of Speeds: Variable.
6. Shaft Type: Solid, carbon steel.
7. Mounting: As required for fan arrangement.

2.6 ACCESSORIES

- A. Equipment Identification Plates: Furnish 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 3/8-inch high engraved or die-stamped block type equipment identification number and letters indicated in this Specification and as shown on Drawings. All units shall include factory installed permanently attached nameplate displaying unit model and serial number.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100pounds.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fans level and plumb.
- B. Ceiling Units: Suspend units from structure; use threaded rod or metal straps.
- C. Labeling: Label fans in accordance with Article Accessories.
- D. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.
- E. Connections:
 1. Refer to Section 233113, Metal Ducts and Accessories.
 2. Isolate duct connections to fans.
 3. Install ductwork adjacent to fans to allow proper service and maintenance.

3.2 FIELD QUALITY CONTROL

- A. Functional Tests:
 1. Verify blocking and bracing used during shipping are removed.
 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.

3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 4. Verify that cleaning and adjusting are complete.
 5. Verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
 6. Verify lubrication for bearings and other moving parts.
 7. Verify manual and automatic volume control and dampers in connected ductwork are in fully open position.
- B. Performance Tests:
1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated revolutions per minute.
 - b. Measure and record motor voltage and amperage.
 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.

3.3 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to manufacturers' written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

END OF SECTION

SECTION 23 38 10

HEAT PUMP SPLIT UNIT

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

The single-zone mini-split heat pump system shall be the Lennox Mini-Split System. The system shall be capable of providing heating and cooling in a one-to-one configuration.

1.2 QUALITY ASSURANCE

- A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) in accordance with ANSI/UL 1995 – Heating and Cooling Equipment and shall bear the Listed mark.
- B. All wiring shall be in accordance with the National Electric Code (NEC).
- C. The System shall be rated in accordance with Air Conditioning Refrigeration Institute (AHRI) Standard 210/240-2008 Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment and bear the AHRI label.
- D. The System shall be rated in accordance to the U.S. Department of Energy (DOE) test procedures.
- E. The units and components within bonded for grounding shall meet safety standards for servicing required by Underwriters Laboratories Inc. (UL), in accordance with Standard for Safety UL 1995 Heating and Cooling Equipment, and that of the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI).
- F. Units shall be Intertek (ETL) certified for the U.S. and Canada.

1.3 DELIVERY, STORAGE, AND HANDLING

Equipment shall be stored and handled according to the manufacturer's recommendation.

1.4 WARRANTY

A. EXTENDED LIMITED WARRANTY

Warranty commences on the date of initial installation. For the compressors, parts shall be covered by the manufacturer's extended limited warranty for a period of 12 years. Other covered components shall also be covered by the manufacturer's extended limited warranty for a period of 12 years. Online product registration is required where applicable or a standard 7-year compressor / 5-year covered parts warranty applies.

1.5 INSTALLATION REQUIREMENTS

The system shall be installed per manufacturer's recommendation.

1.6 PERFORMANCE

A. PERFORMANCE

The system performance shall be rated in accordance with AHRI 210/240-2008 Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment test conditions. The system efficiency shall meet or exceed the following performance criteria stated in 3.01 subsections A and B.

1. Single-Zone Systems

PART 2 PRODUCTS

2.1 COOLING OPERATING RANGE

The operating range in the cooling mode shall be -13 degrees F – 122 degrees F.

2.2 HEATING OPERATING RANGE

The operating range in the heating mode shall be -13 degrees F – 86 degrees F.

2.3 REFRIGERANT PIPING

All refrigerant piping shall be installed in accordance with manufacturer's recommendations. No additional sight glasses or filter/dryers shall be required. All field installed refrigerant piping shall be applied using nitrogen ACR copper tubing and shall be meet ASTM B280. All branch piping joints necessary for Multi-Zone system installation shall be approved by the manufacturer.

Fully serviceable brass service valve shall prevent corrosion and provide access to refrigerant system. Flare connection lines shall be located on side of unit cabinet. Shut-off valve and 2-way service valve (with service port) may be accessed to manage refrigerant charge while servicing system. Refrigerant lines shall be individually insulated to prevent sweating and bundled in line set with UV-rated tape.

The system shall be capable of the following refrigerant piping lengths as stated in 3.04 subsections A and B.

A. Single-Zone Mini-Split System

1. Maximum line set length: 213 ft (65 m)

2. Maximum line set elevation from outdoor unit to indoor unit, when outdoor unit is above: 98 ft (30 m)
3. Maximum line set elevation from outdoor unit to indoor unit, when outdoor unit is below: 98 ft (30 m)

2.4 MPB SINGLE-ZONE OUTDOOR UNIT

A. General

1. The MPB single-zone outdoor unit shall be factory assembled and pre-wired with all controls necessary for operation.
2. All refrigerant piping lines shall be insulated separately in accordance with the adopted state or local energy code requirements.
3. Outdoor unit sound pressure level for an individual condensing unit module shall not exceed 63 dB(A).
4. The system shall be capable of automatically restarting operation when power is restored after a power failure.
5. The unit shall have a terminal strip furnished for easy wiring connections.
6. The unit shall have an automatically enabled function to defrost the unit when frost build-up is detected. Outdoor and indoor blower operations terminate and status is displayed on the indoor unit panel.
7. The unit shall be equipped with a 4-way interchange reversing valve to implement rapid changes in direction of refrigerant flow to result in quick changeover from heating to cooling and vice versa. Valve operates on pressure differential between outdoor unit and indoor unit.
8. The unit shall be equipped with a base pan heater.

B. Unit Cabinet

1. The outdoor unit cabinet shall be constructed of heavy gauge steel and shall be finished with a weatherproof and corrosion resistant baked enamel finish.
2. The unit shall have access covers for power and control wiring connections.
3. The unit shall have access covers for service valves.
4. The outdoor unit shall utilize a base pan heater to prevent build-up of ice during heating operation.

5. The unit shall feature tabs on base to allow secure mounting to slab.
 6. Condensate drain outlets shall be furnished on unit base. Drain shall be field furnished.
- C. Fan
1. The outdoor unit direct fan drive moves large air volumes uniformly through entire outdoor coil for high refrigeration capacity.
 2. The outdoor unit fan motor shall be powered by an inverter drive capable of 5 steps of fan speed control.
 3. An outdoor unit fan guard shall be provided.
- D. Condenser Coil
1. The condenser coil shall be manufactured from copper tubes with aluminum fins.
 2. A wire grille guard shall be provided.
 3. The condenser coil shall be factory coated with a hydrophilic treatment for increased corrosion resistance.
- E. Compressor
1. The unit shall have a compressor that features high-efficiency operation.
 2. The compressor shall be balanced to reduce vibration and promote quiet operation.
 3. The brushless DC motor shall use powerful Neodymium magnets, 15-20 times stronger than the ferrite magnets within conventional AC compressors.
 4. The unit shall utilize a compressor crankcase heater to protect against refrigerant migration that can occur during low ambient operation.
- F. Controls
1. The system utilizes DC inverter control to provide continuous operation while adjusting capacity according to room temperature. The system's accurate sensing of heating and cooling loads prevents frequent changes in capacity and ensures efficient, economical operation.
 2. The microprocessor shall control the electronic expansion valve. It shall also assist the automatic compressor timed-off protection feature, indoor fan-on delay in heating mode after coil is warm, and 4-way reversing valve.

G. Electrical

1. The power supply to the outdoor unit shall be 208-230 volts, single phase, 60 Hz, or 115 volts, single phase, 60 Hz.
2. Dedicated communication cables will be required by the 3- and 4-ton units. The control wiring to the indoor unit requires 18-gauge, 2 core, stranded, and shielded wire. Unshielded communication wire shall not be accepted. Control wire shielding shall be grounded in accordance with manufacturer's recommendations.

H. Refrigerant

1. Refrigerant shall be non-chlorine, ozone friendly R-410A.
2. Each unit shall be pre-charged from the factory with a holding charge. Additional refrigerant shall be added in the field in accordance with manufacturer's recommendations.
3. Flare refrigerant connection lines shall be located on side of unit cabinet.
4. The unit shall have a fully serviceable brass service valve to prevent corrosion and provide access to refrigerant system. Shut-off valve may be fully shut off while 2-way service valve with port may be accessed to manage refrigerant charge while servicing system.
5. The refrigerant oil shall be VG74 ester oil or VG74 Polyolester (POE).

2.5 MCFA/MCFB CEILING/FLOOR NON-DUCTED INDOOR UNIT

A. General

1. The Lennox MCFA ceiling/floor non-ducted indoor unit shall be completely factory assembled and tested. The unit shall include all wiring, piping, electronic expansion valve, and printed circuit boards necessary for operation.
2. The unit shall be provided with a knockout for outside air intake.
3. The unit shall have a pre-heat function to delay fan operation until the indoor coil has reached a field-adjustable temperature.
4. The unit will allow compensation for temperature due to installation height and ground height differentials.
5. The unit shall allow use of remote controller temperature sensor rather than indoor unit temperature sensor.

6. The unit will have an intelligent defrost mode that can vary the defrosting time according to the current system state.
 7. The unit shall restart automatically after power failure after 3 minutes with prior settings.
 8. The unit will be paired with a wireless remote controller; a wired controller may be purchased separately.
 9. The unit must be compatible with primary VRF provider's product line.
 10. The unit shall have a timer that allows the user to automatically turn on or turn off the unit up to 24 hours later.
 11. The indoor unit shall include motor-driven louvers and shall support automatic vertical louver swing functionality.
 12. The unit shall include a factory-provided LED readout display and infrared receiver panel. The LED display shall indicate the current operational set point of the indoor unit, operation status, and codes for maintenance and servicing.
 13. The unit shall be capable of both vertical and horizontal orientation during installation with no field modification required.
 14. The unit shall contain dry contacts for remote on/off and alarm output on the control board.
- B. Fan
1. The fan motor shall be a DC motor capable of operating at 3 fan grades: low, medium, and high.
 2. The fan motor shall be thermally protected.
- C. Connections
1. The unit shall be equipped with liquid and gas flare fittings for quick and secure piping.
 2. The unit shall have refrigerant piping and drainage hose connections on the right and left side.
 3. The unit shall allow for left, right, or rear access for refrigeration line connection.
 4. Return air connections shall be made horizontally or from the bottom of the unit with interchangeable panel.

5. The indoor unit coil shall be rifled copper tubing with hydrophilic coated aluminum fins.
 6. The coil shall have a design pressure of 550 psi.
- D. Filter
1. The unit shall include an easily removable, washable mesh filter.
- E. Electrical
1. The power supply to the indoor unit shall be 208-230 volts, single phase, 60 Hz.
 2. Dedicated communication cables will be required by the 3- and 4-ton units. Control wiring to the indoor unit requires 18-gauge, 2 core, stranded, and shielded wire. Unshielded communication wire shall not be accepted. Control wire shielding shall be grounded in accordance with manufacturer's recommendations.

2.6 LENNOX MINI-SPLIT LOCAL CONTROLLERS

- A. Programmable Wired Remote Controller (M0STAT64Q-1)
1. The programmable local controller shall be approximately 4-7/8 inches x 4-3/4 inches in size and white in color with an auto-timeout touch screen LCD display. LCD display of the programmable local controller shall be a minimum of 6.2 inches. The programmable local controller shall have a USB port for saving settings, loading settings, and loading software changes.
 2. The programmable local controller shall support temperature display of Fahrenheit or Celsius. The programmable local controller shall control the following operations: On/Off, Operation Mode (cool, heat, auto, dry, and fan, temperature set point, fan speed setting, and louver swing setting. The programmable local controller shall be capable of setting temperature setpoint in the range of 62 degrees F - 86 degrees F.
 3. The programmable local controller shall support scheduling up to eight times in a day.
 4. The programmable local controller shall be capable of locking the following user functions: ON/OFF, temperature settings, operation mode, swing, and scheduling.
 5. The programmable local controller shall connect using four-wire, stranded and shielded conductor cable.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufactures instructions.

END OF SECTION

SECTION 23 83 00

UNIT HEATERS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Provisions of Division 23 Heating, Ventilation and Air Conditioning apply to this section.

1.2 DESCRIPTION

- A. Work in this section includes self-contained heating units such as unit heaters, convectors, finned pipe units, cabinet heaters, and radiant heaters.

1.3 REGULATORY AGENCIES

- A. All work shall be in conformance with the requirements of the applicable codes.

1.4 REFERENCE STANDARDS

- A. The publications of the organizations listed below form a part of this specification to the extent referenced.
 1. National Electrical Manufacturers Association (NEMA)
 2. Underwriters Laboratories (UL)

1.5 SUBMITTALS

- A. Product Data
 1. Electric Unit Heaters

PART 2 PRODUCTS

2.1 ELECTRIC UNIT HEATERS

- A. Manufacturers:
 1. Qmark, MUH
 2. Chromalox, LUH
 3. Approved Equal
- B. Unit heaters shall be electric coil, horizontal blow type with propeller fan, size and capacity as scheduled.

- C. Heaters shall be completely factory wired and assembled, with all required electrical power devices and accessories, including automatic re-settingoverheat control, wall bracket, contactors, fuses, transformer, and terminal blocks. Unit shall be UL approved.
- D. Heater shall provide the airflow and heating capacity as shown on the Drawings.
- E. Heater shall be protected from air flow failure so heater is inoperative unless fan is running.
- F. Heater shall be wall mounted using the supplier's wall mounting bracket.
- G. Controls: Heater shall be controlled from the SCADA PLC. Provide transformer as needed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All equipment and accessories shall be installed with required clearances from combustible surfaces. Provide a minimum of 36" clearance in front of the electrical access panel.
- B. Install heater suspended by four, 3/8" steel threaded rod supports from roof structure.
- C. When using an non-integral thermostat, install thermostat outside the heater's direct fan exhaust path to avoid on/off cycling.

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 WORK INCLUDED:

- A. The intent of Divisions 26 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 26 and shown on the accompanying Drawings, including appurtenances, connections, etc., in the finished job.
- B. 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. Items shown on the Drawings are not necessarily included in the Specifications and vice versa.
- C. Imperative language is frequently used in Division 26 Specifications. Except as otherwise specified, requirements expressed imperatively are to be performed by the CONTRACTOR.
- D. Provide complete ground systems as specified herein and shown on the Drawings. Include conduit system, transformer housings, switchboard frame and neutral bus, motors, and miscellaneous grounds required.
- E. Clearly and properly identify the complete electrical system to indicate the loads served or the function of each item of equipment connected under this work.

1.2 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. Payments and fees required by governing authorities for work included in this Division.
 - 4. Change Orders.
- B. Division 1, General Requirements apply to this Division.

- C. All Sections of Division 26 Electrical Specifications, are interrelated and shall be considered in their entirety when interpreting any material, method, or direction listed in any Section of Division 26.
- D. Where specified materials or methods exceed minimum standards allowed by applicable codes, the more stringent requirement shall apply.

1.3 APPLICABLE PUBLICATIONS:

- A. The latest adopted revisions of the 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. International Building Code (IBC).
 - 2. National Electrical Code (NEC).
 - 3. National Fire Protection Association (NFPA).
 - 4. National Electrical Manufacturers Association (NEMA).
 - 5. National Electrical Contractors Association (NECA).
 - 6. American National Standards Institute (ANSI).
 - 7. Institute of Electrical and Electronic Engineers (IEEE).
 - 8. Underwriters Laboratories (UL).
 - 9. Federal Specifications (Fed. Spec.).
 - 10. International Fire Code (IFC).
 - 11. Oregon Administrative Rules (OAR).
 - 12. Oregon Structural Specialty Code.

1.4 SITE VISITATION:

- A. The CONTRACTOR shall visit the site prior to bidding and become familiar with existing conditions and all other factors that may affect the execution of the work. Include all related costs in the initial bid proposal.

1.5 COORDINATION OF WORK:

- A. Conduct work in a manner to cooperate with all other trades for proper installation of all items of equipment. Consult the Drawings of all other trades or crafts to avoid conflicts with cabinets, counters, equipment, structural members, etc. In general, the architectural drawings govern but conflicts shall be resolved with the OWNER prior to rough-in.
- B. Verify the physical dimension of each item of electrical equipment to fit the available space. Coordination of the equipment to fit into the available space and the access routes through the construction shall be the CONTRACTOR'S responsibility.
- C. Prepare detailed layout drawings for panel layouts in electric rooms or closets, utilizing dimensioned shop drawing data of equipment to be furnished. Provide additional

wiring details at switchboards, motor control centers, and other areas where work is of sufficient complexity to warrant additional detailing for coordination. Submit layout drawings for approval prior to commencing field installation and shall be included with shop drawings.

- D. Coordinate rough-in and wiring requirements for all equipment provided under other divisions of the work and requiring electrical connections with equipment supplier and installer. Make installation and connections in accordance with rough-in and wiring diagrams provided for CONTRACTOR'S use. Arrange raceways, wiring, and equipment to permit ready access to switches, motors, and control components. Doors and access panels shall be kept clear.
- E. Coordinate all aspects of the electrical, telephone, and other utility services with the appropriate serving utility. No additional compensation will be allowed the CONTRACTOR for connection fees or additional work or equipment not covered in the Drawings or Specifications which are a result of policies of the serving utility.
- F. Coordinate underground work with other CONTRACTORS working on the site. Particular coordination shall be performed with CONTRACTORS installing storm sewer, sanitary sewer, gas, water and irrigation lines to avoid conflicts. Common trenches may be used with other trades, providing clearances required by codes and ordinances are maintained.

1.6 WARRANTY:

- A. Provide a written warranty covering the work done under this Division as required by the General Conditions. Incandescent lamps will be excluded from this warranty.
- 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. Systems: Any system damage caused by failures of any system component shall be included.

1.7 ELECTRICAL DRAWINGS:

- A. The Drawings that accompany the Division 26 Specifications are diagrammatic. They do not show all offsets, fittings, or accessories that may be required to install work in the space provided and avoid conflicts. Follow the Drawing as closely as is practical and

install additional bends, offsets, fittings, and accessories where required by local conditions from measurements taken at the jobsite. The right is reserved to make minor field order changes in outlet location prior to roughing-in without additional cost to the OWNER.

1.8 STORAGE OF MATERIALS AND EQUIPMENT

- A. Equipment and materials to be located indoors shall be stored indoors and sealed with plastic film wrap.
- B. Provide manufacturer's recommended storage and handling requirements.

1.9 SUBMITTALS:

- A. Coordinate with the requirements of Section 01 for the following items:
 - 1. Detailed layout drawings per 26 05 00-1.5.C.
 - 2. Written warranty for Work per 26 05 00-1.6.
 - 3. Installation Drawings per 26 05 00-1.9.G
 - 4. Record in-progress drawings per 26 05 00-1.9.H.
 - 5. Operating Instructions & Maintenance Manuals per 26 05 00-1.10.
 - 6. Contract Cost Data per 26 05 00-1.11.
- B. Submit five copies of electrical shop drawings and equipment data within 45 days from notice to proceed. Each submitted section shall include data on all equipment requiring submittals for that section. Include in each folder a complete index for all Sections and materials requiring submittals.
- C. Include manufacturer's detailed specifications and data sheets to fully describe equipment furnished. Assure that all deviations from the Drawings and Specifications are specifically noted in the submittals. Failure to comply will automatically void any implied approval for use of the equipment on this project.
- D. Provide two Electrical Power System Studies for the project electrical power system. The preliminary study will be based on the equipment to be installed in the project. The preliminary study must be submitted complete with the electrical switchboard and panel submittals. The final study will be based on the final, as installed and accepted, project configuration. The final study must be submitted prior to the date of Substantial Completion. The study shall include the pertinent local power company available fault current and impedance data at the point of connection to the project. The study will utilize the current SKM Power Tools software package. The studies will produce:
 - 1. Short circuit fault analysis study of the system.
 - 2. Protective device coordination study of the system.

3. Arc Flash Hazard study of the system.
 4. The studies will be stamped and signed by either an Oregon licensed Electrical Engineer or an Oregon licensed Supervisory Electrician.
- E. Review and recommendations by the OWNER or OWNER'S REPRESENTATIVE are not to be construed as change authorizations. If discrepancies between the materials or equipment submitted and the Contract Documents are discovered either prior to or after the data is processed, the Contract Documents will govern.
 - F. OWNER'S or OWNER'S REPRESENTATIVE review is for general conformance with the design concept of the project and the information given in the construction documents. The CONTRACTOR is solely responsible for, and this review does not include: confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating the work with that of other trades and performing all work in safe and satisfactory manner. Corrections or comments made on the submittal during review do not relieve the contractor from compliance with the requirements of the construction documents or with its responsibilities listed herein.
 - G. The Installation Drawings called for under submittals shall show all outlets, devices, terminal cabinets, conduits, wiring, and connections required for the complete system described. Prints of these drawings shall be submitted prior to starting installation. The CONTRACTOR submitted drawings will then form the basis for installation.
 - H. Record in-progress drawings shall be kept up to date as the work progresses showing all changes, deviations, addendum items, change orders, corrections, or other variations from the Contract Drawings. The marked-up drawings shall be kept at the jobsite and available for the Engineer's review. At the completion of the work, all deviations from the installation drawings shall be incorporated on the reproducible to indicate "as-built" conditions. The drawings shall then be submitted to the OWNER as Record Drawings for the system.

1.10 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS:

- A. Coordinate with the requirements of Section 01.
- B. Prior to the date of Substantial Completion, prepare detailed operating and maintenance manuals for equipment and systems installed. Operating and Maintenance Manuals will be used for training of and use by the OWNER's personnel in the operation and maintenance of the systems.
- C. Format of the manuals shall be based on a separate manual or chapter for each class of system as follows:
 1. Secondary distribution system.

2. Low voltage distribution system.
 3. Egress lighting system.
 4. Security system.
 5. Lighting systems, including lamps.
 6. Wiring devices, i.e., GFI receptacles.
- D. Content of each manual or chapter shall include but shall not be limited to the following:
1. Description of system.
 2. Operating Sequence and Procedures:
 - a. Step-by-step procedure for system start-up, including a pre-start checklist. Refer to controls and indicators by nomenclature consistent with that used on panels and in control diagrams.
 - b. Detailed instruction in proper sequence, for each mode of operation (i.e., day-night, staging of equipment).
 - c. Emergency Operation: If some functions of the equipment can be operated while other functions are disabled, give instructions for operations under those conditions. 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.
 - d. Shutdown Procedure: Include instructions for stopping and securing the equipment after operation. If a particular sequence is required, give step-by-step instructions in that order.
 3. Preventive Maintenance:
 - a. Provide a schedule for preventive maintenance. State the recommended frequency of performance of each preventive maintenance task such as cleaning, inspection, and scheduled overhauls.
 - b. Cleaning: Provide instructions and schedules for all routine cleaning and inspection with recommended lubricants.
 - c. 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.
 - d. Provide instructions for lubrication and adjustments required for preventive maintenance routines. Identify test points and given values for each.

4. Manufacturers' Brochures: Include manufacturers' descriptive literature covering devices and equipment used in the system, together with illustrations, exploded views, and renewal parts lists. Manufacturers' standard brochures shall be edited so that the information applying to the ACTUAL installed equipment is clearly defined.
- E. Submit two draft copies of the complete operating and maintenance manual for review to the OWNER for approval.
- F. Submit three copies of the final operating and maintenance manuals bound in 3-ring binders with tabs and index at least five days prior to the inspection for Substantial Completion.

1.11 CONTRACT COST DATA:

- A. Furnish to the OWNER a cost breakdown of the Electrical Work.
- B. The cost breakdown shall include separate amounts for material, labor and mark-up for each CSI specification section included. Include cost data with the shop drawings submittal.

1.12 CHANGE ORDERS:

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

PART 2 PRODUCTS

2.1 MATERIALS:

- A. Electrical products installed in this project shall be listed by a recognized testing laboratory or approved in writing by the local inspection authority as required by governing codes and ordinances.
- B. Materials shall be new, of the best quality, and American made. The materials shall be manufactured in accordance with NEMA, ANSI, U.L. or other applicable standards.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Provide a complete properly operating system for each item of equipment called for under this work. Installations shall be in accord with the equipment manufacturer's instructions, the best industry practices and the contract documents. Where a conflict in these guides appear, the Engineer shall be requested to provide proper clarification before work is roughed in and the OWNER's decision will be final. Work installed without such clarification shall be removed and corrected by the CONTRACTOR at no cost to the OWNER.
- B. Make installation in a neat, finished, and safe manner according to the latest published NECA Standard of Installation under competent supervision.
- C. Install intumescent material around ducts, conduits, etc., to prevent spread of smoke or fire where installed in sleeves or block-outs penetrating rated fire barriers. The penetration sealing system must be capable of passing a 3-hour test per ASTM E-814 (UL 1479) and must consist of a material capable of expanding nominally eight times when exposed to temperatures of 250-350 degrees Fahrenheit. An alternate method utilizing intumescent materials in caulk and/or putty form may be used.

3.2 EXCAVATION AND BACKFILL:

- A. Perform all necessary excavation and backfill for the installation of electrical work in compliance with Division 31, 32, and 33.
- 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 cables or conduit runs. Refer to the duct bank elevation detail in the electrical drawings for more details.

- F. Coordinate patching of all asphalt or concrete surfaces disturbed by this work with GENERAL CONTRACTOR.

3.3 NOISE CONTROL:

- A. Outlet boxes at opposite sides of partitions shall not be placed back to back nor straight through boxes be employed, except where specifically permitted on the drawings by note to minimize transmission of noise between occupied spaces.
- B. Conduit shall be routed along corridors or other “noncritical” space to minimize penetrations through sound rated walls. All penetrations through sound rated partitions shall be grouted solid and airtight. Conduit and its associated attachment shall not rigidly connect (i.e., bridge) independent wall structures. Flexible connections or attachments are required.
- C. Contactors, transformers, starters, and similar noise producing devices shall not be placed on walls which are common to occupied spaces unless specifically called for on the Drawings. Where such devices must be mounted on walls common to occupied spaces, they shall be shock mounted or isolated in such a manner as to effectively prevent the transmission of their inherent noise to the occupied space.
- D. Ballasts, contactors, starters, transformers, and like equipment which are found to be noticeably noisier than other similar equipment on the project will be deemed defective and shall be replaced.

3.4 EQUIPMENT CONNECTIONS:

- A. Provide complete electrical connections for all items of equipment requiring such connections, including incidental wiring, materials, devices, and labor necessary for a finished working installation.
- B. Verify the location and method for connecting to each item of equipment prior to roughing-in. Check the voltage and phase of each item of equipment before connecting.
- C. Make motor connections for the proper direction of rotation. Minimum size flex for mechanical equipment and small control devices shall be 3/4 inch. Exposed motor wiring shall be jacketed metallic flex with 6 inches minimum slack loop. Pump motors shall not be test run until liquid is in the system.
- D. Control devices and wiring relating to the HVAC systems will be furnished and installed under Division 23 except for provisions or items specifically noted on the electrical Drawings or specified herein.

3.5 EQUIPMENT SUPPORT:

- A. Each fastening device and support for electrical equipment, luminaires, panels, outlets, and cabinets shall be 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. Properly and adequately support luminaires installed under this work from the building structure. Supports shall provide proper alignment and leveling of luminaires. Flexible connections where permitted to exposed luminaires shall be neat and straight, without excess slack, 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 4. 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.
 - 2. Anchor conduit installed in poured concrete to the steel reinforcing with No. 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 OWNER.

3.6 ALIGNMENT:

- A. Install panels, cabinets, and equipment level and plumb, parallel with structural building lines. Switchgear panels and all electrical enclosures shall fit neatly without gaps, openings, or distortion. Properly and neatly close all unused openings with approved devices.
- B. Fit surface panels, devices, and outlets with neat, appropriate trims, plates, or covers without overhanging edges, protruding corners, or raw edges to leave a finished appearance.

3.7 CUTTING AND PATCHING:

- A. Include cutting, patching and restoration of finishes necessary for this work. Surfaces damaged by this work and spaces around conduits passing through floors and walls shall be neatly patched and finished to match the adjacent construction including painting or other finishes. Clean up and remove all dirt and debris. This work shall all be performed to the satisfaction of the OWNER.

- B. Where equipment installations or connections require the installation of an access panel, arrange with General CONTRACTOR to provide a properly sized and installed access panel similar to those used for mechanical equipment access.

3.8 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. Equipment found damaged or in other than new condition will be rejected as defective.
- B. Switchgear, transformers, panels, luminaires, and all electrical equipment shall be kept covered or closed to exclude dust, dirt, and splashes of plaster, cement, or paint and shall be free of all such contamination before acceptance. Enclosures and trims shall be in new condition, free of rust, scratches, and other finish defects. Properly refinish in a manner acceptable to the OWNER, if damaged.

3.9 MAINTENANCE OF SERVICE:

- A. Electrical service shall be maintained to all functioning portions of the building throughout construction, except as noted below, during all normal working hours of the building occupants. Outages to occupied areas shall be kept to a minimum and be pre-arranged with the OWNER or OWNER's REPRESENTATIVE. This CONTRACTOR will be liable for any damages resulting from unscheduled outages or for those not confined to the pre-arranged times.
- B. Signal and communication systems and equipment shall be kept in operation wherever these serve occupied or functional portions of the building. Outages of these facilities shall be treated the same as electrical power outages.
- C. Telephone services where required during the construction work will be maintained by the OWNER's communications personnel. This work shall be coordinated with the OWNER's REPRESENTATIVE and OWNER in such a manner that service, as required by the building occupants, can be readily installed and maintained.
- D. Include all costs for temporary facilities, overtime labor and necessary provisions to maintain electrical services in the initial bid proposal. Temporary wiring and facilities, if used, shall be removed and the site left clean before final acceptance.

3.10 COMPLETION AND TESTING:

- A. Upon completion, systems shall be tested to show the equipment installed operates as designed and specified, free of faults and unintentional grounds. The system tests shall be set up for as many at one time as possible to work into construction phasing. Tests shall be done in the presence of the OWNER or OWNER's REPRESENTATIVE, and shall be scheduled 48 hours in advance.

- B. A journeyman electrician with required tools shall be available to conduct all tests, with or without the equipment factory representative present.
- C. Systems shall include, but not be limited to the following systems:
 - 1. Lighting control systems
 - 2. Megger testing
 - 3. Ground electrode test
 - 4. GFI receptacles testing
- D. A written record of performance tests shall be compiled, dated, witnessed, and submitted along with operating and maintenance data to the OWNER prior to final acceptance.

END OF SECTION

SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 WORK INCLUDED:

- A. Conductor sizes shown on Drawings are sized for copper and shall be considered minimum for ampacities and voltage drop requirements.
- B. Conductors for special systems shall be as recommended by the equipment manufacturer except as noted.
- C. Deliver conductors to the job site in cartons, protective covers, or on reels.

1.2 SUBMITTALS:

- A. Product data and test reports for the following materials:
 - 1. Conductors, 600 Volt
 - 2. Power Limited Wiring
 - 3. Connectors – 600 Volt and Below.

PART 2 PRODUCTS

2.1 CONDUCTORS–600V:

- A. Type:
 - 1. Copper: No. 12 AWG minimum size unless noted otherwise, No. 8 and larger, Class B concentric or compressed stranded.
- B. Insulation:
 - 1. Copper: XHHW-2 90 degrees Celsius Dry and 90 degrees Celsius Wet N unless noted or specified otherwise. XLP where required for low leakage.
- C. Thru wiring in fluorescent luminaires shall be rated for 90-degree Celsius minimum.
- D. Manufacturers: Alcan, General, Essex, Rome, Southwire, Houston wire or approved equal.

2.2 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.
- C. Cable System Identification: SIC
1. Description: Single twisted, shielded pair or triad, 16 AWG, instrumentation and signal cable; UL listed; Cable Tray rated.
 2. Voltage: 600 volts
 3. Conductor Material: Bare annealed copper; stranded per ASTM B8.
 4. Insulation: 15 mil, Polyvinyl Chloride (PVC),
90 degrees Celsius temperature rated
Color Code per ICEA Method-1: Pairs- Black and White with one conductor in each pair printed alpha-numerically for identification.
 5. Lay: Twisted on a 2-inch lay.
 6. Shield: 100 percent, 1.35 mil aluminum-Mylar tape with a 7-strand tinned copper drain wire.
 7. Jacket: 35 mil Polyvinyl Chloride (PVC).
 8. Flame Resistance: UL 2250.
 9. Manufacturer(s): Okonite, Type-OS (Pair)s Overall Shield) and Type TOS (Triad(s) Overall Shield; or Cooper Industries-Belden equal; or General Cable equal.
 10. Execution:
 - a. Use: Analog signal cable and RTD device Triad extension cable.
 - b. Installation: Install in accordance with paragraph 3.03 of this section.
 - c. Testing: Test in accordance with paragraph 3.05 of this section.
- D. Cable System Identification: DC2
1. Description: Shielded Data Communication Cable; Remote I/O Cable: RS-485 #22 AWG Copper.
 2. Voltage: 30 V RMS
 3. Conductor Material: Tinned copper.
 4. Insulation: Polyethylene; Trade Name Example: Datalene.
 5. Jacket: PVC or CPE; Color: Chrome.

6. Manufacturer(s): Cooper Industries-Belden YM-29560, or Cooper Industries-Belden 88760 or equal.
7. Execution:
 - a. Application: DCU or PLC to Remote 1/0 –Data Communications Cable.
 - b. Installation: Install in accordance with associated equipment manufacturers instruction.
 - c. Testing: Test in accordance with paragraph 3.05 of this section

2.3 CONNECTORS – 600V AND BELOW:

- A. Branch Circuit Conductor Splices: 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 approved equal with 600V heat shrink insulation. For cable splices in sub-terrain/underground vaults or any wet locations shall be provided with 600V 3M Series DBR-6 or approved.
- C. Terminator Lugs for Stranded Wire:
 1. No. 10 Wire and Smaller: Spade flared, tool applied.
 2. No. 8 Wire and Larger: Compression tool applied, Burndy, Anderson, or approved equal. Set screw type terminator lugs supplied as an integral part of switches and circuit breakers will be acceptable for terminating only copper conductors.

PART 3 EXECUTION

3.1 CONDUCTORS:

- A. Pulling compounds may be used for pulling all but low leakage type XLP insulated conductors on isolated power systems. 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. A dynamometer shall be utilized on all high voltage cable pulls to ensure that the maximum allowed cable tension is not exceeded. The OWNER or OWNER’s REPRESENTATIVE shall be notified prior to all cable pulls. Record the maximum strain of each pull.
- C. Conductors entering terminal or junction boxes mounted on hermetically sealed refrigeration compressor motors shall be copper.

- D. 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.
- E. Wire devices external to isolating panels with copper stranded conductors having a cross-linked polyethylene insulation or equivalent with a dielectric constant of 3.5 or less.

Minimum insulation wall thickness shall be 1/32 inches for #10 and #12 AWG and 5/64 inches for #8 AWG and larger conductors. Wiring shall be color coded in accordance with NEC and appropriate NFPA Standards.

- F. Minimum insulation wall thickness shall be 1/32 inches for #10 and #12 AWG and 5/64 inches for #8 AWG and larger conductors. Wiring shall be color coded in accordance with NEC and appropriate NFPA standards.

3.2 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.

3.3 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. Color code shall be as follows:

208Y/120 volt	Phase	480 volt 480 Y/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray*
Green	Ground*	Green

* Grounds for isolated ground receptacles shall be green with yellow tracer.

- B. Use solid color compound or solid color coating for No. 12 and No. 10 branch circuit conductors and neutral sizes.
- C. Phase conductors No. 8 and larger color code using one of the following:
 - 1. Solid color compound or solid color coating.
 - 2. Stripes, bands, or hash marks of color specified above.
 - 3. Colored as specified using 3/4-inch wide tape. Apply tape in half overlapping turns for a minimum of three inches for terminal points and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
- D. Switchlegs, travelers, etc., to be consistent with the phases to which connected or a color distinctive from that listed.
- E. Color coding of the flexible wiring system conductors and connectors shall be the manufacturer's standard.
- F. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

3.4 TESTS:

- A. Perform insulation resistance tests on all phase and neutral conductors of feeders and circuits over 100 ampacity, 480 volt and below, with a 1000-volt megger. The written test report listing the results of the test to be submitted to OWNER or OWNER's REPRESENTATIVE. Equipment which may be damaged by this test shall be disconnected prior to the test.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 GENERAL

1.1 WORK INCLUDED:

- A. Provide complete ground systems as specified herein and shown on the Drawings. Include conduit system, transformer housings, switchboard frame and neutral bus, motors, and miscellaneous grounds required.
- B. Provide 600 volt 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.
- C. Continue existing system as specified herein and shown on the Drawings.

1.2 SUBMITTALS:

- A. Provide material certification and product information on the following items:
 - 1. Ground Conductors
 - 2. Connectors
 - 3. Ground Pads
 - 4. Ground Rods

PART 2 PRODUCTS

2.1 GROUND CONDUCTORS:

- A. Bare or green insulated copper for interior systems.
- B. Bare copper for underground or exterior systems.

2.2 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.

2.3 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 x 3-inch x 12 inch long.

- B. 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.

2.4 GROUND RODS:

- A. Copperclad steel, 3/4 inch x 10 feet 0-inch-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.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Grounding Conductors: Sized in accord with Article 250, Tables 250-122 and 250-66 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.
- E. Provide equipment grounding conductor in all PVC conduit runs.
- F. Provide ground bonding to above ground portion of metal gas piping per NEC 250-104(b).
- G. All separately derived systems shall be solidly grounded to the nearest metal water piping.

3.2 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 No. 10 AWG conductor. Connect the equipment ground to the building system ground. Use the same size equipment ground conductors as phase conductors, up through No. 10 AWG.

3.3 GROUND PADS:

- A. Drill ground pads as necessary for attachment of all grounding conductors as required.
- B. Utilize 2-hole lugs for terminating No. 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.

3.4 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 fifty (50) feet apart. Drive the two reference electrodes five (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 OWNER or OWNER's REPRESENTATIVE will issue additional instructions.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope.
 2. Reference Standards.
 3. Quality Assurance.
 4. Submittals.
 5. Products.
 6. Execution.

1.2 SCOPE

- A. This Section specifies requirements for design, furnishing and installation of support systems for electrical raceways, cables and enclosures.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI C80.1	Rigid Steel Conduit-Zinc Coated
ANSI C80.3	Electrical Metallic Tubing-Zinc Coated
ASTM A48 REV A	Gray Iron Castings
ASTM F512	Smooth-Wall Polyvinylchloride Conduit and Fittings for Underground Installation
FEDSPEC WW-C-581E	Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated

Reference	Title
FEDSPEC W-C-1094A	Conduit and Conduit Fittings, Plastic, Rigid
NEMA ICS 6	Industrial Control and Systems Enclosures
NEMA TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA VE1	Cable Tray Systems
NEMA VE 2	Cable Tray Installation Guidelines
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NFPA 70	National Electrical Code (NEC)
NFPA 79	Electrical Standards for Industrial Machinery
UL 1	Flexible Metal Electrical Conduit
UL 6	Rigid Metal Electrical Conduit
UL 360	Liquid Tight Flexible Electrical Conduit
UL 651	Rigid Nonmetal Electrical Conduit
UL 797	Electrical Metallic Tubing

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00.
- B. ACTION SUBMITTAL ITEMS FOR THIS SECTION:
 1. A copy of this Section, addendum updates included, with each paragraph check-marked to indicate compliance or marked to indicate requested deviations from Section requirements.
 2. Supports, seismic bracing, and other electrical system mounting elements are generally not shown on the plan drawings. Hangers, supports, seismic restraints, and other electrical system mounting elements shall be submitted in accordance 01 41 20.

PART 2 PRODUCTS

2.1 RACEWAY SUPPORTS

A. CONDUIT SUPPORTS

1. Framing channel with end caps and straps shall be provided to support groups of conduit. Individual conduit supports shall be one-hole pipe straps used with clamp backs and nesting backs where required. Material as specified herein.
2. Conduit supports for PVC coated rigid steel and PVC conduit systems shall be one-hole PVC coated rigid steel clamps or oversized stainless-steel clamps.

B. CEILING HANGERS: Ceiling hangers shall be adjustable steel rod hangers and fittings. Provide J-Type conduit support for single conduit. Straps or hangers of plumber's perforated tape are not acceptable. Unless otherwise shown, hanger rods shall meet ASTM A193 and be sized as 3/8-inch up to 2-inch conduit and shall be 1/2-inch all-thread rod over 2-inch conduit. Material as specified herein.

C. SUSPENDED RACEWAY SUPPORTS AND RACKS:

1. Suspended raceway supports shall consist of concrete inserts, steel rod hangers, and jamb nuts supporting framing channel or lay-in pipe hangers as required. Framing channel shall be a minimum of 12-gauge. Material as specified herein.
2. Hanger rods shall be a minimum of 1/2-inch diameter all-thread rod and shall meet ASTM A193. Suspended raceway supports and racks shall be braced for seismic forces as specified in Section 26 05 00.

D. MATERIALS: Table A specifies the type of raceway supports required for each location and application.

Table A

Location	Framing Channel and Accessories	Threaded Rod, Hardware, & Fittings
Indoor Dry	Zinc Plated Steel	Zinc Plated Steel
Indoor, Wet	316 Stainless Steel HDG Steel	316 Stainless Steel
Outdoor	316 Stainless Steel PVC Steel	316 Stainless Steel
Submerged	316 Stainless Steel PVC Steel	316 Stainless Steel
Headspace	316 Stainless Steel PVC Steel	316 Stainless Steel
Chemical Corrosive	316 Stainless Steel PVC Steel	316 Stainless Steel
Process Corrosive	316 Stainless Steel PVC Steel	316 Stainless Steel

HDG = Hot Dip Galvanized Finish PVC = PVC Coated

2.2 EQUIPMENT SUPPORTS

- A. Equipment supports shall be installed where shown on the drawings and as required to support the panels and enclosures being installed.
- B. Equipment supports shall be installed per details in the Construction Documents.

2.3 ANCHOR BOLTS

- A. Anchor bolts shall be as specified in Section 05 50 00.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Hangers and supports shall be installed with spacing between support points in compliance with all applicable codes.
- B. The cut ends of support channels shall be smoothed and without burrs left from cutting.

END OF SECTION

SECTION 26 05 33

CONDUITS, RACEWAYS, BOXES, AND FITTINGS

PART 1 GENERAL

1.1 WORK INCLUDED:

- A. Provide raceways and conduits of specified types for all electrical systems wiring, except where clearly shown or specified otherwise. All fittings, boxes, hangers and appurtenances shall be included.
- B. Size raceways and conduits as specified. Where no size is indicated, conduits may be 3/4-inch minimum diameter for above ground and 1 inch for below ground or larger for the quantity of conductors installed, based upon NEC tables for conductors with type XHHW-2 insulation.

1.2 SUBMITTALS

- A. Provide material certification and product information on the following items:
 - 1. Metal Conduits
 - 2. Non-Metallic Conduits
 - 3. Wireways
 - 4. Fittings
 - 5. Metallic Boxes

PART 2 PRODUCTS

2.1 METALLIC CONDUITS:

- A. Galvanized Rigid Conduit (GRC): 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. GRC shall comply with NEC Article 344.
- B. Intermediate Metallic Conduit (IMC): Not permitted to be used.
- C. Electrical Metallic Tubing (EMT): Not permitted to be used.
- 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.

2.2 NON-METALLIC CONDUITS:

A. Underground Ducts:

1. PVC, Encased Burial: Type EB for concrete encasement, shall meet or exceed the current requirements of EB-20/ASTM F512, NEMA TC-6 and U.L. 65I. Rate for use with 90 degrees Celsius wire.
2. PVC, Direct Burial: Type DB suitable for direct burial, shall meet or exceed the current requirements of DB-20/ASTM F512 and NEMA TC-6. Rate for use with 90 degrees Celsius wire.

- ### B. Rigid Non-Metallic Conduit: Type II PVC Schedule 40, suitable for use with 90 degrees Celsius rated wire. Conduit shall conform to UL Standard 65I and carry appropriate UL listing for above and below ground use.

2.3 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.

2.4 FITTINGS:

A. GRC:

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 16450.
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. Threadless: Not permitted to be used.

- ### C. Weatherproof Connectors: Threaded.

- ### D. Expansion Couplings: Approved equal to O.Z. type EX with jumper.

- E. Seal-Offs: With filler fiber, compound, removable cover.

2.5 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 approved equal.
- 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 approved equal.
- 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.
- E. Pump and valve house: Galvanized cast boxes with steel galvanized gasketed covers or suitable weather proof device plates.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Conceal all conduits in finished spaces. Concealed conduits shall run in a direct line with long sweep bends and offsets. GRC embedded in concrete below grade or in damp locations shall be made watertight by painting the entire male thread with Rustoleum metal primer or approved equal before assembly.
- B. Conduit may be run in concrete members and slabs with permission of the Owner or OWNER's REPRESENTATIVE, provided the outside diameter of the conduit does not exceed 1/3 the thickness of the concrete:
 - 1. Locate conduit in the center of the concrete or where the minimum concrete cover will be 3 inches around the conduit;
 - 2. Space conduits at least 7 feet, 6 inches apart on centers;
 - 3. Conduit shall not cross other conduit or pipe in concrete members or slabs.
- C. 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. Conduit fittings shall be used to "saddle" under beams. Drilling or

notching of existing beams, trusses on structural members shall be coordinated with OWNER prior to commencing.

- D. GRC 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.

3.2 CONDUIT

- A. GRC may be used in all areas for wiring systems. GRC may be installed for wiring underground in cast concrete construction and shall be installed in damp locations, and in hazardous areas or where subject to mechanical injury with threaded fittings made up tight.
- B. PVC jacketed flex shall be used for connections to vibration producing equipment and where installation flexibility is required with a minimum 12 inches slack connection. Limit length to 36 inches for exposed equipment connections and 72 inches in concealed ceiling and wall cavities. PVC jacketed flex shall be used in wet locations, areas subject to washdown, and exterior locations.
- C. PVC Type II Schedule 40 may be used underground and in and under interior slabs, poured concrete walls, and where scheduled or noted on the Drawings. Make connections with waterproof solvent cement. Provide GRC at 60 degree and larger bends and where penetrating slabs.

3.3 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.

3.4 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.

3.5 BOXES:

- A. Boxes and outlets shall be mounted at nominal center line heights shown on the drawings. Adjust heights in concrete masonry unit (CMU) walls to prevent devices or finish plates from spanning masonry joints.
- B. Outlet boxes shall be of code required size to accommodate all wires, fittings, and devices. Provide multi-gang boxes as required to accept devices installed with no more than one device per gang. Equip all metallic boxes with grounding provisions.
- C. 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.
- D. 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 to have single gang opening where required to accommodate fixture canopy. Provide larger boxes or extension rings where quantity of wires installed requires more cubic capacity.
- E. 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.
- F. Boxes for the special systems shall be suitable for the equipment installed. Coordinate size and type with the system supplier.
- G. 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. Use galvanized boxes of code required size with removable covers installed so that covers will be accessible after work is completed.
- H. 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.
- I. 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.
- J. Boxes installed attached to a stud in sheet rock walls shall be equipped with opposite side box supports equal to Caddy #760 or approved equal. 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.

3.6 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 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED:

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

1.2 SUBMITTALS:

- A. Provide samples of all labels to be used on project for OWNER approval.

PART 2 PRODUCTS

2.1 LABELS:

- A. Pre-printed: Permanent material pre-printed with black on white, with adhesive backing, Brady, 3M or approved equal.
- B. Laminated Plastic: 3-ply laminated plastic, black with white letters, for 208/120V equipment and red with white letters for 480/277V equipment. Lamicoid or approved equal.
- C. Clear Plastic Tape: Black 12-point Helvetica medium characters machine imprinted on clear tape, Merlin, Kroy or approved equal.
- D. Plastic Tape: Black or red with white letters, adhesive backing, field printed with proper tool, Dymo-tape or approved equal.
- E. Wire Markers: White with black numbers, adhesive backed tape on dispenser roll, Brady, 3M or approved equal.

PART 3 EXECUTION

3.1 BRANCH CIRCUIT PANELBOARDS:

- A. Indicate panel number with laminated plastic labels. Indicate voltage phase and feeder source, feeder wire size, and feeder breaker or fuse size with plastic tape labels on the inside of the panel door.

- B. Provide typewritten panel directories, with protective, clear transparent covers, accurately accounting for every breaker installed including spares. Schedules shall use the actual room designations assigned by name or number near completion of the work and not the space designation on the Construction Drawings.

3.2 EQUIPMENT:

- A. Label all disconnect switches, motor starters, relays, contactors, and time switches indicating equipment served with plastic tape labels.
- B. Where the controlling device is remote mounted from the serving panel, include the serving panel designation and circuit number with additional plastic tape labels.

3.3 DEVICES:

- A. Label each receptacle plate with preprinted clear plastic press on labels with 3/16 inches minimum black letters indicating serving panel and circuit number. Clean all oils, dirt and any foreign materials from plate prior to label application.
- B. Receptacles connected to a GFCI protected circuit downstream from the protecting device shall be so labeled.

3.4 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: 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.

3.5 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 05 73

POWER SYSTEM STUDIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes requirements for:

1. Short Circuit Fault Analysis Study and Protective Devices Coordination Study:

a. The protective device coordination study includes protective device settings for all functions indicated on the Drawings, including, but not limited to:

- 1) Current.
- 2) Voltage.
- 3) Frequency.
- 4) Negative sequence.
- 5) Reverse power.
- 6) Machine protection functions.

2. Arc-Flash Hazard Study.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.2 REFERENCES

A. Refer to Section 26 05 00.

B. Institute of Electrical and Electronics Engineers (IEEE):

1. 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (Red Book).
2. 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).

3. 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).
 4. 1015 - IEEE Recommended Practice for Applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems - Corrigendum 1 (Blue Book).
 5. 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations.
 6. 315 - IEEE Standards Electrical and Electronics Graphic and Letter Symbols and Reference Designations.
 7. 902 - IEEE Guide for Maintenance, Operation and Safety on Industrial and Commercial Power Systems (Yellow Book).
- C. National Fire Protection Association (NFPA):
1. 70E - Standard for Electrical Safety in the Workplace.

1.3 DEFINITIONS

- A. Refer to Section 26 05 00.

1.4 SYSTEM DESCRIPTION

- A. General study requirements:

1. Scope:

- a. The short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall include all new and modified equipment in the power distribution system including but not limited to:
 - 1) Utility equipment.
 - 2) Switchgear.
 - 3) Switchboards.
 - 4) Generators.
 - 5) Transformers:
 - a) Including all dry-type transformers.
 - 6) Motor Control Centers.
 - 7) Free standing variable frequency drives and starters.

- 8) Disconnect Switches.
- 9) Motors.
- 10) Panelboards:
 - a) Including all 208, 240, and 480-volt systems.
- 11) Vendor Control Panels.
- 12) HVAC Equipment.
- b. Study Scenarios:
 - 1) The studies shall include all possible electrical system configurations, for example:
 - a) Operation on normal (utility) source.
 - b) Operation on generator source.
 - c) Main-breakers closed, tie-breaker open.
 - d) Either main-breaker open, tie-breaker closed.
- 2. Obtain, for all equipment, the required data for preparation of the study, including, but not limited to:
 - a. Transformer kilovolt-ampere (KVA) and impedances.
 - b. Generator impedances.
 - c. Generator decrement curves.
 - d. Bus withstand ratings.
 - e. Cable and bus data.
 - f. Protective device taps, time dials, instantaneous pickups, and time delay settings.
- 3. Obtain the electric utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, utility protective device settings, manufacturer, and model number, interrupting ratings, X/R ratios, and model information one level above the point of connection:
 - a. Utility tolerances and voltage variations.

4. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.
5. Obtain equipment layouts and configurations from the manufacturer's final submittal requirements and project layout drawings as required.
6. For the Short Circuit Fault Analysis and Protective Device Study all equipment shall be modeled down to, but not limited to, the smallest adjustable or fixed trip circuit breaker in the 480-volt distribution system.
7. The short-circuit fault and coordination study shall include all equipment in the power distribution system. Study scenarios shall include, but not be limited to, normal source (utility), standby generators, motor contribution, and other separately derived sources down to, but not limited to the smallest adjustable trip circuit breaker or fixed trip circuit breaker in the 480-volt distribution system. Normal system connections and those that result in maximum fault conditions shall be covered in the study.
8. The scope of the Arc-Flash Hazard Study shall be as defined for the short-circuit fault and coordination study.
9. Bus and Conductor Data:
 - a. Use impedances based on actual installed or specified conductors, unless otherwise indicated.
 - b. Use cable and bus resistances calculated at 25 degrees Celsius, unless otherwise indicated.
 - c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.
 - d. Use bus withstand values for all equipment having buses.
 - e. Use medium voltage cable reactances based on typical dimensions of shielded cables with 133 percent insulation levels, unless otherwise indicated.
10. Motors:
 - a. Each motor shall be individually modeled:
 - 1) Grouping of motors for fault contribution current is not acceptable.
 - b. Motors with variable frequency drives may be assumed to have no contribution to fault current.

11. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.
- B. Short-circuit fault analysis study additional requirements:
1. The short-circuit fault analysis shall be performed and submitted in 2 phases:
 - a. Initial short-circuit fault analysis:
 - 1) Based on the Contract Documents and Electric Utility information.
 - 2) The initial short-circuit fault analysis report shall indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.
 - 3) Provide a list of assumptions used in the initial study.
 - b. Final short-circuit analysis:
 - 1) The final short-circuit fault analysis shall modify the initial analysis as follows:
 - a) Utilize the actual equipment provided on the project.
 - b) Utilize conductor lengths based on installation.
 2. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit $\frac{1}{2}$ cycle momentary symmetrical and asymmetrical RMS, 1-1/2 and 4 cycle interrupting symmetrical RMS, and 30 cycle steady state short circuit current values at each piece of equipment in the distribution system.
 3. Evaluate bus bracing, short circuit ratings, fuse interrupting capacity, and circuit breaker adjusted interrupting capacities against the fault currents, and calculate X/R values:
 - a. Identify and document all devices and equipment as either inadequate or acceptable.
 4. Provide calculation methods, assumptions, one-line diagrams, and source impedance data, including Utility X/R ratios, typical values, recommendations, and areas of concern.
 5. Evaluate bus bracing, fuse interrupting capacity and circuit breaker adjusted interrupting capacities against the fault currents and calculate X/R values. Flag inadequate devices and document all acceptable devices and equipment.

- C. Protective device coordination study additional requirements:
1. Furnish protective device settings for all functions indicated on the Drawings, including, but not limited to:
 - a. Current.
 - b. Voltage:
 - 1) Provide settings for all voltage relays based upon actual Utility and generator tolerances and specifications.
 - c. Frequency:
 - 1) Provide settings for all frequency relays based upon actual Utility and generator tolerances and specifications.
 - d. Negative sequence.
 - e. Reverse power.
 - f. Machine protection functions:
 - 1) Provide settings for all motor and generator protective relays based on the manufacturer's recommended protection requirements.
 2. Provide log-log form time-current curves (TCCs) graphically indicating the coordination proposed for the system:
 - a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC.
 - 1) Typical time-current curves for identical portions of the system, such as motor circuits, are acceptable as allowed by the Engineer.
 - b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics.
 - 1) These details can be included on the TCC.
 - c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings.
 - 1) These details can be included on the TCC.
 3. TCCs shall include all equipment in the power distribution system where required to demonstrate coordination. Include utility relay and fuse characteristics, medium

voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system protective devices:

- a. Include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards and fused disconnect switches.
 - b. Provide ground fault TCCs with all adjustable settings for ground fault protective devices.
 - c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.
 - d. On the TCCs show transformer full load currents, transformer magnetizing inrush, and ANSI transformer damage curves.
 - e. Cable damage curves.
 - f. Terminate device characteristic curves at a point reflecting the maximum symmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.
 - g. Coordinate time interval relay characteristic with upstream and downstream device to avoid nuisance tripping.
4. Site Generation: Include phase and ground coordination of the generator protective devices. Show the generator decrement curve, damage curve, and operating characteristic of the protective devices.
 5. Suggest modifications or additions to equipment rating or settings in a tabulated form.
- D. Arc-flash hazard study additional requirements:
1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:
 - a. Perform study with 15 percent arcing fault variation as defined by IEEE 1584.
 - b. Perform arc-flash calculations at minimum and maximum utility fault contributions.
 - c. Perform Arc-flash calculations for both the line side and load side of service disconnect, motor control center, and panelboard main breakers.

- d. Perform arc-flash calculations for all short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.
 - e. Protective device clearing time shall be limited to 2 seconds, maximum.
 2. Provide executive summary of the study results.
 - a. Provide summary based upon worst case results.
 3. Provide a detailed written discussion and explanation of the tabulated outputs.
 - a. Include all scenarios.
 4. Provide alternative device settings to allow the Owner to select the desired functionality of the system:
 - a. Minimize the arc-flash energy by selective trip and time settings for equipment maintenance purposes.
 - b. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.
 5. Perform the arc flash study calculations using both IEEE 1584 and NFPA 70E. Provide both studies in the final report. Provide summary based upon worst case results between IEEE 1584 and NFPA 70E.
- E. Electrical system study meetings:
 1. The individual conducting the short circuit analysis, protective device coordination, and the arc-flash hazard studies shall meet with the Owner and Engineer 3 times.
 2. The purpose of the 3 meetings is as follows:
 - a. Initial Meeting:
 - 1) Meet with the Owner and Engineer to discuss the scope of the studies.
 - 2) Discuss the Owner's operational requirements for both normal operation and maintenance.
 - b. Preliminary Results Meeting:
 - 1) This meeting will be held after the studies have been completed, reviewed, and accepted by the Engineer.

- 2) The purpose of this meeting is to inform the Owner of the results of the study and impacts on normal operation and maintenance including:
 - a) Protective device coordination problems and recommended solutions.
 - b) Explanation of the arc-flash study results and its potential impact on operations.
 - c) Recommendations for reduction of arc-flash category levels including reduction of protective device settings or changes in operational practices.
- c. Final Meeting:
 - 1) Discuss changes to the reports based on the previous meeting.
 - 2) Discuss with the Owner how changes to the electrical system may change the arc-flash hazard category.
 - 3) Deliver the final electrical system studies report.
3. The Meetings Will Be at the Owner's Facility:
 - a. Provide a minimum of 3 weeks' notice to the Owner and Engineer in advance of the projected meeting date.
 - b. Submit a draft of the meeting agenda when each meeting is requested.
4. The Owner reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash study shall be modified based on the results of the meetings with the Owner.

1.5 SUBMITTALS

- A. Furnish submittals in accordance with Sections 01 33 00 and 26 05 00.
- B. Initial studies and reports:
 1. Include the following in the initial short-circuit current report:
 - a. List of all devices included in the studies.
 - b. A description of all operating scenarios.
 - c. Form and format of arc flash labels

C. Final studies and reports:

1. Format and quantity:

- a. Provide 6 bound copies of all final reports.
- b. Provide 3 complete sets of electronic files on CD or DVD media, including the electrical system model(s), configuration files, custom libraries, any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.

2. Include the sections below in the final report:

- a. Copies of correspondence and data obtained from the Electric Utility Company.
- b. Letter certifying the inspection and verification of existing equipment.

c. One-line diagrams:

1) The following information shall be included at a minimum:

a) Motor horsepower.

b) Transformer data:

(1) kVA.

(2) Configuration.

c) Cable data:

(1) Insulation.

(2) Size.

(3) Length.

2) One-line diagrams shall be fully legible at 11-inch by 17-inch size.

d. Short-Circuit Fault Analysis Study Shall Include:

1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.

2) Normal system connections and those, which result in maximum fault conditions.

3) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.

- 4) Fault current calculations for the case studied, including a definition of terms and guide for interpretation of computer software printouts.

e. Protective Device Coordination Study Shall Include:

- 1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
- 2) List all requirements used in the selection and setting criteria for any protective device.
- 3) Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.
- 4) Time-current curves (TCCs) graphically indicating the coordination proposed for the system on log-log graphs. At least 3 of the copies shall be in color.
- 5) Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form, with a one-line diagram to display area coordination.
- 6) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.

f. Include in the Arc-Flash study:

- 1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
- 2) Normal system connections and those, which result in maximum arc-flash conditions.
- 3) Arc-flash raw data, calculations, and assumptions.
- 4) Arc-flash label data:
 - a) Identifying the content of each label.
 - b) Identifying the location of each label.

D. Certification:

1. Submit written certification, sealed, and signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor stating that the data used in the study is correct.

- E. Submit the credentials of the individual(s) performing the study and the individual in responsible charge of the study.
- F. The Engineer shall review all studies and reports. After review, the Engineer may recommend changes for the short-circuit coordination, and/or arc-flash studies. Study revisions shall be provided as part of the Scope of Work.
- G. Submit course outline for Owner's training.

1.6 QUALITY ASSURANCE

- A. As specified in Section 26 05 00.
- B. Qualifications of the individual responsible for electrical system studies:
 - 1. The studies shall be performed, stamped, and signed by a Professional Engineer registered in the State of Oregon.
 - 2. A minimum of 5 years' experience in power system analysis is required for the individual in responsible charge of the studies.
 - 3. The short-circuit analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a digital computer program:
 - a. Point-to-point calculations are not acceptable.
- C. The study shall be performed by an independent firm.

1.7 SEQUENCING

- A. Site visit to gather data on the existing facility systems for all studies:
 - 1. Make multiple trips as required to obtain all data for the short-circuit, protection device coordination and arc flash study.
- B. Initial electrical system study meeting.
- C. Submit the preliminary short-circuit analysis protective device coordination and arc flash studies.
- D. Second electrical system study meeting for preliminary results.
- E. Final arc-flash meeting and final short-circuit analysis, protective device coordination, and arc-flash studies.
- F. Label equipment with approved arc flash labels.

G. Owner's training.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Electrical System Study Software shall be one of the following or equal:

1. ETAP by Control Technologies.
2. SKM.
3. EDSA.

2.2 COMPONENTS

A. Arc-Flash Hazard Labels:

1. Dimensions:
 - a. Minimum 5 inches by 3.5 inches.
2. Materials:
 - a. Polyester with polyvinyl polymer over-laminate.
 - b. Self-adhesive.
 - c. Resistant to:
 - 1) UV.
 - 2) Chemicals and common cleaning solvent resistant.
 - 3) Scuffing.
 - 4) Wide temperature changes.
3. Contents:
 - a. Short-circuit bus identification.
 - b. Calculated incident energy (calories/square centimeter) range.
 - 1) Based on worst case study results.
 - c. Hazard/risk, personnel protective equipment category number.
 - d. Arc-flash protection boundary.

- e. Shock Hazard Boundary:
 - 1) The CONTRACTOR may provide separate labels for indication of the shock hazard boundary.
 - f. Description of the combined level of personnel protective equipment.
4. Color Scheme:
- a. For locations above 40 calories/square centimeter:
 - 1) White label with red "DANGER" strip across the top.
 - 2) Black lettering.
 - b. For locations below 40 calories/square centimeter:
 - 1) White label with orange "WARNING" strip across the top.
 - 2) Black lettering.

PART 3 EXECUTION

3.1 INSTALLATION

- A. As specified in Section 26 05 00.
- B. After review and acceptance of the arc-flash hazard study by the Engineer, install all arc-flash hazard labels:
 - 1. Install labels at all locations required by NFPA, ANSI, or IEEE standards.
 - 2. At a minimum, install labels in the following locations:
 - a. The front of each main or incoming service compartment.
 - b. The front of each low voltage motor control center section.
 - c. The front of each medium voltage circuit breaker door.
 - d. The front of each accessible auxiliary or conductor compartment.
 - e. Each accessible rear or side vertical section.
 - f. Each motor control center compartment.
 - g. Each panelboard covered by the study.
 - h. Each control panel, VFD, or other equipment covered by the scope of the study.

3. Install labels prior to equipment energization.
- C. After review and acceptance of the arc-flash hazard study and coordination study by the Engineer, adjust protective device settings per final study prior to equipment energization.
1. Devices which require power for configuration may be set during energization, but before any sub-fed loads are energized.
 2. Ensure that settings for upstream equipment are set prior to energizing downstream devices.

3.2 FIELD QUALITY CONTROL

- A. Refer to Section 26 05 00.
- B. The individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:
1. Remove and replace any improperly applied labels.
 2. Repair the equipment finish damaged by removal of any label.
 3. Install labels to within 1/64 inch of level or plumb across the entire dimension of the label.

3.3 ADJUSTING

- A. After review and acceptance of the recommended settings in the Protective Device Coordination Study, make settings in accordance with the manufacturer's instructions.

3.4 DEMONSTRATION AND TRAINING

- A. Refer to Section 26 05 00.
- B. Training:
1. Provide the minimum of training sessions requested by the Owner for his electrical maintenance personnel:
 - a. Each session shall be a minimum of 4 hours.
 2. The training shall cover at a minimum:
 - a. Hazards associated with arc-flash.
 - b. Causes of arc-flash.

- c. Explanation of the arc-flash labels installed on the Owner's electrical equipment.
 - d. Proper use of Personal Protective Equipment.
 - e. PPE requirements for maintenance work.
3. The individual in charge of the arc-flash study or qualified representative shall conduct the training sessions.

END OF SECTION

SECTION 26 05 83
WIRING CONNECTIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes requirements for:
 - 1. Wire connecting devices.
 - 2. Terminations.
 - 3. Splices.

1.2 REFERENCES

- A. Refer to Section 26 05 00.
- B. ASTM International (ASTM):
 - 1. D3005 – Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.
- C. CSA International (CSA):
 - 1. C22.2 - No.197-M1983 (R2208) - PVC Insulating Tape.
- D. Underwriters Laboratories, Inc. (UL):
 - 1. UL 510 - Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

1.3 DEFINITIONS

- A. Refer to Section 26 05 00.

1.4 SYSTEM DESCRIPTION

- A. Provide a complete system of wiring connectors, terminators, and fittings for a complete wiring system suitable for the cables and conductors used.

1.5 SUBMITTALS

- A. Furnish submittals in accordance with Section 26 05 00.
- B. Product Data:
 - 1. Catalog cut sheets.
 - 2. Installation instructions.

1.6 QUALITY ASSURANCE

- A. Refer to Section 26 05 00.
- B. All materials shall be UL listed.
- C. Perform work to meet the requirements of legally constituted authorities having jurisdiction. Comply with the latest editions, amendments, practices, and rulings of the following documents and organizations, except where these specifications are more stringent:
 - 1. National Electrical Code (NFPA No. 70).
 - 2. Emergency and Standby Power systems (NFPA 110).
 - 3. Institute of Electrical and Electronic Engineers.
 - 4. National Electrical Manufacturers Association.
 - 5. Insulated Power Cable Engineers Associations.
 - 6. American National Standards Institute.
 - 7. American Society of Testing Materials.
 - 8. Rules of the National Board of Fire Underwriters.
 - 9. Underwriters' Laboratories, Inc.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 26 05 00.

1.8 PROJECT OR SITE CONDITIONS

- A. Refer to Section 26 05 00.
- B. Environmental Requirements:
 - 1. If required, the equipment shall be de-rated in accordance with the manufacturer's guidelines for the project altitude and ambient temperature as defined in Section 26 05 00.

1.9 WARRANTY

- A. Refer to Section 26 05 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers for each type of technology are specified with the equipment in this Section.

2.2 EQUIPMENT

A. Control Connections:

1. Use insulated ring type wire terminators for connections to all screw terminals:
 - a. With chamfered/funneled terminal barrel entry.
 - b. Deep internal serrations.
 - c. Long barrel design to reduce electrical resistance and increased insulator-barrel surface area to ensure that the insulator remains in contact with the barrel.
 - d. Electroplated-Tin copper conductor.
 - e. Manufacturer: One of the following or equal:
 - 1) Thomas and Betts, Stakon.
2. For process equipment connections, work from manufacturer's drawings.

B. Joints, Splices, Taps, and Connections:

1. 600-volt conductors.
 - a. Use solderless connectors.
 - b. Use only plated copper alloy connectors or lugs:
 - 1) Aluminum connectors or lugs are not acceptable for copper conductors.
 - c. Under those specific conditions where aluminum conductors have been allowed or are specified then the connectors for aluminum conductors shall be specifically designed for that purpose.
 - d. For wire Number 10 AWG and smaller, use compression splice caps, with insulating caps:
 - 1) Manufacturer: One of the following or equal:
 - a) Buchanan 2006S or 2011S, with 2007 or 2014 insulating caps.
 - e. For wire Number 8 AWG and larger, use heavy duty copper compression connectors:
 - 1) Manufacturer: One of the following or equal:
 - a) Burndy.

- b) Thomas and Betts.
- f. Where waterproof splices are required:
 - 1) Suitable for indoor, outdoors, weather exposed, direct buried, or submersed applications.
 - 2) Utilizing an epoxy, polyurethane, and re-enterable compounds.
 - 3) For use with shielded or unshielded plastic- and rubber-jacketed, signal, control, and power cables rated up to 1 kV.
 - 4) 2-part mold body with tongue and groove seams and built in spacer webbing.
 - 5) Manufacturer: One of the following or equal:
 - a) 3M - Scotchcast 72-N.
- g. Heat shrink tubing:
 - 1) Suitable for indoors, outdoors, overhead, direct burial or submerged applications.
 - 2) Minimum shrink ratio: 4 to 1.
 - 3) Continuous operating temperature: -55 degrees Celsius to 110 degrees Celsius.
 - 4) Internally applied adhesive sealant.
 - 5) Cross-linked polyolefin:
 - a) Manufacturers, one of the following or equal:
 - (1) 3M ITCSN.
 - (2) Thomas & Betts Shrink-Kon.
- h. Splices shall not be permitted for 600-volt circuits.
- 2. 120-volt conductors
 - a. Splices shall be permitted in 120-volt light and receptacle circuits.
- 3. Instrumentation class cable splices:
 - a. Splices shall not be permitted for control circuits.

- b. Suitable for indoor, outdoors, weather exposed, direct buried, or submersed applications.
- c. Utilizing an epoxy, polyurethane, and re-enterable compounds.
- d. For use with shielded or unshielded plastic- and rubber- jacketed, signal, control, and power cables rated up to 1 kilovolt.
- e. Two-part mold body with tongue and groove seams and built in spacer webbing.
- f. Manufacturer: The following or equal:
 - 1) 3M - Scotchcast 72-N.

C. Insulating Tape:

1. General purpose insulating tape:

- a. Minimum 7 mil vinyl tape.
- b. Suitable for application in an ambient of -18 degrees Celsius (0 degrees Fahrenheit).
- c. Operating range up to 105 degrees Celsius (220 degrees Fahrenheit).
- d. Flame retardant, hot- and cold- weather resistant, UV resistant.
- e. For use as a primary insulation for wire cable splices up to 600 VAC.
- f. Meeting and complying with:
 - 1) ASTM D-3005 Type I.
 - 2) UL 510.
 - 3) CSA C22.2.
- g. Manufacturer: One of the following or equal:
 - 1) 3M - Scotch Number Super 33+.

2. General-purpose color-coding tape:

- a. Minimum 7-mil vinyl tape.
- b. Suitable for application on PVC and polyethylene jacketed cables.
- c. For use indoors and outdoors in weather protected enclosures.

- d. Available with the following colors:
 - 1) Red.
 - 2) Yellow.
 - 3) Blue.
 - 4) Brown.
 - 5) Gray.
 - 6) White.
 - 7) Green.
 - 8) Orange.
 - 9) Violet.
 - e. For use as phase identification, marking, insulating, and harnessing.
 - f. Meeting and complying with:
 - 1) UL 510.
 - 2) CSA C22.2.
 - g. Manufacturer: One of the following or equal:
 - 1) 3M - Scotch Number 35.
3. Fire and electric arc proofing tape:
- a. Minimum 30-mil, flexible, elastomer tape that expands in fire to form an insulating firewall between flame and cable.
 - b. Bind in place with glass cloth electrical tape.
 - c. Manufacturer: One of the following or equal:
 - 1) 3M - Scotch Number 77.
4. Glass cloth electrical tape:
- a. 7.4-mil thermosetting silicone adhesive that performs at Class H temperatures 180 degrees Celsius (356 degrees Fahrenheit).
 - b. Use for the following applications:
 - 1) To secure non-PSA insulations such as glass in high-temperature areas.
 - 2) Splice wire rated at 150 degrees Celsius, 180 degrees Celsius, 200 degrees Celsius.
 - 3) For binding Fire and Electric Arc Proofing Tape.

- c. Meeting and complying with:
 - 1) MIL-I-19166C.
 - 2) UL Recognized Component listing for 200 degrees Celsius (Guide OANZ2, File E17385).
 - 3) CSA accepted component 180 degrees Celsius file LR93411.
 - d. Manufactured by one of the following or equal:
 - 1) 3M - Scotch Number 69.
5. Self-fusing silicone rubber tape:
- a. 12-mil, high-temperature, track resistant, insulating tape.
 - b. Composed of fully cured inorganic silicone rubber.
 - c. Use as a protective overwrap for terminating medium voltage cables.
 - d. Manufactured by one of the following or equal:
 - 1) 3M - Scotch Number 70.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Section 26 05 00.
- B. Load connections:
 - 1. Connect loads to the circuits as indicated. Color-code all branch circuits per Section 26 05 19.
- C. Zero to 600-Volt systems:
 - 1. Make all connections with the proper tool and die as specified by the device manufacturer.
 - 2. Use only tooling and dies manufactured by the device manufacturer.
 - 3. Insulate all connections and splices with Scotch 33+ tape and Scotchfill, or pre-molded plastic covers, or heat shrink tubing and caps.
 - 4. Number all power and control wires before termination.

- D. Motor connections (600 Volts and Below):
 - 1. Terminate wires with compression type ring lugs at motors.
 - 2. Connection at both the motor leads and the machine wires are to have ring type compression lugs.
 - 3. Cover bolted connectors with a heat shrinkable, cross-linked polyolefin material formed as a single opening boot:
 - a. In damp and wet locations, use a complete kit containing mastic that shall seal out moisture and contamination.
 - b. Shrink cap with low heat as recommended by manufacturer.
 - 4. Wire markers shall be readable after boot installation.
 - 5. Manufacturer: one of the following or equal:
 - a. Raychem MCK.

3.2 CLEANING

- A. Refer to Section 26 05 00.
- B. Clean and vacuum enclosures to remove metal filings, surplus insulation, and visible dirt, dust, and other matter before starting system or energization of equipment.
- C. Do not use compressors or air blowers for cleaning.

3.3 DEMONSTRATION AND TRAINING

- A. Refer to Section 26 05 00.

3.4 FIELD QUALITY CONTROL

- A. Refer to Section 26 05 00.

3.5 PROTECTION

- A. Refer to Section 26 05 00.

END OF SECTION

SECTION 26 20 00

LOW-VOLTAGE AC INDUCTION MOTORS

PART 1 GENERAL

1.1 RELATED SECTIONS

- A. This section applies only when referenced by a motor-driven equipment specification. Application, horsepower, enclosure type, mounting, shaft type, synchronous speed, and deviations from this section will be listed in the equipment specification. Where such deviations occur, they shall take precedence over this section.

1.2 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Bearing Manufacturers Association (ABMA):
 - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
 - b. 11, Load Ratings and Fatigue Life for Roller Bearings.
 - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 - b. 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines.
 - c. 841, Standard for Petroleum and Chemical Industry—Premium Efficiency Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 hp).
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C50.41, Polyphase Induction Motors for Power Generating Stations.
 - c. MG 1, Motors and Generators.
 - 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 5. Underwriters Laboratories (UL):
 - a. 83, Standard for Safety for Thermoplastic-Insulated Wire and Cables.

- b. 674, Standard for Safety for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.
- c. 2111, Standard for Safety for Overheating Protection for Motors.

1.3 DEFINITIONS

- A. CISD-TEFC: Chemical industry, severe-duty enclosure.
- B. DIP: Dust-ignition-proof enclosure.
- C. EXP: Explosion-proof enclosure.
- D. Inverter Duty Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Parts 30 and 31.
- E. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.
- F. ODP: Open drip-proof enclosure.
- G. TEFC: Totally enclosed, fan-cooled enclosure.
- H. TENV: Totally enclosed, nonventilated enclosure.
- I. WPI: Open weather protected enclosure, Type I.
- J. WPIL: Open weather protected enclosure, Type II.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Descriptive information.
 - 2. Nameplate data in accordance with NEMA MG 1.
 - 3. Additional Rating Information:
 - a. Service factor.
 - b. Locked rotor current.
 - c. No load current.
 - d. Adjustable frequency drive motor load classification (for example, variable torque) and minimum allowable motor speed for that load classification.

4. Enclosure type and mounting (such as, horizontal, vertical).
5. Dimensions and total weight.
6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
7. Bearing type.
8. Bearing lubrication.
9. Bearing life.
10. Space heater voltage and watts.
11. Description, ratings, and wiring diagram of motor thermal protection.
12. Motor sound power level in accordance with NEMA MG 1.
13. Maximum brake horsepower required by the equipment driven by the motor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this section shall be products of:
 1. General Electric.
 2. Reliance Electric.
 3. MagneTek.
 4. Siemens Energy and Automation, Inc., Motors and Drives Division.
 5. Baldor.
 6. U.S. Electrical Motors.
 7. TECO-Westinghouse Motor Co.
 8. Toshiba International Corp., Industrial Division.
 9. WEG Electric Motors Corp.

2.2 GENERAL

- A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.
- B. In order to obtain single source responsibility, use a single supplier to provide drive motor, its driven equipment, and specified motor accessories.
- C. Meet requirements of NEMA MG 1.

- D. For motors used in hazardous (classified) locations, Class I, Division 1, Groups B, C, and D, and Class II, Division 1, Groups E, F, and G provide motors that conform to UL 674 and have an applied UL listing mark.
- E. Motors shall be specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.
- F. Lifting lugs on motors weighing 100 pounds or more.
- G. Operating Conditions:
 1. Maximum ambient temperature not greater than 40 degrees Celsius.
 2. Motors shall be suitable for operating conditions without reduction being required in nameplate rated horsepower or exceeding rated temperature rise.
 3. Overspeed in either direction in accordance with NEMA MG 1.

2.3 HORSEPOWER RATING

- A. As designated in motor-driven equipment specification.
- B. Constant Speed Applications: Brake horsepower of driven equipment at any head capacity point on pump curve not to exceed motor nameplate horsepower rating, excluding service factor.
- C. Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake horsepower at any head capacity point on pump curve not to exceed motor nameplate horsepower rating, excluding service factor.

2.4 SERVICE FACTOR

- A. Inverter-duty Motors: 1.0 at rated ambient temperature, unless otherwise noted.
- B. Other Motors: 1.15 minimum at rated ambient temperature, unless otherwise noted.

2.5 VOLTAGE AND FREQUENCY RATING

- A. System Frequency: 60 Hz.
- B. Voltage Rating: Unless otherwise indicated in motor-driven equipment specification:

Voltage Rating		
Size	Voltage	Phase
1/2 hp and smaller	115	1
3/4 hp through 400 hp	460	3
450 hp and larger	4,000	3

- C. Suitable for full voltage starting.
- D. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

2.6 EFFICIENCY AND POWER FACTOR

- A. For all motors except single-phase, under 1 hp, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:
 - 1. Efficiency:
 - a. Tested in accordance with NEMA MG 1, Paragraph 12.59.
 - b. Guaranteed minimum at full load in accordance with NEMA MG 1, or as indicated in motor-driven equipment specification.
 - 2. Power Factor: Guaranteed minimum at full load shall be manufacturer's standard or as indicated in motor-driven equipment specification.

2.7 LOCKED ROTOR RATINGS

- A. Locked rotor kVA Code G or lower, if motor horsepower not covered by NEMA MG 1 tables.
- B. Safe Stall Time: 12 seconds or greater.

2.8 INSULATION SYSTEMS

- A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.
- B. Motors Rated Over 600 Volts: Sealed windings in accordance with NEMA MG 1.
- C. Three-phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specification, Class F at nameplate horsepower and designated operating conditions.

2.9 ENCLOSURES

- A. Enclosures to conform to NEMA MG 1.
- B. TEFC and TENV: Furnish with drain hole with porous drain/weather plug.

2.10 TERMINAL (CONDUIT) BOXES

- A. Oversize main terminal boxes for motors.
- B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.
- C. Except ODP, furnish gaskets between box halves and between box and motor frame.
- D. Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19 and NFPA 70, Article 430:

Terminal Box Usable Values		
Voltage	Horsepower	Percentage
Below 600	15 through 125	500
Below 600	150 through 300	275
Below 600	350 through 600	225
Above 600	All sizes	200

- E. Terminal for connection of equipment grounding wire in each terminal box.
- F. Coordinate motor terminal box conduit entries versus size and quantity of conduits shown on Drawings.

2.11 BEARINGS AND LUBRICATION

- A. Horizontal Motors:
 - 1. 3/4 hp and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
 - 2. 1 hp through 400 hp: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
 - 3. Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.
- B. Vertical Motors:
 - 1. Thrust Bearings:
 - a. Antifriction bearing.
 - b. Manufacturer's standard lubrication 100 hp and smaller.
 - c. Oil lubricated 125 hp and larger.
 - d. Minimum 50,000 hours L-10 bearing life.

- 2. Guide Bearings:
 - a. Manufacturer's standard bearing type.
 - b. Manufacturer's standard lubrication hp and smaller.
 - c. Oil lubricated 250 hp and larger.
 - d. Minimum 100,000 hours L-10 bearing life.
- C. Regreasable Antifriction Bearings:
 - 1. Readily accessible, grease injection fittings.
 - 2. Readily accessible, removable grease relief plugs.
- D. Oil Lubrication Systems:
 - 1. Oil reservoirs with sight level gauge.
 - 2. Oil fill and drain openings with opening plugs.
 - 3. Provisions for necessary oil circulation and cooling.
- E. Inverter Duty Rated Motors, Bearing Isolation: Motors larger than 50 hp shall have electrically isolated bearings to prevent stray current damage.

2.12 NOISE

- A. Measured in accordance with NEMA MG 1.
- B. Motors controlled by adjustable frequency drive systems shall not exceed sound levels of 3 dBA higher than NEMA MG 1.

2.13 BALANCE AND VIBRATION CONTROL

- A. In accordance with NEMA MG 1, Part 7.

2.14 EQUIPMENT FINISH

- A. External Finish: Prime and finish coat manufacturer's standard.
- B. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.15 SPECIAL FEATURES AND ACCESSORIES

- A. Nameplates:
 - 1. Raised or stamped letters on stainless steel or aluminum.
 - 2. Display motor data required by NEMA MG 1, Paragraph 10.39 and Paragraph 10.40 in addition to bearing numbers for both bearings.

3. Premium efficiency motor nameplates to display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor, and maximum allowable kVAR for power factor correction capacitors.
- B. Anchor Bolts: Provide meeting manufacturer's recommendations and of sufficient size and number for specified seismic condition.

2.16 SPECIAL MOTORS

- A. Requirements in this article take precedence over conflicting features specified elsewhere in this section.
- B. Inverter Duty Motor:
1. Motor supplied power by adjustable voltage and adjustable frequency drives shall be inverter duty rated.
 2. Suitable for operation over entire speed range indicated.
 3. Provide forced ventilation where speed ratio is greater than published range for motor provided.
 4. When installed in Division 1 hazardous (classified) location shall be identified as acceptable for variable speed when used in Division 1 location.
 5. Shaft Grounding Device: Motors larger than 20 hp shall be provided with shaft grounding brush or conductive micro fiber shaft grounding ring. Shaft grounding device shall be solidly bonded to grounded motor frame per manufacturer's recommendations.
 - a. Manufacturers:
 - 1) Grounding Brush: Sohre Turbomachinery, Inc.
 - 2) Grounding Ring: EST-Aegis.

2.17 FACTORY TESTING

- A. Tests:
1. In accordance with IEEE 112 for polyphase motors.
 2. Routine (production) tests in accordance with NEMA MG 1. Test multispeed motors at all speeds.
 3. For energy efficient motors, test efficiency and power factor at 50 percent, 75 percent, and 100 percent of rated horsepower:

- a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, Paragraph 12.59. and Paragraph 12.60.
- b. For motors 500 hp and larger where facilities are not available to test by dynamometer (Test Method B), determine efficiency by IEEE 112, Test Method F.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.

PART 3 EXECUTION

3.1 INSTALLATION

- A. In accordance with manufacturer's instructions and recommendations.
- B. Align motor carefully and properly with driven equipment.
- C. Secure equipment to mounting surface with anchor bolts.

3.2 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative at Site for installation assistance, inspection, equipment testing, and startup assistance for motors larger than 100 hp.

END OF SECTION

SECTION 26 22 13

LOW VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish and install three-phase general purpose MCC mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.2 RELATED SECTIONS

1.3 REFERENCES

- A. The transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, NEMA and UL.
- B. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Outline dimensions and weights
 - 2. Transformer ratings including:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic impulse level (BIL) for equipment over 600 volts
 - e. Design impedance
 - f. Insulation class and temperature rise
 - g. Sound level.
 - 3. Product data sheets

1.5 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes.
 - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
 - 2. Connection diagrams
 - 3. Installation information
 - 4. Seismic certification and equipment anchorage details as specified

1.6 QUALIFICATIONS

- A. The manufacturer of the dry-type distribution transformers shall be the same as the manufacturer of the other major electrical distribution equipment on the project.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer shall be a participant in the UL Data Acceptance Program (DAP) under the Client Test Data Program (CTDP) certification to ensure UL test methodologies and record traceability complies with the requirements of ISO 17025.
- D. Transformer must bear the UL Energy Efficiency Verification Mark to confirm that the unit meets the requirements of 10 CFR Part 431.
- E. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

- A. All transformers shall be UL listed and bear the UL label.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton
- B. Allen Bradley
- C. Approved equal.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.2 RATINGS

- A. The kVA and voltage ratings shall be as indicated on the drawings.
- B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
- C. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".
- D. Transformers efficiency shall be measured according to federal law 10 CFR Part 431.
- E. Transformer sound levels shall not exceed 45dB for self-cooled ratings.

A. Insulation Systems

1. Transformer insulation system shall be as follows:

- a. Less than 15 kVA: 180 degrees Celsius insulation system with 115 degree Celsius rise, encapsulated design; 15 kVA and above: minimum of 200 degrees Celsius insulation system with 115 degree Celsius rise, ventilated design.

-- *OR--

- b. 1 – 75 kVA, three-phase (37.5 kVA, single-phase): 180 degrees Celsius insulation system with 115 degree C rise, encapsulated design; 5-45 kVA minimum of 200 degrees Celsius insulation system with 115 degree Celsius rise; 50 kVA and above: minimum of 220 degrees Celsius insulation system with 115 degree Celsius rise, ventilated design.

2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees Celsius maximum ambient, and a 24-hour average ambient of 30 degrees Celsius.

3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.
- B. Core and Coil Assemblies
1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.
- C. Taps
1. Three-phase transformers rated 15 through 225 kVA shall be provided with six 2-1/2 percent taps, two above and four below rated primary voltage. Three-phase transformers rated greater than 225 kVA shall be provided with manufacturer's standard taps for that rating.
 2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.
- A. Recommended external cable shall be rated 90 degrees Celsius (sized at 75 degrees Celsius ampacity) for encapsulated and 75 degrees Celsius for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.5 ENCLOSURE

- A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees Celsius per UL requirement. The core of the transformer shall be grounded to the enclosure.
- B. The enclosure construction shall be encapsulated, totally enclosed, non-ventilated, NEMA 1G.
- C. Transformer shall be placed inside the MCC structure.

2.6 FINISH

- A. Steel enclosures shall be finished with ANSI 61 color, weather-resistant enamel. Stainless steel enclosures shall not be painted.

3.1 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - 1. Ratio tests at the rated voltage connection and at all tap connections
 - 2. Polarity and phase relation tests on the rated voltage connection
 - 3. Applied potential tests
 - 4. Induced potential test
 - 5. No-load and excitation current at rated voltage on the rated voltage connection

3.2 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.3 FIELD ADJUSTMENTS

- A. Adjust taps to deliver appropriate secondary voltage.

3.4 FIELD TESTING

- A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish and install the panelboards as specified and as shown on the contract drawings.

1.2 REFERENCES

- A. The panelboards and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL as follows:
 - 1. UL 67 – Panelboards
 - 2. UL 50 – Cabinets and boxes
 - 3. NEMA PB1
 - 4. Fed. Spec. W-P-115C
 - 5. UL98 – Fusible Switches

1.3 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Breaker layout drawing with dimensions indicated and nameplate designation
 - 2. Component list
 - 3. Conduit entry/exit locations
 - 4. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - 5. Cable terminal sizes
 - 6. Product data sheets

1.4 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in Paragraph 1.04, and shall incorporate all changes made during the manufacturing process

2. Installation information
3. Seismic certification and equipment anchorage details as specified

1.5 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.6 REGULATORY REQUIREMENTS

- A. Panelboard overcurrent protective devices shall be selectively coordinated with all supply side overcurrent protective devices as required for this project by the National Electrical Code/NFPA 70 Articles 645.27, 700.32, 701.32 and 708.54.
- B. The panelboards shall be UL labeled.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.8 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Allen Bradley

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.2 RATINGS

- A. Panelboards rated 240 VAC or less shall have short-circuit ratings as shown on the drawings or panelboard schedules, but not less than 10,000 amperes RMS symmetrical.
- B. Panelboards rated 480 VAC shall have short-circuit ratings as shown on the drawings or panelboard schedules, but not less than 14,000 amperes RMS symmetrical.
- C. Panelboards shall be labeled with a UL short-circuit rating. Series rated panelboards shall be provided with a label or manual stating the conditions of the UL series ratings. Information in the manual shall include, at minimum:
 - 1. Size and type of upstream device
 - 2. Branch devices that can be used
 - 3. UL tested and listed series short-circuit rating

2.3 CONSTRUCTION

- A. Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
- B. Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner's option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.
- C. Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.
- D. Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.
- E. A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.
- F. All locks shall be keyed alike.
- G. Panelboard shall be part of the MCC structure.

2.4 BUS

- A. Main bus bars shall be tin-plated copper sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees Celsius above an ambient of 40 degrees Celsius maximum.
- B. A system ground bus shall be included in all panels.
- C. Full-size (100 percent-rated) insulated stand-off neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200 percent-rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.5 BRANCH CIRCUIT PANELBOARDS – CIRCUIT BREAKER

- A. The minimum short-circuit rating for branch circuit panelboards shall be 10,000 amperes symmetrical at 240 volts, and 14,000 amperes symmetrical at 480 volts, or as indicated on the drawings. Panelboards shall be series rated.
- B. Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
- C. All circuit breakers shall be thermal-magnetic type with common handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame. Ratings through 100-ampere trip shall take up the same pole spacing. Circuit breakers shall be UL listed as type SWD for lighting circuits.
 - 1. Circuit breaker handle locks (ON position) shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

2.6 ENCLOSURE

- A. Enclosures shall be at least 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.
- B. Enclosures shall be provided with blank ends.

- C. Where indicated on the drawings, branch circuit panelboards shall be column width type.
- D. Panelboard shall be part of MCC structure.

2.7 NAMEPLATES

- A. Provide an engraved nameplate for each panel section.

2.8 FINISH

- A. Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray ANSI 61 paint applied.

PART 3 EXECUTION

3.1 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.2 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

END OF SECTION

SECTION 26 27 00

SERVICE AND DISTRIBUTION

PART 1 GENERAL

1.1 SCOPE

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. Work consists of providing the complete service and distribution system shown on the drawings and specified herein. The requirements of all other sections of the specification are equally applicable to the work to be performed under this section.

1.2 GENERAL

- A. See CONDITIONS OF THE CONTRACT and Division 1, GENERAL REQUIREMENTS, and Section 26 05 00, ELECTRICAL - GENERAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are necessary for this project.

1.3 SUBMITTALS AFTER AWARD OF CONTRACT

- A. Submittals after award of Contract shall be made in accordance with Division 1, GENERAL REQUIREMENTS, and Section 26 05 00, ELECTRICAL - GENERAL REQUIREMENTS.
- B. Provide complete coordination study of the electrical system. Include trip settings and trip curves for each overcurrent device provided in the project, including, but not necessarily limited to, the circuit breaker mounted in the generator, main circuit breaker/service disconnect, motor control center (MCC), motor starters, and panelboards. The coordination study shall conform to the requirements of the latest IEEE standard 242 – Protection and Coordination.
- C. The Contractor shall submit a coordination study report to the Engineer for review prior to project completion. The Engineer may direct the Contractor to make adjustments to trip settings based on the coordination study report findings. These adjustments shall be at no additional cost to the Owner.

1.4 ELECTRICAL SERVICE

- A. The utility company rendering electrical service to this project is Pacific Power. Furnish all labor and install all material not furnished by the utility company, including meter

bases, CT cans, and transformer pads or poles as shown, or as required by utility company to render service to the project from utility service point. Verify service point metering requirements, pad construction details, service charges, etc., and include all costs in bid proposal.

- B. Provide ground services as required to satisfy utility company and code requirements.
- C. Provide trenching and backfill at locations shown on the plans and as required by the utility company for service cable to the project site.
- D. For utility service conduit, provide sweeps per utility company standards.
- E. Verify all pull boxes, transformer details, and cable details with the utility company and observe utility company standards throughout.
- F. The Contractor shall pay all Power Company fees.

1.5 SYSTEM VOLTAGE CHARACTERISTICS

- A. Provide electrical system nominal utilization voltage characteristics as follows:

Typical Voltage Description Herein	Nominal Utilization Voltage
480/277	460/265
120/208	115/200
120/240	115/230

PART 2 PRODUCTS

2.1 UTILITY METERING

- A. As shown in the drawings, provide a separate NEMA 3R EUSERC approved commercial metering switchboard section, bottom feed for underground service termination. Main lugs only ampere rating as shown in the drawings. Metering section shall include a metering and CT compartment, or as required by the Utility company to provide service to the project.

2.2 MOTOR CONTROL CENTER

- A. As specified in Section 26 24 19.

PART 3 EXECUTION

3.1 EQUIPMENT BASES

- A. Provide equipment bases for all floor-mounted electrical equipment. Unless otherwise indicated, bases shall be poured-in-place concrete, nominally four inches high, and be one inch larger on all exposed edges than the equipment to be mounted. Provide additional surface-mounted channels where required to match and lineup with existing equipment. Provide concrete pads and mounting provisions for all exterior equipment as indicated on the drawings or specified in other portions of the specifications.

3.2 SUPPORTS

- A. Provide hangers or other devices such as pads, channels, struts, joists, anchors, etc., necessary for the support of electrical equipment. Provide the design, fabrication and erection of supplementary structural framing electrical equipment. Show on shop drawing supplementary framing including design loads, member size and location. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.

3.3 DAMP AND WET LOCATION

- A. Provide 1/4-inch air space behind all electrical equipment mounted in damp and wet locations and on concrete walls below grade. Use corrosion-resistant washers, bolts and anchors.

END OF SECTION

SECTION 26 27 16

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

1.3 REFERENCES

- A. NECA (National Electrical Contractors Association) -Standard of Installation.
- B. National Electrical Manufacturers Association.
 - 1. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000V Maximum).

1.4 SUBMITTALS

- A. Section 01 33 00
- B. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.

1.5 EXTRA MATERIALS

- A. Furnish two of each key.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be labeled and/or listed as acceptable to the authority having jurisdiction as suitable for the use intended.

2.2 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 1, 3R or 4 steel, stainless steel or fiberglass enclosure as indicated on Drawings.
- B. Covers: Continuous hinge, held closed by hasp and staple for padlock.
- C. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.
- D. Enclosure Finish: Manufacturer's standard enamel.

2.3 CABINETS

- A. Boxes: Galvanized steel.
- B. Box Size: As shown on Drawings.
- C. Fronts: Steel, surface type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- D. Furnish metal barriers to form separate compartments for wiring of different systems and voltages.
- E. Furnish accessory feet for free-standing equipment.

2.4 TERMINAL BLOCKS

- A. Manufacturers:
 - 1. Allen Bradley
 - 2. AMP
 - 3. Ideal Industries
 - 4. Ilsco Corp.
 - 5. Phoenix Contact
 - 6. Weidmuller
- B. Terminal Blocks: NEMA ICS 4
- C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- E. Furnish ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Maintain access to existing cabinets and enclosures and other installations remaining active and requiring access. Modify installation or provide access panel.
- B. Clean and repair existing cabinets and enclosures to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 26 05 29.
- C. Install cabinet fronts plumb.

3.3 CLEANING

- A. Clean electrical parts to remove conductive and harmful materials.
- B. Remove dirt and debris from enclosure.
- C. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 28 16

DISCONNECT SWITCHES

PART 1 GENERAL

1.1 WORK INCLUDED:

- A. Provide switches of proper characteristics as disconnecting means.

1.2 SUBMITTALS:

- A. Shop Drawings: Indicate field dimensions, description of materials and finishes, component connections, anchorage methods, hardware, and installation procedures.
- B. Disconnects, Rejection Fuse Clips - Product data.
- C. Operating and Maintenance Data.

1.3 WORK IN RELATED SECTIONS

- A. 26 05 53 Identification for Electrical Systems.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. General Electric, Siemens, Schneider Electric, Square D, Cutler Hammer or approved equal.

2.2 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 and indicating handle that will accept a minimum of three padlocks.
- B. Enclosures shall be NEMA 3 for use in the pump and valve house, 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.
- D. Rejection Fuse Clips: Provide for fusible switches (30 to 600A) to prevent the installation of Class H and Class K non-current-limiting fuses.

PART 3 EXECUTION

3.1 DISCONNECT SWITCHES:

- A. Provide all code required disconnect switches under this work, whether specifically shown or not.
- B. Provide one manufacturer for all disconnect switches on the project.
- C. Disconnect switches shall be installed as recommended by the manufacturer and shall be square with the building structural lines.
- D. Install fuses in all fused switches.
- E. Provide identification as specified in Section 26 05 53.

END OF SECTION

SECTION 26 28 16.13

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes requirements for:
 - 1. Low voltage molded case circuit breakers.

1.2 REFERENCES

- A. As specified in Section 26 05 00.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. AB 1. - Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures.
 - 2. AB 3. - Molded Case Circuit Breakers and Their Application.
- C. Underwriter's Laboratories (UL):
 - 1. UL 489- Molded Case Circuit Breakers and Circuit Breaker Enclosures.
 - 2. UL 943- Ground Fault Circuit Interrupters.

1.3 DEFINITIONS

- A. As specified in Section 26 05 00.
- B. In accordance with UL 489.

1.4 SYSTEM DESCRIPTION

- A. Molded case thermal magnetic (current limiting) or motor circuit protector (MCP) type circuit breakers where indicated on the Drawings and connect to form a completed system:
 - 1. Molded case circuit breakers (MCCB) used to open and close a circuit, and to open a circuit automatically on a predetermined overload or over current, without damage to itself when properly applied within its rating.
 - 2. Circuit breakers rated 1000 Amps or more to operate as the main disconnect means in Motor Control Centers (MCC) shall be provided with ground fault protection and LSIG electronic trip unit.

1.5 SUBMITTALS

- A. Furnish submittals in accordance with Sections 01 33 00 and 26 05 00.
- B. Product Data:
 - 1. Catalog cut sheets.
 - 2. Manufacturer's time-current curves for all molded case circuit breakers furnished.

1.6 QUALITY ASSURANCE

- A. As specified in Section 26 05 00.
- B. Low voltage molded case circuit breakers shall be UL listed and labeled.

1.7 DELIVERY, STORAGE AND HANDLING

- A. As specified in Section 26 05 00.

1.8 PROJECT OR SITE CONDITIONS

- A. As specified in Section 26 05 00.

1.9 WARRANTY

- A. As specified in Section 26 05 00.

1.10 SYSTEM START UP

- A. As specified in Section 26 05 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. One of the following or equal:
 - 1. Eaton/Cutler-Hammer.
 - 2. Allen Bradley.
 - 3. General Electric Company.
 - 4. Schneider Electric/Square D Company.
 - 5. ABB.

2.2 MANUFACTURED UNITS

- A. General:
 - 1. Conforming to UL 489.

2. Operating mechanism:
 - a. Quick-make, quick-break, non-welding silver alloy contacts.
 - b. Common Trip, Open and Close for multi-pole breakers such that all poles open and close simultaneously.
 - c. Mechanically trip free from the handle.
 - d. Trip indicating handle - automatically assumes a position midway between the manual ON and OFF positions to clearly indicate the circuit breaker has tripped.
 - e. Lockable in the "OFF" position.
 3. Arc Extinction:
 - a. In arc chutes.
 4. Voltage and Current Ratings:
 - a. Minimum ratings as indicated on the Drawings.
 - b. Minimum frame size 100A.
 5. Interrupting Ratings:
 - a. Minimum ratings as indicated on the Drawings.
 - b. Modify as required to meet requirements of Contractor's Short Circuit Fault Analysis - As specified in Section 26 05 73.
 - c. Not less than the rating of the assembly (panelboard, switchboard, motor control center, etc.)
 6. Selective Coordination Requirements:
 - a. All system distribution breakers shall have adjustable solid state LSI (long, short, and instantaneous) adjustable trip and adjustable delay units that allow for field adjustment in order to comply with the selective coordination requirements of NEC Article 701 as determined by the protective device coordination study required – As specified in Section 26 05 73.
- B. Motor Circuit Protectors:
1. Instantaneous (magnetic) only circuit breaker as part of a listed combination motor controller.
 2. Each pole continuously adjustable in a linear scale with 'LO' and 'HI' settings factory calibrated.

2.3 COMPONENTS

A. Terminals:

1. Copper line and load terminals suitable for the conductor type, size, and number of conductors in accordance with UL 489.
2. UL listed for Copper conductors.

B. Case:

1. Molded polyester glass reinforced.
2. Tamper proof.
3. Ratings clearly marked.

C. Trip units:

1. Instantaneous (magnetic) short circuit protection.
2. Inverse time delay overload (thermal).
3. Ambient or enclosure compensated by means of a bimetallic element.

D. Molded case circuit breakers for use in panelboards:

1. Bolt-on type.
2. Plug-in type breakers are not acceptable.
3. Ground fault trip devices where indicated on the Drawings.

E. Molded Case Circuit Breakers For Use In MCC's and Incoming Service:

1. "Push-to-Trip" button or a "Twist-to-Trip" adjustment on the breaker front to mechanically simulate an overcurrent trip not operated by the ON-OFF handle.
2. Provide trip mechanism as indicated on the Drawings:
 - a. Thermal magnetic.
 - b. Thermal high magnetic.
 - c. Solid State:
 - 1) Adjustable current setting.
 - 2) Adjustable long time delay.
 - 3) Adjustable short time pickup.
 - 4) Adjustable short time delay.
 - 5) Adjustable instantaneous pickup.
 - 6) Adjustable ground fault pickup (where shown on the drawings).
 - 7) Adjustable ground fault delay (where shown on the drawings).

8) Long time pickup indicator.

3. Fault Indicators:

- a. Mechanical or powered from a separate battery and charger that is an integral component of the MCC.
- b. Overload fault trip indication.
- c. Short circuit fault trip indication.
- d. Ground fault trip indication (where applicable).

2.4 ACCESSORIES

A. Lockable handle:

- 1. Provide assembly to lock operating handle in 'OPEN' position.

2.5 SOURCE QUALITY CONTROL

A. Test breakers in accordance with:

- 1. UL 489.
- 2. Manufacturer's standard testing procedures.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install breakers to correspond to the accepted shop drawings.

3.2 ADJUSTING

- A. Adjust trip settings in accordance with Protective Device Coordination Study as accepted by the Engineer and in accordance with manufacturer's recommendations.
- B. Adjust motor circuit protectors in accordance with NEC and the manufacturer's recommendation based on the nameplate values of the installed motor.

3.3 PROTECTION

- A. As specified in Section 26 05 00.

END OF SECTION

SECTION 26 28 16.16

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes requirements for:
 - 1. Fusible and non-fusible disconnect switches.
 - 2. Non-automatic transfer switches.

1.2 REFERENCES

- A. As specified in Section 26 05 00.
- B. Underwriters Laboratories Inc. (UL):
 - 1. UL-20 - UL standards for General-Use Snap Switches.
 - 2. UL-98 - UL standards for Enclosed and Dead-Front Switches.
 - 3. UL-508 - UL standards for Industrial Control Equipment.
 - 4. UL1008 – Transfer Switch Equipment
- C. National Electric Manufacturer’s Association (NEMA):
 - 1. KS 1-2001- Enclosed Disconnect Switches.
 - 2. 250 - Enclosures for Electrical Equipment.
 - 3. ICS1 – Industrial Control and Systems: General Requirements
 - 4. ICS6 – Enclosures.
- D. American National Standards Institute (ANSI) Publication:
 - 1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment.
- E. International Electrical Testing Association (NETA):
 - 1. Acceptance Testing Specifications (ATS) for Electrical Power Distribution Equipment and Systems.

1.3 DEFINITIONS

- A. As specified in Section 26 05 00.
- B. Specific Definitions:
 - 1. Safety Switches and Disconnect Switches are to be considered synonymous.

1.4 SYSTEM DESCRIPTION

- A. Provide heavy-duty type disconnect switches where indicated on the Drawings and in the Specifications.
- B. Provide disconnect switches, with the number of poles, voltage, current, short circuit, and horsepower ratings, as required by the load and the power system.

1.5 SUBMITTALS

- A. Furnish submittals in accordance with Sections 01 33 00 and 26 05 00.
- B. Product Data:
 - 1. Manufacturer.
 - 2. Manufacturer's specifications and description.
 - 3. Ratings:
 - a. Voltage.
 - b. Current.
 - c. Horsepower.
 - d. Short Circuit rating.
 - 4. Fused or non-fused.
 - 5. NEMA enclosure type.
 - 6. Dimensions:
 - a. Height.
 - b. Width.
 - c. Depth.
 - 7. Weight.
 - 8. Dimensioned drawings.
 - 9. Elementary diagrams.
 - 10. Wiring diagrams.
 - 11. Nameplate list.
 - 12. Evidence that the equipment will be provided with all specified accessories, options, features, and characteristics.

- 13. Certifications that the equipment is designed and manufactured in conformance with applicable codes and standards.
- C. Manual. Provide manufacturer's installation and maintenance instruction manuals in conformance with Section 26 05 00, Common Work Results for Electrical.
- D. Shop Drawings:
 - 1. Manufacturer's Installation Instructions:
 - a. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Quality Assurance, Regulatory Requirements.
 - b. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
 - 2. Identify motor or equipment served by each switch; indicate nameplate inscription.
- E. Installation Instructions:
 - 1. Provide anchorage instructions and requirements based on the seismic requirements at the project site as indicated in Section 26 05 00 and calculations stamped by a Professional Engineer registered in the State of Oregon.

1.6 QUALITY ASSURANCE

- A. As specified in Section 26 05 00.
- B. Regulatory Requirements:
 - 1. NEMA KS1- Enclosed Disconnect Switches.
 - 2. UL 98 - UL standards for Enclosed and Dead-Front Switches.
 - 3. UL 1008 – Transfer Switch Equipment.
- C. Disconnect switches shall be UL listed and labeled.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 26 05 00.

1.8 PROJECT OR SITE CONDITIONS

- A. As specified in Section 26 05 00.

1.9 WARRANTY

- A. As specified in Section 26 05 00.

1.10 SYSTEM STARTUP

- A. As specified in Section 26 05 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Disconnect switches: One of the following or equal:
 - 1. Schneider Electric/Square D Company.
 - 2. Eaton/Cutler-Hammer.
 - 3. General Electric.
 - 4. Siemens.
 - 5. Appleton.
 - 6. Crouse-Hinds.

- B. Non-automatic transfer switch: One of the following or approved equal:
 - 1. Schneider Electric/Square D Company.
 - 2. Eaton/Cutler-Hammer.
 - 3. General Electric.
 - 4. Siemens.
 - 5. ASCO Series 7000.

2.2 EQUIPMENT

- A. Disconnect Switch
 - 1. Switch Mechanism:
 - a. Quick-make, quick-break heavy-duty operating mechanisms:
 - 1) Provisions for padlocking the switch in the OFF position.
 - 2) A minimum of 90-degree handle travel position between OFF and ON positions:
 - a) Provide handle position indicators to identify the handle position.
 - 3) Full cover interlock to prevent opening of the switch door in the ON position and to prevent closing the switch mechanism with the door open:
 - a) With an externally operated override.

2. Switch Interior:
 - a. Switch blades visible when the switch is OFF and the cover is open.
 - b. Lugs, front accessible and removable and UL listed for:
 - 1) 60/75 degrees Celsius copper conductors.
 - c. Current carrying parts completely plated to resist corrosion.
 - d. Removable arc suppressors to facilitate easy access to line side lugs.
 - e. Furnish equipment ground kits for every switch.
3. Fused switches:
 - a. UL approved for field conversion from standard Class H fuse spacing to Class J fuse spacing:
 - 1) Ratings 100 amperes through 600 amperes at 240 volts.
 - 2) Ratings 30 amperes through 600 amperes at 600 volts.
 - 3) Provide spring reinforced and plated fuse clips.
4. Ratings:
 - a. UL horsepower rated for AC or DC with the rating not less than the load served.
 - b. Current:
 - 1) 30 to 1200 amperes.
 - c. Voltage:
 - 1) 250 Volts AC, DC.
 - 2) 600 Volts (30 A to 200 A, 600 Volts DC).
 - d. Poles:
 - 1) 2, 3, 4, and 6 poles.
 - e. UL Listed short circuit ratings:
 - 1) 10,000 RMS symmetrical amperes when used with or protected by Class H or K fuses (30-600 amperes).
 - 2) 200,000 RMS symmetrical amperes when used with or protected by Class R or J fuses (30-600 amperes employing appropriate fuse rejection).

- 3) 200,000 RMS symmetrical amperes when used with or protected by Class L fuses (800-1200 amperes).
 - f. Where not indicated on the Drawings, provide switches with the NEMA ratings indicated in Section 26 05 00 for the installed location.
 5. Size, fusing and number poles as indicated on the Drawings or as required:
 6. Provide solid neutral where indicated on the Drawings.
 7. Provide heavy duty pre-wired receptacle disconnect switches for 3 phase, 3 wire, grounded type plugs. Interlock receptacle disconnect switch handle mechanisms so that power plugs may not be inserted or removed when switch is in the ON position:
 - a. 30 to 100 Amp fusible, non-fusible, or with circuit breaker as indicated on the Drawings.
 8. Local power disconnects for 480V electrical actuators shall be 3 pole, 600V, non-fusible, NEMA 4X SS, 16 UL Amps. Power disconnect shall be ABB EOT16U3S4-P or approved equal.
 9. Auxiliary Contacts. Two sets of Form C contacts shall be provided for disconnect switches on all VFD driven loads.
- B. Non-automatic Transfer Switch
1. General. The non-automatic transfer switch shall transfer from the normal service to an alternate service. The transfer shall not take place automatically but shall be initiated manually by operating personnel. Transfer back to the normal power supply shall also be initiated manually. The switch shall be UL listed and shall bear the UL label.
 2. Construction.
 - a. The non-automatic transfer switch shall be of the mechanically held double throw type and connected to the transfer mechanism by a simple over-center linkage. All main power contacts and auxiliary contacts shall be mechanically attached to a common shaft, shall be double-break silver alloy with wiping action, and shall be protected by arcing contacts. Arcing contacts shall close before and open after the main contacts and shall be readily replaceable. Contact design and arrangement shall permit repeated making and breaking of full-load current, in a combination of motor and other loads, without damage to the main contacts. Provide a main transfer mechanism utilizing rugged metal parts throughout. Molded circuit breaker type designs are not acceptable.

- b. The switch transfer shall be produced in such a way that a time delay of at least 0.4 seconds exists between the opening of the closed contacts and the closing of the open contacts. The transfer switch shall be capable of transferring in either direction with 70 percent of rated voltage applied at the switch terminals.
- c. All switch and relay contacts, coils, springs, and control elements shall be serviceable or removable from the front of the mounted switch and accessory assembly without the removal of either assembly from its compartment and without disconnection of drive linkages, power conductors, or control conductors.
- d. The enclosure shall be NEMA 12 construction with hinged doors on the front for access to the interior controls. Secure doors by a locking type latch. Provide two keys for the lock.
- e. Cable connections shall be accessible from the front without removing internal components.
- f. Safety Requirements.
 - 1) Arrange the electrical supply to each control panel to be disconnected by a single switch or circuit breaker, except for necessary foreign circuits. Cover any live parts within the control panel fed from foreign control or signal circuits or arrange for them to be disconnected by one of the following methods:
 - a) Enclosed relays which are automatically de-energized when the main disconnecting switch is opened; or
 - b) Door-operated enclosed disconnect switches; or
 - c) Clearly identified enclosed manually operated disconnect switches, which may be located inside the control panel door, provided the operating handles are isolated or barriered from all open live parts.
 - 2) Arrange the controls so that manipulation of control switches, adjustments to timing relays, or replacement of fuses can be done without exposure to live parts.
- g. The transfer switch shall have the following features:
 - 1) Continuous rating of 480 volts, 3-phase, with 3-poles and full neutral bus. Current rating shall be as shown on the Drawings.

- 2) Adequate line and load lugs for terminating the power conductors shown on the Drawings.
 - 3) A terminal strip with terminals for terminating all external control circuits. Number all terminals using the wire number for the wire terminated.
 - 4) Cable wiring with cable ties, secured in place and guarded where subject to mechanical injury.
 - 5) Permanent identification of each wire at each point of connection using numbered wiring sleeves. Provide electrically common wires with the same number. Uniquely number electrically different wires.
3. Controls. Include the following controls and accessories:
- a. Normal-Side/Emergency-Side source selector push buttons mounted on front of enclosure.
 - b. Provision for addition of remote push buttons to transfer from Normal-Side to Emergency-Side and vice- versa.
 - c. Indicating Lights. One each to indicate whether the switch is at Normal-Side or Emergency-Side position. Mount lights on front of switch enclosure.
 - d. Nameplates. Provide engraved lamacoid plastic nameplate for each control device and indicating lamp. Engraving shall be subject to review by the Engineer.
 - e. Transfer Relay. A relay to inhibit transfer unless the selected power source is at 90 percent or greater of rated voltage and frequency.
 - f. Transfer Delay. A timer to provide an adjustable delay of 1 to 5 seconds in the closing of the open switch contacts after the closed switch contacts are opened. Provide delay for switch operation in either direction.
 - g. Auxiliary Contacts. Two sets of Form C contacts which transfer whenever the switch transfers.
4. UL Label. The transfer switch shall have a UL label on the unit when it arrives at the site. Absence of the UL label shall be sufficient cause for the unit to be rejected. Provide all of the specified features, options, and accessories. If the manufacturer's standard UL unit does not have the specified features, options, or accessories, then provide alternative features, options, or accessories to accomplish the same purpose in a manner similar to that specified, while still providing a unit with a UL label.

5. Current Ratings. The transfer switch shall have continuous ampere rating and short circuit withstand rating for 3 cycles at 480 volts as shown on the Drawings.
6. Finish. Shall be manufacturer's standard not less than 3 mils thick. Color shall be light gray ANSI 61 per Z55.1.
7. Factory Tests. Assemble, wire and test the non-automatic transfer switch at the factory. Conduct tests to assure that every component functions properly. Submit prototype test reports on bus bracing for the Engineer's review.

2.3 ACCESSORIES

- A. Disconnect switches shall have provisions for a field installable "B" type electrical interlock for position indication.
- B. Disconnect switches shall have provisions for a field installed insulated groundable neutral kit.
- C. NEMA Type 7 and 9 enclosures shall be furnished with drain and breather kit when used in outdoor applications.
- D. Provide disconnect switches with at least one auxiliary contact.

PART 3 EXECUTION

3.1 INSTALLATION

- A. As specified in Section 26 05 00.
- B. Install disconnect switches per the manufacturer's guidelines and submitted installation instructions to meet the seismic requirements at the project site.
- C. General:
 1. Use Myers hubs or bolt-on hubs for all conduit penetrations on NEMA 12, 4, and 4X enclosures.
 2. Provide all mounting brackets, stands, supports, and hardware as required:
 - a. Match finish and materials for all brackets, stands, and hardware with the switch installed.
 - b. Provide adequate supporting pillar(s) for disconnect switches in accordance with the approved seismic calculations, and locate aboveground or above decks, where there is no structural wall or surface for box.

3. When possible, mount switches rigidly to exposed building structure or equipment structural members:
 - a. For NEMA 4 and 4X locations, maintain a minimum of 7/8-inch air space between the enclosure and supporting surface.
 - b. When mounting on preformed channel, position channel vertically so that water may freely run behind the enclosure.
 4. Provide a nameplate for each disconnect switch:
 - a. Provide per requirements specified in Section 26 05 53.
 - b. Identify voltage, circuit, fuse size, and equipment served on the nameplate.
- 3.2 FIELD QUALITY CONTROL
- A. As specified in Section 26 05 00.
- 3.3 CLEANING
- A. As specified in Section 26 05 00.
- 3.4 PROTECTION
- A. As specified in Section 26 05 00.
- 3.5 TESTING
- A. Field Tests. Perform the tests for non-automatic transfer switches as outlined in NETA. Submit reports for review by the Owner.

END OF SECTION

SECTION 26 29 24

ACTIVE FRONT END LOW VOLTAGE ADJUSTABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products Requirements.
 - 6. Coordination.
 - 7. Products.
 - 8. Execution.

1.2 SCOPE

- A. This specification specifies low voltage, adjustable frequency drives (AFDs), and variable frequency drives (VFDs). For the purpose of this specification the terms AFD and VFD are interchangeable and equivalent.
- B. The Variable-frequency Drive (VFD) system for motors rated 3Hp and larger shall use an Active Front End (AFE) Low Harmonic design and shall contain all components required to meet the performance, protection, safety and certification criteria of this specification.

Units shall utilize an insulated gate bipolar transistor (IGBT) technology as the input rectifier unit. This system shall be designed and configured such that IEEE 519 harmonic emission limits are inherently met without the need for external mitigation devices such as line reactors or filters.

- C. Refer to the drawings for control and monitoring requirements including special interlocking requirements.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI/IEEE C37.30A(1984)	Definitions and Requirements for High- Voltage Air Switches, Insulators, and Bus Supports, Supplement to C37.30-1971
ANSI C37.32	Schedules of Preferred Ratings, Manufacturing Specifications and Application Guide for High-Voltage Air Switches, Bus Supports, and Switch Accessories
NEMA ICS 1	General Standards for Industrial Controls and Systems
NEMA ICS 2	Standards for Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3	Industrial Systems
NEMA ICS 3.1	Safety Standards for Construction and Guide for Selection, Installation and Operation of Variable-speed Drive Systems
NEMA ICS 4	Terminal Blocks for Industrial Control Equipment and Systems
NEMA ICS 6	Enclosures for Industrial Controls and Systems
ANSI C37.90	Relays and Relay Systems Associated with Electric Power Apparatus
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
NFPA 70	National Fire Protection Association – US National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for a period of twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. Submittals requirements specified in: Section 01 33 00.
- B. Product Data: For each type of device and system:
1. A copy of this specification Section with addenda updates, and all referenced Sections, with addenda updates, with each paragraph check-marked to show specification compliance or marked to show deviations.
 2. Catalog and technical data indicating the equipment complies with the Construction Document.

3. Provide Seismic calculations for anchoring and support of equipment stamped by a Professional Engineer registered in the State of Oregon.
4. Installation instructions, outline dimensions and weights including filters and/or phase shifting autotransformers, front view drawing identifying control and monitoring devices, nameplate engravings, shipping section dimensions, weight, and foundation requirements or wall mounting requirements for all assemblies.
5. External connection diagram showing function and identification of all terminals requiring field connections.
6. O&M manuals per Section 01 33 00 and Section 26 05 00.
7. Product Data Sheets
 - a. VFD and Operator Interface publications.
 - b. Data sheets and publications on all major components including, but not limited to, the following:
 - 1) Contactors
 - 2) Circuit breaker and fuse (power and control)
 - 3) Control power transformers
 - 4) Pilot devices
 - 5) Relays/Timers
8. Schematics and wiring diagrams.
9. Plan drawings showing conduit entry locations.
10. Current and voltage distortion calculations.
 - a. Point of Common Coupling (PCC)
 - b. Include first 36 odd current and voltage harmonics. Voltage shall be calculated on line-to-line basis.
 - c. Provide distortion figures for each harmonic and the total demand distortion.
11. Efficiency and power factor calculations:
 - a. Calculate efficiencies of the VFD controller including the auto- transformer (where applicable), ventilation fans, control power and all VFD losses.
 - b. Calculate displacement and total power factor including filter.
 - c. Perform calculations at 100, 75, and 50 percent speed.

- d. Include first 36 harmonics.
- 12. Calculations of cooling and ventilation requirements.
- 13. Certified final factory test procedure and results for each drive.
- 14. Location and description of service center and spare parts stock.
- 15. Recommended spare parts list.
- 16. Factory and field test documentation.
- 17. Training schedule and materials.
- 18. Written descriptions explaining ladder diagram operation, system operation, and analog signal processing.
- 19. Comprehensive interconnection diagrams for VFD and motor.
- 20. In accordance with seismic anchoring requirements:
 - a. Certification of compliance with local code and seismic designation.
 - b. A sketch or description of the anchorage and restraint system.
- 21. Certification that VFD, motor, and driven load are compatible throughout the specified speed range.
- 22. Certified statement from the manufacturer accepting responsibility for providing a fully functioning installation as specified herein.

1.6 PRODUCT REQUIREMENTS

- A. The VFD system shall convert 460 volt, 60-Hertz nominal input to a suitable voltage and frequency to cause a premium efficient, inverter duty, squirrel- cage induction motor to run at a speed proportional to an external input analog 4 to 20 ma dc or digital input command as specified for the required VFD speed range.
- B. The VFD system shall include converter units, inverter units, control circuitry, protective equipment, load side DV/dt and sine wave filters, LCL filters and other filters and accessories as necessary to provide the specified functions to meet voltage and current harmonics at the specified point of common connection and to mitigate the motor reflected voltage wave. Unless otherwise specified, the point of common connection for VFDs shall be the 480V-distribution bus (motor control center, distribution panel, etc.) immediately upstream of the VFD.

- C. Active Front End Low Voltage Adjustable Frequency Drives.
 - 1. Listed and labeled by Underwriter’s Laboratories, Inc. (UL), ETL, or Factory Mutual (FM).
 - a. All upgrades to specified requirements per UL or ETL.
 - 2. QUALITY ASSURANCE: The Owner reserves the right to observe factory tests on the VFD controller at the Owner’s option and expense.
 - a. All inspection and testing procedures shall be developed and controlled under the guidelines of the supplier’s quality control system and must be registered to ISO 9001 and audited by a third party registrar.
 - 3. COMPATIBILITY: VFD controller’s performance shall be compatible and tolerant of disturbances produced by other VFD controllers and not interfere with each other.
 - 4. PROGRAMMING: Provide VFD controller configuration and MACRO or sub-routine programming to meet specified driven equipment requirements.
 - 5. MAINTAINABILITY: VFD controller’s parts shall be interchangeable and modular for all controllers.
- D. FACTORY TEST: Subject complete VFD system to a complete simulated operational test. Drive a calibrated load at various speeds over the specified speed range to determine VFD efficiency.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. See 26 05 00 – Section 1.7
- B. Contractor shall coordinate shipping of the equipment to the site with the manufacturer/supplier.

1.8 COORDINATION

- A. Obtain and review the appropriate data for the driven motor and load over the required speed range, for a complete system analysis. Verify that equipment is mutually compatible and free of resonance over the complete operating range. Coordinate the assignment of any critical frequencies with the equipment suppliers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Variable frequency drives shall be as manufactured by the vendors listed below. The Owner will not consider substitutions. To conform with specified requirements, a manufacturer's standard product may require modification.

1. Allen Bradley Powerflex 755 TL

2.2 SYSTEM

- A. The System shall use a transistor-based Active Front End as the input rectifier that uses a Selective Harmonic Elimination algorithm, mitigating the harmonics enough to meet IEEE-519-2014 without the need for phase shifting transformers and multi-pulse diode rectifiers. Total current harmonic distortion shall not exceed 5% at the VFD input terminals at full load conditions. AFE rectifier shall be phase rotation insensitive, tolerant of line voltage imbalance up to 10% without affecting the harmonic mitigation or VFD output, and capable of operating the motor at full output with a 10% drop on input voltage.
- B. The unit shall use an LCL filter assembly to filter up to and including the 50th harmonic to reduce EMI/RFI emissions. The LCL filter assembly shall include Passive Dampening. The drive will provide Active Resonance Detection and Protection to minimize any damage to the drive from supply side resonance: Provide integrated, all solid-state variable frequency drives (VFD) complete with incoming line reactors. Provide all components, with terminal numbers as shown on the Drawings.
- C. Operation: Accomplish speed control by adjusting the output frequency according to the desired reference speed. Adjust ac voltage and frequency simultaneously to provide the constant Volts/Hertz necessary to operate the motor at the desired speed. The VFD must use pulse width modulation (PWM) technology.
- D. The drive shall have a built-in circuit breaker as part of the drive's pre-charge circuit (250 hp and up) or provide built-in electrical connections for one to be field connected (10hp-250hp).
- E. The drive will have two sets of tuning settings for the configuration of the line side converter such that appropriate values can be selected for two input sources (example: main utility power or back-up generator) and can be selected from the Human Interface Module or communications network
- F. The VFD shall meet the voltage sag ride-through requirements of SEMI-F47.
- G. Incorporate phase-to-phase and phase-to-ground MOV protection on the AC input line.

- H. Microprocessor-based inverter and converter logic shall be isolated from power circuits.
- I. Use latest generation IGBT inverter and converter sections that shall not require commutation capacitors.
- J. Motor side inverters, line side converters and LCL filter modules (for drives greater than 250 Hp) shall be on roll-out chassis with front accessible connections for ease of repair or replacement and to provide access to load cables. Motor side inverter modules shall be removable without disturbing the load cables after installation.
- K. Line converter modules and load inverter modules sections (for drives greater than 250 Hp) shall be interchangeable so as to reduce necessary spare parts.
- L. Rating:
 - 1. Line Voltage: 480 volts, -5 percent continuous, -10 percent momentary, +10 percent, 3- phase.
 - 2. Line Frequency: 60 Hz, ± 2 Hz
 - 3. Ambient Temperature: 5°C to 40°C
 - 4. Altitude: Up to 3,300 feet above sea level.
 - 5. Power Factor: Above 0.95 at full speed and rated load.
- M. Performance:
 - 1. Efficiency: Above 95 percent at 100 percent full speed, above 93 percent at 70 percent full speed.
 - 2. VFD Inrush Current: Limited to less than 100 percent of motor full load
 - 3. Duty Cycle: 6 starts per hour.
 - 4. Flying Start: The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to “pick-up” the motor at the rotating speed.
- N. Features:
 - 1. Provisions to accept the following control signals for automatic and manual operation:
 - a. Ethernet communications port support Ethernet/IP protocol. All operating parameters and control functions shall be accessible via Ethernet communications.

- b. FWD & REV Run signal from a single remote contact closure when specified
 - c. A 4-20 mA dc signal for speed control. The VFD shall provide linear speed control of the motor from zero to full speed as the variable speed input signal varies from its minimum to maximum. Input impedance shall be 250 ohms resistive.
2. Have a lineside converter input frequency range from 47 to 63 Hz
 3. The carrier frequency of the lineside converter shall be fixed at 4 kHz.
 4. The motor side inverter frequency output will be sine coded PWM with a carrier frequency that can be selected at 1.33 kHz, 2 kHz, or 4 kHz.
 5. The VFD motor side inverter shall be capable of the following maximum frequency outputs:
 - a. 325 Hz when operating with an output carrier frequency of 1.33kHz or 2 kHz.
 - b. 590 Hz when operating with an output carrier frequency of 4kHz
 6. Use gold plated plug-in connections on printed circuit boards.
 7. Motor speed indicator calibrated in percent of full speed.
 8. A 4-20 mA dc signal for remote speed indication to a local PLC. The VFD shall provide linear speed indication of the motor speed from zero to full speed. Input impedance shall be 250 ohms resistive.
 9. A 4-20 mA dc signal for remote motor current indication to a local PLC. The VFD shall provide linear current indication of the motor from zero to full current. Input impedance shall be 250 ohms resistive.
 10. Incoming line fused lockable disconnect or lockable main circuit breaker.
 11. 24 VDC control circuitry and 480V-120V step down transformer.
 12. Variable time delay for delaying motor drive restart after power failure; timer range shall be 0 to 120 seconds, with initial settings differing by 10 seconds for each drive; provide module which causes multiple attempts to restart.
 13. Provision for automatic emergency shutdown in any mode, activated by the following:
 - a. Any additional abnormal conditions as shown on the Drawings. Provide for manual restart.
 14. Auxiliary contacts for remote indication of "Run" and "VFD Fault."

15. VFD operable with motor disconnected, in order to test VFD.
 16. Linearity and repeatability accuracy of 3 phase output of 1 percent of analog input control signal regardless of input power voltage fluctuations between 437 and 505 volts.
 17. Independent acceleration and deceleration controls, adjustable from 2 to 30 Hz per second.
 18. Label with fault current rating per NEC article 409.110 and arc flash warning label per NEC Article 110.16.
- O. Motor Control
1. Selectable Sensorless Vector, Flux Vector, V/Hz, economizer mode selectable through programming.
 2. The drive shall be supplied with an auto-tune mode.
 3. The V/Hz mode shall be programmable for fan curve or full custom patterns.
 4. Capable of Open Loop V/Hz.
 5. Capable of operating induction and permanent magnet motors
- P. Protection: Protect VFD against the following conditions:
1. Reverse phase sequence and single phasing of input power.
 2. Input power failure.
 3. Input transient voltages, including peak suppression and snubbers, in accordance with ANSI C37.90.
 4. Transmission signal interference.
 5. Output overcurrent.
 6. Input overcurrent.
 7. Motor over temperature.
 8. Cabinet over temperature.
 9. Under voltage: VFD shall automatically shut down if input voltage falls below preset limit with automatic restart upon return to a stable supply.

Q. Enclosure Door Mounted Human Interface Module (HIM)

1. VFD shall provide a HIM with integral LCD display, operating keys and programming keys.
2. An enclosure door-mounted HIM, rated UL Type 12, shall be provided
3. The HIM shall have the following features:
4. A four (4) to seven (7) line backlit LCD display with graphics capability.
5. Shall indicate drive operating conditions, adjustments and fault indications.
6. Shall be configured to display in the following:
7. One zone shall display the status of direction, drive condition, fault / alarm conditions and Auto / Manual mode.
8. Another zone shall display drive output frequency, voltage or current.
9. Another Zone shall display one of 6 to 12 user selected values such as power, torque, DC bus voltage, Analog values, discrete I/O status and etc.
10. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.

R. Construction:

1. All stand-alone VFDs provided for this project shall be of the same manufacturer chosen from Paragraph 2.1 above.
2. VFDs mounted in motor control centers (MCCs) shall be of the same manufacturer as the MCC.
 - a. Door-mount the following devices:
 - 1) HMI with the following indications:
 - a) Power On
 - b) Speed indication
 - c) Motor Run
 - d) VFD Fault Indication
 - e) External operating handle for the incoming line fused disconnect.
 - b. Control components shall be in accordance Section 26 27 16. Configuration of the enclosure and the components shall be as shown on the drawings.

- c. Components: Mount components on circuit cards or modules, which can be adjusted or replaced in the field without the use of special tools.
 - d. Finish: Paint finish shall be ANSI Grey.
- S. Spare Parts: Furnish two sets of spare power fuses for each size and type of fuse used; furnish a minimum of five fuses of each size and type of control circuit fuse.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 26 05 00 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Properly level and plumb VFDs so that doors will open and close freely.
- C. Clean and repair scratched or damaged surfaces to "new" condition.
- D. Provide the services of a factory trained service technician to inspect and check out each system before energizing.
- E. Per manufacturer's instructions, lace power conductors to resist short circuit forces.

3.2 COMPONENT TEST PHASE

- A. PROCEDURES: Section 01 75 16
- B. Operate each drive from no load to full load and perform a spectrum analysis to verify that the waveform on the line side of the VFD is in compliance with IEEE 519 for general systems.

3.3 MANUFACTURER'S SERVICES

- A. ON-SITE INSPECTIONS AND TRAINING: Provide a factory-trained manufacturer's representative at the Site for the following activities. Specified durations do not include travel time to or from the Site.
 - 1. INSTALLATION INSPECTIONS: Assist, supervise, and inspect the Contractor's activities during installation. Provide 8 hours of installation inspection.
 - 2. TRAINING SESSIONS: Procedures: Section 01 75 16. Coordinate training with operations and maintenance staff schedules to ensure all required staff can attend.

END OF SECTION

SECTION 26 32 13

STANDBY POWER SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. The work consists of furnishing electric generating set with features and accessories as specified herein and shown on the drawings.
- B. Pendleton Airport Reservoir and Booster Pump Station – Standby Power System shall consist of:
 - 1. A diesel engine-driven, standby generator with an alternator rated 480/277-volt, 3-phase, 60 Hz; digital (micro-processor based) electronic generator set control system; and fuel transfer pump, if required. Minimum rating of the generating sets will be as shown in the electrical drawings. Generator shall be furnished with a 1500 gallon sub-base tank providing a minimum 24 hour operating time and a 100 percent rated circuit breaker protection.
 - 2. Automatic Transfer Switch (ATS) rated 480-volt, 3-phase, 4-pole, 4-wire to be provided as part of the Motor Control Center as shown in the electrical drawings and in accordance with Section 26 36 23 Automatic Transfer Switch.

1.2 GENERAL REQUIREMENTS

- A. Materials and workmanship:
 - 1. Materials and parts comprising the standby power system specified herein shall be new, unused, of current manufacture and of the highest grade, free from all defects.
 - 2. Workmanship shall be the highest grade, in accordance with modern practice.
- B. Parts and service: Bidders shall specify nearest location of permanent parts depots from which replacement parts may be obtained in necessary quantities at any time, day or night. Service facilities and personnel shall be equally available.

1.3 GENERATOR SET PERFORMANCE

- A. Steady-State Voltage Operational Bandwidth: 0.25 percent of rated output voltage from no load to full load.
- B. Steady-State Voltage Modulation Frequency: Less than one Hz.

- C. Transient Voltage Performance: Not more than 15 percent variation for 50 percent step-load increase; not more than 10 percent variation for 50 percent step-load decrease. Voltage recovers to remain within the steady-state operating band within 2 seconds.
- D. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
- E. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there are no random speed variations outside the steady-state operational band and no hunting or surging of speed.
- F. Transient Frequency Performance: Less than 4-Hz variation for a 50 percent step-load increase or decrease. Frequency recovers to remain within the steady-state operating band within 2.5 seconds.
- G. Output Waveform: At no load, harmonic content measured line-to-line or line-to-neutral does not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, does not exceed 50.
- H. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at the system output terminals, the system will supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to any generator system component.
- I. Temperature Rise of Generator: Within limits permitted by NEMA MG 1 when operating continuously at full-rated load, including 2 hours per 24 hours at 100 percent of rated capacity.
- J. Starting Time: Maximum total time period for a cold start, with ambient temperature at the low end of the specified range, is 7 seconds. Time period includes output voltage and frequency settlement within specified steady-state bands.

1.4 SUBMITTALS

- A. Product Data: For each component. Include data on features, components, ratings, and performance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components.
- B. Shop Drawings: Show details of fabrication, piping, wiring, and installation of field-installed portions of system. Include general arrangement drawings showing locations of auxiliary components in relation to engine generator set and duct, piping, and wiring

connections between generator set and auxiliary equipment. Show connections, mounting, and support provisions and access and workspace requirements.

1. Wiring Diagrams: Show details of power and control connections and differentiating between factory-installed and field-installed wiring.
- C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article.
- D. Field Test and Observation Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Certified Test Reports of Components and Accessories: For devices that are equivalent, but not identical, to those tested on prototype unit.
- F. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet critical performance criteria.
- G. Factory Test Reports: For units to be shipped for this Project showing evidence of compliance with specified requirements.
- H. Exhaust Emissions Test Report: To show compliance with applicable, current regulations.
- I. Sound measurement test report.
- J. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.
- K. Field test report of tests specified in Part 3.
- L. Maintenance data for system and components to include in the maintenance manuals specified in Division 1. Include the following:
 1. List of tools and replacement items recommended to be stored at the site for ready access. Include part and drawing numbers, current unit prices, and source of supply.
 2. Detail operating instructions for both normal and abnormal conditions.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a firm experienced in manufacturing equipment of types and capacities similar to those indicated for this Project and with a service center maintained by engine generator set manufacturer capable of providing training, parts, and emergency maintenance and repairs at the Project site with 24 hours maximum response time.

- B. Source Limitations: Obtain engine generator set and auxiliary components from a single manufacturer with responsibility for entire system.
- C. Listing and Labeling: Provide system components of types and ratings for which listing or labeling service is established and components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- D. Comply with NFPA 70.
- E. Comply with NFPA 99.
- F. Comply with NFPA 704, Hazard Identification signage.
- G. Engine Exhaust Emissions: Comply with all current, applicable federal, state, and local government requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operations. Remove protection only after equipment is safe from such hazards.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the OWNER of other rights the OWNER may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the CONTRACTOR under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty signed by CONTRACTOR and manufacturer, with single-source responsibility for engine generator and auxiliary components, agreeing to repair or replace items that do not meet requirements or that deteriorate as defined in this Section within the specified warranty period.
- C. Warranty Period: 5 years (for engine-generator set) from date of Substantial Completion. Warranty shall cover 100 percent parts (except consumables, unless consumables were damaged by the failure) and labor.

1.8 MAINTENANCE SERVICE

- A. Maintenance: Beginning at Substantial Completion, provide 12 months full maintenance by skilled employees of the manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies as used in the manufacture and installation of original equipment.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver extra materials to OWNER.
 - 1. Fuses: 1 for every 10 of each type and rating, but not less than 1 of each.
 - 2. Indicator Lamps: 2 for every 6 of each type used, but not less than 2 of each.
 - 3. Filters: One set each of lubricating oil, fuel, and combustion air filters.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers:
 - 1. Cummins.
 - 2. Caterpillar/Peterson Power.
 - 3. Kohler.
 - 4. Similar units by other manufacturers may be considered for use on this project based on comparison to these lines. Approval of substitutions is solely at the discretion of the Engineer.

2.2 SERVICE CONDITIONS

- A. Environmental Conditions: Engine generator system withstands the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 - 1. Ambient Temperature: Minus 15 degrees Celsius to plus 40 degrees Celsius.
 - 2. Relative Humidity: 0 to 95 percent.
 - 3. Altitude: Sea level to 3,000 feet (909 m).

B. Unusual Service Conditions: Engine generator equipment and installation is required to operate in the following conditions:

1. Applicable seismic requirements as defined in the International Building Code (IBC) for the location of installation.

2.3 DIESEL ENGINE-GENERATOR SET

A. Rating: The generator ratings are summarized below:

1. Pendleton Airport Reservoir and Booster Pump Station kW (Standby) rating as shown on the drawings, 480/277 V, 60 Hz, three-phase, 4 wire, 0.8 Power Factor, minimum 3313 starting KVA (sKVA) at 90 percent of rated sustained voltage during starting and shall operate continuously for 4hrs at full-rated load.

B. Generator Set Performance: As specified in 1.3.

1. The diesel engine-generator set shall be capable of single step load pick up of 100 percent nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
2. The generator set shall be capable of starting a minimum of 90 percent of rated kVA load at no more than 35 percent voltage dip applied to the generator set.

C. AC Generator, Regulator and Exciter Units.

1. The AC Generator shall comply with NEMA MG 1 and specified performance requirements. The generator shall be synchronous, four pole, 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(s). Exciter shall rotate integrally with generator rotor. All insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation systems. Actual temperature rise measured by resistance method at full load shall not exceed 120 degrees Celsius. The generator shall have 2/3 pitch stator winding. The subtransient reactance 15 percent, maximum.
2. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator for immunity from voltage distortion caused by non-linear SCR controlled loads on the generator. The PMG shall sustain main field excitation power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system overcurrent devices. The automatic voltage regulator shall be temperature compensated, solid-state design.
3. The voltage regulator shall be equipped with three-phase RMS sensing. The regulator shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The regulator shall include an under frequency rolloff torque-

matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 58 hertz. The torque-matching characteristic shall include differential rate of frequency change compensation to the maximum available engine torque and provide optimal transient load response. Regulators that use fixed volts per hertz characteristic are not acceptable. The voltage regulator shall have adjustable rheostat on control and monitoring panel to provide plus or minus 5 percent adjustment of output voltage operating band.

4. The generator shall be broad range, 12 lead reconnectable. Instrument transformers shall be mounted within generator enclosure. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage within the broad range.

D. Engine-Generator Set Controls

1. The controls shall be digital (microprocessor based) electronic, fully NFPA 110 compliant, and shall have automatic remote start capability from a panel-mounted 3-position (Stop, Run, Remote) switch.
2. Provide cycle cranking of 15 SEC (ON)/15 SEC (OFF) for three attempts (75 SEC). If engine fails to start, lockout the engine, and indicate overcrank on alarm status panel.
3. The control shall shut down and lock out upon:
 - a. Failing to start (overcrank)
 - b. Overspeed
 - c. Low lubricating oil pressure
 - d. High engine temperature
 - e. Operation of a remote manual stop station.
4. A panel mounted switch shall reset the engine monitor and test all the lamps. Lamp indication on the control panel shall include:
 - a. Overcrank shutdown - red
 - b. Overspeed shutdown - red
 - c. Low oil pressure shutdown - red
 - d. High engine temperature shutdown - red
 - e. High engine temperature pre-alarm - yellow
 - f. Low engine oil pressure pre-alarm - yellow
 - g. Low coolant temperature - yellow
 - h. Low coolant level - yellow
 - i. Low fuel - yellow
 - j. Run - green
 - k. Not in automatic start - flashing red

- I. Auxiliary (2) - red
5. The NEMA 1 enclosed control panel shall be mounted on the generator set with vibration isolators. A front control panel illumination lamp with ON/OFF switch shall be provided. Control panel mounted indicating meters and devices shall include:
- a. Engine Oil Pressure Gauge
 - b. Coolant Temperature Gauge
 - c. DC Voltmeter
 - d. Running Time Meter (hours)
 - e. Digital Voltmeter
 - f. Digital Ammeter
 - g. Digital Frequency Meter
 - h. Seven position phase selector switch with OFF position to allow meter display of current and voltage in each generator phase
- E. Engine: The engines shall be 1800 RPM, diesel.
- 1. Governing: The unit shall have an engine speed electronic governor to provide isochronous generator set frequency control. The governor shall be capable of parallel operation with the addition of load sharing controls.
 - 2. Cooling Systems: The engines shall be cooled by a skid-mounted closed loop horizontal radiator systems, including centrifugal fan, coolant pump and thermostat temperature control. The cooling system shall be rated for full rated load operation in 122 degrees Fahrenheit (50 degrees Celsius), minimum, ambient conditions. The size of radiator shall be adequate to contain expansion of total system coolant from cold start to 100 percent load condition. The cooling system, including cooling air flow paths, shall be designed to minimize noise. The cooling capability of the generator set shall be demonstrated by prototype tests on a representative generator set model. The provided engine thermostat shall regulate engine water temperature as recommended by the manufacturer. Provide a high-coolant temperature device to shut down the engine through the engine control panel when the engine temperature exceeds 200 degrees Fahrenheit. The engine cooling system shall be filled with an extended life coolant to protect the system to a temperature of 0 degrees Fahrenheit.
 - 3. Engine Fuel System: Comply with NFPA 30. Fuel: Diesel fuel oil grade DF-2.
 - 4. Lubrication System: Pressurized by a positive-displacement pump driven from engine crankshaft.
 - 5. Accessories: To include:
 - a. An electric starter capable of three complete cranking cycles

- b. Block (coolant) heater(s), size as recommended by manufacturer. Block heater(s) shall be 120V, 1-phase.
 - c. Battery charger with “high charge” option
 - d. Positive displacement, mechanical, full pressure, lubrication oil pump.
 - e. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
 - f. Fuel filter with replaceable spin-on canister element.
 - g. Replaceable dry element air cleaner with restriction indicator.
 - h. Flexible supply and return fuel lines.
 - i. Engine mounted battery charging alternator, 35 ampere minimum, and solid-state voltage regulator.
 - j. Starting batteries.
- F. Bases: The engine-generator set will be mounted with vibration isolators on a heavy-duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate a battery tray with battery hold down clamps within the base rails. The engine-generator sets will have Seismic Zone 3 isolator pads for mounting.
- G. Main Circuit Breaker: Provide a generator mounted circuit breaker, molded case, 3 pole, NEMA 1/IP22, which will disconnect the generator from the supply circuit. Circuit breaker to be sized as shown. Breaker shall utilize a solid-state trip unit and shall have the electrical characteristics, rating, and modifications as shown. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set and shall have a metal nameplate that contains a permanent record of the circuit breaker catalog number and maximum ratings. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.
1. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated drawing. The solid-state trip circuit breaker shall include the following adjustments; each adjustment shall have

discrete settings (fully adjustable) and shall be independent of all other adjustments:

- a. An ampere trip setting (long time pickup) that is adjustable from 0.5 times (or less) to 1.0 times the plug ampere rating, in 0.1 (or less) increments.
 - b. An adjustable long time pickup delay, with a minimum of 5 different delay settings.
 - c. A short time pickup trip setting that is adjustable from 2 times (or less) to 9 (or greater) the long time ampere trip setting.
 - d. An adjustable short time pickup delay, with a minimum of 5 different delay settings.
 - e. An instantaneous pickup that is capable of being disabled (preferable) or is adjustable from 1.5 times (or less) to 15 times (or greater) the long time ampere trip setting. Units that are capable of disabling the instantaneous pickup shall be configured with the instantaneous pickup disabled.
2. Main Circuit Breaker shall have a quick-make, quick break, over-center toggle type, trip-free mechanism to prevent holding contacts closed against a position between "ON" and "OFF" when tripped automatically. Breaker shall be common trip such that an overload or short circuit on any one pole will result in all poles opening simultaneously.
 3. The interrupting capacity of the Main Circuit Breaker shall be 65 kAIC at 480 volts, minimum.

2.4 OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET

A. Sound Attenuated Enclosure

1. The generator set shall be provided with a sound attenuated enclosure level 2, with the entire package listed under UL2200. The package shall comply with the requirements of the National Electrical Code for all wiring materials and component spacing. The total assembly of generator set, enclosure, and sub-base fuel tank (when used) shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100F. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.

2. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two-step electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted.
3. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.
4. Enclosure shall be constructed of minimum 12 gauge steel for framework and 14 gauge steel for panels. All hardware and hinges shall be stainless steel.
5. A factory-mounted exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.
6. The enclosure shall include the following maintenance provisions:
 7. Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure, with internal drain valves
 8. External radiator fill provision.
 9. Provide an external emergency stop switch that is protected from accidental actuation.
 10. Provide motorized louvers to minimize air flow through the enclosure when generator set is not operating. Louvers shall include provisions to prevent accumulation of ice or snow that might prevent operation.
11. Inlet ducts shall include rain hoods.
12. The generator set shall be provided with a sound-attenuated housing which allows the generator set to operate at full rated load in an ambient temperature of up to 100F. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 75 dBA at any location 23 feet from the generator set in a free field environment.
13. The enclosure shall be insulated with non-hydroscopic materials.

PART 3 EXECUTION

3.1 GENERAL

- A. Install equipment and materials in a neat and workmanlike manner and align, level, and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance, and repair.

3.2 SUPPORTS

- A. Provide hangers or other devices such as pads, anchors, etc., necessary for the support of the equipment.
- B. Provide anchorage according to manufacturer's written instructions, unless otherwise indicated.

3.3 INSTALLATION

- A. Material and Equipment Installation: Follow manufacturer's installation instructions explicitly, unless otherwise directed. Wherever any conflict arises between manufacturer's instructions and these Contract Documents, follow ENGINEER's direction, at no additional cost to the OWNER. Keep copy of manufacturer's instructions on the job site available for review at all times.
- B. If required and shown on the electrical drawings, the generator set supplier shall supply and install a load bank next to the generator (not mounted to the genset).
- C. The CONTRACTOR shall be responsible and shall provide for the supply, installation adjustment, and startup of complete, coordinated systems, which shall reliably perform the specified functions.
- D. Maintain minimum workspace around components according to manufacturer's Shop Drawings and National Electrical Code.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise installation and connection of the generator-set unit and to report results in writing.
- B. Supervised Adjusting and Pretesting: Under supervision of factory-authorized service representative, pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation is according to Specifications. Load system using a variable resistive load bank simulating kW of loads for which unit is rated.

3.5 TESTING AND STARTUP

A. The following shall be provided:

1. The manufacturer shall provide a certified copy of a 4-hour full-load factory test of a prototype engine-generator unit of the same size as the one being provided with recordings of voltage, frequency, amperage, engine temperature, lube oil pressure, and load transfer results to the ENGINEER.
2. The actual generator unit shall be field tested with all standby loads picked up and operated for a minimum period of 4 hours. One electronic PDF copy of the test results shall be provided to the ENGINEER. This testing is to be accomplished only after control system startup and verification to ensure only the correct load is brought on line with the generator in operation.

3.6 CLEANING

A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.7 DEMONSTRATION

A. Training: Engage a factory-authorized service representative to demonstrate adjustment, operation, and maintenance of system and to train OWNER's maintenance personnel as specified below.

1. Conduct a minimum of 8 hours of training as specified in Division 1 Section "Contract Closeout."
2. Schedule training with at least 7 days' advance notice.

3.8 SPARE PARTS

A. Provide the following spare parts for each generator unit

1. Three sets fuel oil filter elements and gaskets.
2. Three lubricating oil filter elements and gaskets.
3. One air cleaner filter element.
4. Two sets packing for each auxiliary pump.
5. Two sets V-belts for pump drives.

END OF SECTION

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.1 SCOPE

- A. Furnish and install the low voltage automatic transfer switches having the ratings, features/accessories and enclosures as specified herein and as shown on the contract drawings.

1.2 RELATED SECTIONS

1.3 REFERENCES

- A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:
 - 1. UL 1008 – Transfer Switches
 - 2. UL 991 - Tests for Safety-Related Controls Employing Solid-State Devices
 - 3. NFPA 70 – National Electrical Code
 - 4. NFPA 99 – Essential Electrical Systems of Health Care Facilities
 - 5. NFPA 110 – Emergency and Standby Power Systems
 - 6. NEMA ICS 10 – AC Transfer Switch Equipment
 - 7. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems

1.4 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Front view and plan view of the assembly
 - 2. Schematic diagram
 - 3. Conduit space locations within the assembly.
 - 4. Assembly ratings including:
 - a. Withstand and Closing rating
 - b. Voltage
 - c. Continuous current rating
 - d. Short-Time rating if applicable
 - e. Short-circuit rating if ordered with integral protection

5. Cable terminal sizes
 6. Product Data Sheets.
- B. Where applicable, the following additional information shall be submitted to the Engineer:
1. Busway connection
 2. Connection details between close-coupled assemblies
 3. Composite front view and plan view of close-coupled assemblies

1.5 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
1. Final as-built drawings and information for items listed in section 1.4
 2. Wiring diagrams
 3. Certified production test reports
 4. Installation information
 5. Seismic certification as specified
- B. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.6 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Provide Seismic tested equipment as follows:
1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).
 2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

- a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
- b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.7 REGULATORY REQUIREMENTS

- A. Provide a certificate of compliance with UL 1008 for the transfer switches furnished under this section.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.9 FIELD MEASUREMENTS

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

1.11 EXTRA PRODUCTS

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Allen Bradley
- B. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.2 CONSTRUCTION

- A. Switches shall be free standing construction utilizing fixed mounted power case switches or circuit breakers.
- B. Ratings shall be per the drawing. All breakers shall be UL listed for application in their intended enclosures for 100 percent of their continuous ampere rating. Breakers shall be electrically operated.
- C. All breakers shall be provided with a true, two-step stored energy mechanism providing a maximum of three-cycle closing. All the energy required for closing the breakers shall be completely stored and held in readiness pending a release to close action. The power case switch or breaker shall have high-endurance characteristics being capable of no-load and full-load interruptions at rated current equal to or exceeding the UL endurance ratings for power circuit breakers without maintenance.
- D. Transfer switches shall be open transition and provided with in-phase monitor, which will permit a transfer or re-transfer between two live sources that have a phase angle difference of +/- 8 degrees or less.
- E. The switching panel shall consist of completely enclosed contact assemblies and a separate control or transformer panel. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.
- F. Each transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources under either automatic or manual operation. Main contacts shall be mechanically locked in position in both normal and emergency positions. A neutral position shall not be possible under normal electrical operation unless a delayed transition accessory is required for switching highly inductive loads.
- G. Transfer switches shall be capable of being operated manually under full rated load conditions. Manual operation shall be accomplished by a permanently attached manual operator, or by integrally mounted pushbuttons. Removable manual operating handles and handles that may move in the event of an electrical operation during the manual operation, are not acceptable. Manual operators requiring source or load disconnection prior to manual operation are not acceptable.
- H. On transfer switches requiring a fourth pole for switching the neutral, the neutral shall be fully rated with equal withstand, closing and interrupting ratings to the power poles. Switched neutral poles which are add-on or overlap, or that are not capable of breaking full rated load current are not acceptable.
- I. The transfer switch shall have a multi-tap voltage selection plug for ease of voltage adjustment in the field.

- J. Where shown on the drawings, transfer switches applied as service entrance equipment, shall be provided with over-current trip units and a service entrance label. A key-operated selector switch shall be provided to disconnect the power supplies. Indicators shall be provided to show the availability of each source as well as breakers in a disconnected position. Provide a neutral disconnect link for three-pole solid neutral switches, and a neutral-to-ground main bonding jumper for all switches to meet UL service entrance requirements. Ground fault protection shall be provided for all switches rated 1000 amperes or more applied on 480Y/277 Vac systems in accordance with NEC Article 230-95.
- K. Where indicated on the drawings, the transfer switches shall be provided with a draw-out mechanism to allow easy access for preventive maintenance, testing or inspection. The draw-out mechanism shall provide visual indicators as to the position of the switch/breaker during the draw-out operation.
- L. When the transfer switches shall be provided with a draw-out mechanism, shuttered cassettes should be provided for safety purposes
- M. When the transfer switches shall be provided with a draw-out mechanism and NEMA 1 enclosure, a roof mounted breaker lifting device shall be included.

2.3 MICROPROCESSOR LOGIC

- A. The transfer switch shall be controlled by a type microprocessor-based controller. The controller shall be hardened against potential problems from transients and surges. Operation of the transfer switch and monitoring of both sources shall be managed by the controller.
- B. The automatic transfer switch controllers shall meet or exceed the following standards in addition to the basic switch standards:
 - 1. IEC 61000-4-2 - EMC Testing and Measurement Techniques - Electrostatic Discharge Immunity Test
 - 2. IEC 61000-4-3 - EMC Testing and Measurement Techniques - Radio-frequency, Electromagnetic Field Immunity Test
 - 3. IEC 61000-4-4 - EMC Testing and Measurement Techniques - Electrical Fast Transient/Burst Immunity Test
 - 4. IEC 61000-4-5 - EMC Testing and Measurement Techniques - Surge Immunity Test
 - 5. IEC 61000-4-6 - EMC Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio-frequency Fields

6. IEC 61000-4-11 - EMC Testing and Measurement Techniques - Voltage Dips, Short Interrupts and Voltage Variations Immunity Tests
7. CISPR11, Class B - Industrial, Scientific and Medical Radio-frequency Equipment - Electromagnetic Disturbance Characteristics - Limits and Methods of Measurement
8. FCC Part 15, Subpart B, Class B

2.4 ENCLOSURE

- A. Each transfer switch shall be provided in a NEMA 1 enclosure suitable for use in environments indicated in the drawings.
- B. NEMA 1 enclosures shall be painted with the manufacturer's standard light gray ANSI 61 paint.

2.5 CONTROLLER DISPLAY AND KEYPAD

- A. The microprocessor-based controller display shall be UV resistant and include a 4.3 inch Color TFT (480x272), backlit display. The controller shall be capable of displaying transfer switch status, parameters, and diagnostic data. All set point parameters shall be password protected and programmable using the controller keypad, USB port, or remotely using serial port access. Limited abbreviations or codes shall be used for transfer switch functions.
- B. The microprocessor-based controller shall include a mimic bus display consisting of six (6) individual LED's (3mm) for indicating the following:
 1. Availability status of source 1
 2. Availability status of source 2
 3. Connection status of source 1
 4. Connection status of source 2
 5. Source 1 Preferred
 6. Source 2 Preferred

2.6 VOLTAGE AND FREQUENCY SENSING

- A. The controller shall have a voltage range of 0-790 volts (50/60 Hz) and an accuracy of +/- 1 percent of the reading and a frequency range of 40-70 Hz and an accuracy of +/- .3 Hz.

- B. Voltage and frequency dropout and pickup parameters are set as a percentage of the nominal voltage as indicated in the table below.

Setpoint	Sources	Dropout	Pickup
Undervoltage	Source1 and 2	70 – 97%	(DO + 2%) - 99%
Overvoltage	Source 1 and 2	105 – 110%	103% - (DO – 2%)
Underfrequency	Source 1 and 2	90 – 97%	(DO + 1Hz) – 99%
Overfrequency	Source 1 and 2	103 – 105%	101% - (DO – 1Hz)
Voltage Unbalance	Source 1 and 2	5 – 20%	(UNBAL DO% - 2) – 3%

- C. The normal and emergency sources shall include phase reversal protection. The preferred rotation is programmable as ABC or CBA.

2.7 TIME DELAYS

- A. A time delay shall be provided on transfer to source 2, adjustable from 0 to 166 minutes.
- B. A time delay shall be provided to override a momentary power outage or voltage fluctuation, adjustable from 0 to 120 seconds.
- C. A time delay shall be provided on re-transfer from source 2 to source 1, adjustable from 0 to 166 minutes.
- D. A time delay shall be provided after re-transfer that allows the generator to run unloaded prior to shut-down, adjustable from 0 to 166 minutes.
- E. A time delay shall be provided for engine failure to start, adjustable 0- 60 seconds.
- F. A pre- and or post- transfer time delay output adjustable from 0-120 seconds. The contact shall be a Form C contact rated for 10-Amp at 250-Vac and 10-Amp at 30-Vdc.
- G. All delays shall be field adjustable from the microprocessor-based controller without the use of special tools.

2.8 ADDITIONAL FEATURES

- A. One Form C contact for closure of the source 1 generator start circuit for optional use with a dual generator system. The contacts shall be rated for 5-Amp at 250-Vac and 5-Amp at 30-Vdc.
- B. One Form C contact for closure of the source 2 generator start circuit. The contacts shall be rated for 5-Amp at 250-Vac and 5-Amp at 30-Vdc.
- C. The controller shall include two independently programmable Engine Exercisers, selectable as disabled, 7, 14, or 28 day interval, or by calendar date. Run time shall be

adjustable for 0-600 minutes, with or without load. Upon loss of source 2 power, the ATS shall automatically return to source 1. Transfer time delays shall also be independently programmable for test events.

- D. The controller shall include a keypad pushbutton to initiate a system test.
- E. The controller shall include four (4) user configurable inputs. Each input provides 50 volts at 10ma and can be user configured to one of the following features:
 - 1. Input to accept a remote contact which closes to initiate a transfer to source 2. This feature shall be failsafe and an automatic re-transfer shall occur in the event that source 2 power is lost.
 - 2. Input to accept a remote contact which closes to initiate a transfer to source 2. This feature shall be failsafe and an automatic re-transfer shall occur in the event that source 2 power is lost.
 - 3. Input to accept a remote contact which opens to inhibit transfer to source 2.
 - 4. Input to enable monitor mode to disable automatic operation of the transfer switch while continuing to display status. Monitor mode allows set point programming at the controller display.
 - 5. Input to enable lockout feature to disable automatic operations of the transfer switch following an overcurrent trip of an integral circuit breaker.
 - 6. Input to enable or disable manual re-transfer to source 1.
 - 7. Input to initiate manual re-transfer to source 1.
 - 8. Input to initiate a remote engine test. The test will run using the programmed engine test set points.
 - 9. Input to select source 1 or source 2 as the preferred source.
 - 10. Input to initiate a remote load test.
 - 11. Input to indicate the bypass transfer switch is closed on a source.
 - 12. Input to bypass time delays
 - 13. Input to receive engine start signal from a master controller in a three source application.

- F. The controller shall include four (4) user configurable outputs rated for 10-Amp at 250-Vac and 10-Amp at 30-Vdc. Each input can be user configured to one of the following features:
1. Source 1 connected
 2. Source 2 connected
 3. ATS in test
 4. ATS not in automatic mode (Monitor Mode)
 5. General Alarm indication for failure to transfer, mechanical fault, or electrical fault.
 6. Engine Test Aborted
 7. Engine cool down in process
 8. Engine start contact status
 9. Emergency inhibit on
 10. Load sequence – Output used to signal select loads to disconnect prior to transfer and reconnect 0-120 seconds after. Loads are reconnected sequentially.
 11. Selective load shed – Output used to shed low priority loads when the load reaches a programmed threshold value. A load shed and load restore set point (measured in kW) are associated with this feature.
 12. Load bank control – Output to disconnect a load bank during an engine run test if a transfer to a source 2 generator is required.
 13. Pre- and/or post- transfer signal: A pre- and or post- transfer time delay output adjustable from 0-120 seconds.
- G. One Form C auxiliary contact to indicate Source 1 position and one Form C contact to indicate source 2 position. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.
- H. One Form C contact for Source 1 Available. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.
- I. One Form C contact for Source 2 Available. The contacts shall be rated for 10-Amp, 1/3-Horsepower at 250-Vac and 10-Amp at 30-Vdc.

J. Data Logging

1. Historical Data Storage to include:

- a. Engine Run Time
- b. Source 1 Available time
- c. Source 2 Available time
- d. Source 1 Connected time
- e. Source 2 Connected time
- f. Source 1 Engine Run Time
- g. Source 2 Engine Run Time
- h. Load Energized Time
- i. Number of Transfers

2. Event Summary shall include up to 100 date and time stamped events. All metered values are logged for each event. Event summaries include:

- a. Transfer events
- b. Alarms
- c. Changes to the set points
- d. Changes to the time/date
- e. Resetting a historical counter
- f. Engine Run test

3. Event Details shall include up to 350 date and time stamped events. All metered values are logged for each event. Event details include detailed sequence of operations of a transfer event.

4. Event recording shall capture 4 seconds of metered data, stored every 20 msec for certain events. The data is captured 2 seconds before and 2 seconds after the event. Oscillographic data for 10 events is stored and may be downloaded over USB. Events Include:

- a. Source unavailability actions that initiate a transfer sequence (Undervoltage, Overvoltage, etc.)
- b. Successful transfers (at the point of breaker/contactator closure)
- c. Unsuccessful transfers (at the point of breaker/contactator failure to close or open)

L. Manual Re-transfer Control: The ATS shall remain connected to the emergency source after the normal source becomes available until a momentary pushbutton contact closure signal is received to initiate the re-transfer. Should a failure of the emergency

source occur while waiting for the manual return, the re-transfer proceeds automatically.

PART 3 ADDITIONAL REQUIREMENTS

3.1 WITHSTAND AND CLOSING RATINGS

- A. The transfer switch shall have a 3-cycle short circuit withstand and closing rating of 100 KA at 480 volts.
- B. The transfer switch shall have a 30-cycle short time withstand and closing rating of 85 KA at 480 volts.

PART 4 EXECUTION

4.1 EXAMINATION

4.2 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
 - 1. Insulation check to ensure the integrity of insulation and continuity of the entire system
 - 2. Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards
 - 3. Mechanical tests to verify that the switch's power sections are free of mechanical hindrances
 - 4. Electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic
- B. The manufacturer shall provide a certified copy of factory test reports.
- C. Transfer switch shall include a label indicating order number, catalog number and date

4.3 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings

- B. All necessary hardware to secure the assembly in place shall be provided by the contractor

4.4 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of (1) working day. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

4.5 TRAINING

- A. The Contractor shall conduct a training session for up to two (2) owner's representatives for (1) normal workday at a jobsite location determined by the owner. The training program shall consist of the instruction on the operation of the transfer switch and the major components within the assembly.

4.6 FIELD SERVICE ORGANIZATION

- A. The manufacturer of the ATS shall also have a national service organization that is available throughout the contiguous United States and is available on call 24 hours a day, 365 days a year.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes requirements for:
 - 1. LED luminaires, drivers, and accessories.
- B. Related Sections:
 - 1. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and its Sub-Contractors to review all sections to ensure a complete and coordinated project.

1.2 REFERENCES

- A. Refer to Section 26 05 00.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. C62.41 - Recommended Practice for Surge Voltage in Low-Voltage Ac Power Circuits.
- C. American National Standards Institute (ANSI):
 - 1. C82.77 - Harmonic Emission limits - Related Power Quality Requirements for Lighting Equipment.
- D. Underwriters Laboratories (UL):
 - 1. UL1598 – Safety Standards for Luminaires.
 - 2. UL8750 – Outline of Investigation for Light Emitting Diode Light Sources for Use in Lighting Products.
- E. Illuminating Engineering Society of North America (IESNA):
 - 1. LM-79 - IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 - 2. LM-80 - IES Approved Method: Measuring Lumen Maintenance of LED Light Sources.

3. TM-21 - Projecting Long Term Lumen Maintenance of LED Light Sources.
- F. National Electrical Manufacturers Association (NEMA):
1. 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

1.3 DEFINITIONS

- A. Refer to Section 26 05 00.
- B. Specific Definitions and Abbreviations:
1. CCT: Correlated color temperature - Scientific scale to describe how “warm” or how “cool” the light source is, measured in Kelvin. The lower the Kelvin temperature, the warmer the light feels, or appears.
 2. CRI: Color Rendering Index - A quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source.
 3. Driver - Device that manages power and controls the current flow from AC to DC for an LED lighting product.
 4. Efficacy - Lumen output of a light source per unit of power supplied to that source (lumens per watt).
 5. EMI: Electromagnetic Interference - Electrical interference (noise) generated by electrical and electronic devices.
 6. FC: Foot Candles - Measure of light level on a surface being illuminated.
 7. L70 - The extrapolated life in hours of the luminaire when the luminous output depreciates 30 percent from initial values.
 8. LED: Light emitting diode - A solid-state semiconductor device that produces light when electrical current flows through it.
 9. LED light source - See LED luminaire.
 10. LED luminaire - A complete lighting unit consisting of LED-based light emitting elements and a matched driver together with parts to distribute light, to position and protect the light emitting elements, and to connect the unit to a branch circuit.
 11. Lumen - The international (SI) unit of luminous flux or quantity of light. The amount of light that is spread over a square foot of surface by one candle power when all parts of the surface are exactly one foot from the light source.

12. Lumen ambient temperature multiplier - LED light source relative lumen output when compared to a standard ambient temperature.
13. Lumen maintenance factor - How well an LED light source is able to retain its intensity when compared to new.
14. Luminaire - Lighting unit.
15. THD: Total harmonic distortion - The combined effect of harmonic Distortion on the AC waveform produced by a driver or other device.

1.4 SYSTEM DESCRIPTION

- A. Provide luminaires, and accessories for all lighting systems, complete and operable, in accordance with the requirements of the Contract Documents.
- B. Individual luminaire types are indicated on the Drawings and on the Luminaire Schedule.

1.5 SUBMITTALS

- A. Furnish submittals in accordance with Sections 01 33 00 and 26 05 00.
- B. Product Data:
 1. LED Luminaires:
 - a. Catalog literature for each luminaire specified, cross-referenced to the luminaire type on the Luminaire Schedule in the Drawings.
 - b. Provide for each luminaire type:
 - 1) Materials.
 - 2) Type of diffuser.
 - 3) Hardware.
 - 4) Gasketing.
 - 5) Reflector.
 - 6) Chassis.
 - 7) Finish and color.
 - 8) Driver type and protection.

9) LED luminaire:

- a) Initial lumen output at 40 degrees Celsius ambient.
- b) Correlated color temperature.
- c) Lumen maintenance factors.
- d) Lumen ambient temperature multipliers.
- e) Drive current.
- f) Efficacy.

10) Picture of luminaire.

11) Dimensioned drawings:

- a) Effective projected area rating for pole mounted luminaires.

12) Weight.

13) Photometric data:

- a) Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.
- b) Luminaire dirt depreciation factor.
- c) Candlepower distribution curves.
- d) Average luminaire brightness.
- e) Lumen output charts.

14) Furnish support method for interior luminaires weighing more than 30 pounds and all wall-mounted luminaires:

- a) Support methods shall be based on seismic requirements at the project site as specified in Section 260500.

c. Luminaire Substitutions:

1) Provide complete literature for each luminaire substitution:

2) Submittals for substituted luminaires shall be sufficient for competent comparison of the proposed luminaire to the originally specified luminaire:

a) Photometric data:

- (1) IES file in standard IES format.

- (2) Coefficient of utilization tables based on the IES Zonal Cavity System by an approved testing laboratory.
 - (3) Candlepower distribution curves.
 - (4) Average luminaire brightness.
 - (5) Lumen output charts.
 - (6) Power requirements in watts and volt-amperes.
- b) Calculations:
- (1) Provide software generated calculations showing illuminance levels in foot-candles and power usage in watts per square foot for each of the areas in which substitutions are proposed:
 - (a) Use surface reflectance values and luminaire light loss factors approved by the Owner to perform all calculations.
- c) Specification sheets:
- (1) If lacking sufficient detail to indicate compliance with contract documents, standard specification sheets will not be accepted. This includes, but is not limited to, luminaire type designation, manufacturer's complete catalog number, voltage, LED type, CCT, CRI, specific driver information, system efficacy, L70 life rating, and any modifications necessary to meet the requirements of the contract documents
 - 3) Substitutions for specified luminaires will be evaluated upon quality of construction, light distribution, energy use, appearance, and maintenance.
 - 4) Substitutions shall comply with all applicable building codes.
2. Driver: Provide for each driver type:
- a. Catalog number.
 - b. Type of driver.
 - c. Output wattage.
 - d. Input voltage.
 - e. Operating voltage range.

- f. Maximum input power.
- g. Efficiency.
- h. Operating line current.
- i. Power factor.
- j. Operating temperature range.
- k. Current output range in ambient temperatures of 30 degrees Celsius to 55 degrees Celsius.
- l. Surge suppression data.

C. Record Documents:

- 1. Update the Luminaire Schedule in the Drawings to reflect the acceptable substitutions, after the substitution has been reviewed and accepted by the Engineer.

1.6 QUALITY ASSURANCE

- A. Refer to Section 26 05 00.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 26 05 00.

1.8 PROJECT OR SITE CONDITIONS

- A. Refer to Section 26 05 00.

1.9 SCHEDULING

- A. Exterior and outdoor lighting system operation shall be demonstrated during the hours of darkness.
- B. Lighting demonstration shall occur within 2 weeks before substantial completion.

1.10 WARRANTY

- A. Refer to Section 26 05 00.
- B. LED luminaire:
 - 1. 5-year warranty from the date of installation including material, workmanship, photometrics, driver, and LED modules.

1.11 SYSTEM START UP

- A. Refer to Section 26 05 00.

1.12 MAINTENANCE

- A. Furnish 1 complete spare LED luminaire, with driver, of each type used.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Luminaires: One of the following or equal:
 - 1. As noted on the Luminaire Schedule.
- B. Drivers, LED Luminaires:
 - 1. Lithonia
 - 2. Holophane
 - 3. Approved equal
- C. Substitutions:
 - 1. The lighting design and luminaire selection has been based upon the photometric data of the identified luminaire. It is the Contractor's responsibility to ensure and prove to the Engineer at time of submittal the substitutions meet the quality and photometric requirements of the original design.

2.2 EQUIPMENT

- A. LED Luminaires:
 - 1. General:
 - a. Pre-wired with leads of 18-AWG, minimum, for connection to building circuits.
 - b. Provide the luminaires furnished per the Luminaire Schedule as indicated on the Drawings:
 - 1) The specifications noted herein are an addition or supplement to the Luminaire Schedule.
 - c. Individual LEDs connected such that a catastrophic loss or the failure of 1 LED will not result in the loss of the entire luminaire.

2. Minimum ambient temperature range of -20 degrees Celsius to 40 degrees Celsius.
 3. Minimum rated life:
 - a. Office Areas: 70,000 hours when operated at 25 degrees Celsius.
 - b. Process Areas: 60,000 hours when operated at 40 degrees Celsius.
 4. Minimum efficacy of 100 lumens/watt.
 5. Minimum Color Rendering Index of 80.
 6. Tested according to IESNA LM-79 and LM-80.
 7. Lumen maintenance projection in accordance with IESNA TM-21.
 8. RoHS compliant.
 9. Integral driver.
 10. Suitable for dry, damp, or wet locations as indicated on the Drawings or on the Luminaire Schedule.
 - a. Wet or damp locations: UL 1598 listed.
 11. Designed as a complete LED assembly. Retrofit LED lamps in luminaires not designed specifically for LED light sources shall not be used.
 12. Provide with integral photocell.
 13. Exterior/Outdoor Luminaires:
 - a. Luminaires in combination with their mounting pole and bracket shall be capable of withstanding:
 - 1) Wind levels at the project site without damage.
 - 2) Seismic levels at the project site.
 - b. Corrosion-resistant hardware and hinged doors or lens retainer.
 - c. Luminaires furnished with integral photoelectrical control shall be of the luminaire manufacturer's standard design.
- B. Drivers:
1. Input power source:
 - a. As indicated on the Drawings.

2. Drive current:
 - a. As indicated in the Luminaire Schedule.
3. Power factor: greater than 0.90.
4. Efficiency: greater than 80 percent.
5. Total harmonic distortion (THD) of the input current less than 20 percent.
6. Rated life of 60,000 hours in an LED luminaire operated at an ambient temperature of 40 degrees Celsius.
7. Minimum operating temperature of -20 degrees Celsius.
8. Sound rating: Class A+ or quieter.
9. UL listed Class 2 Outdoor in accordance with UL 8750.
10. In accordance with IEEE C62.41 Category A for transient protection.
11. Driver must limit inrush current:
 - a. Meet or exceed NEMA 410 driver inrush standard:
 - 1) 230 Amps per 10 Amp load with a maximum of 106 Amps squared-seconds at 120V.
 - 2) 430 Amps per 10 Amp load with a maximum of 370 Amps squared-seconds at 277V.
12. Luminaires in Hazardous Areas:
 - a. Meet NEC Section 500 requirements.
 - b. UL labeled and identified for hazardous area.
 - c. Marking on Class I and II Division 1 and 2 areas shall identify the applicable material classification group.
 - d. Marking shall include the Temperature Class (T Code).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Section 26 05 00.

- B. Install luminaires per the manufacturer's guidelines and submitted installation calculations to meet seismic and wind requirements at the project site.
- C. Special Techniques:
 - 1. Luminaires shall be installed plumb and square with building and wall intersections:
 - a. Suspend pendant-mounted luminaries that are mounted from sloping ceilings with ball hangers, unless otherwise indicated on the Drawings.
 - b. Install luminaires in machinery rooms after machines have been installed, so as to ensure no conflict with machinery, piping, or duct work.
 - 2. In all cases, coordinate luminaire locations with work of other trades to prevent obstruction of light from the fixtures:
 - a. Locate bottom of luminaire approximately at the bottom of ductwork, unless otherwise specified or indicated on the Drawings.
 - 3. Install luminaires in accordance with the manufacturer's instructions.
 - 4. Luminaires weighing more than 25 pounds shall be supported independently of the outlet box and the conduit.

3.2 FIELD QUALITY CONTROL

- A. Refer to Section 26 05 00.

3.3 ADJUSTING

- A. Aim and verify all exterior and outdoor luminaires alignment, during dark evening hours, as directed by the Owner's Representative or the Engineer.

3.4 CLEANING

- A. Refer to Section 26 05 00.
- B. Clean all lenses, diffusers, and reflectors.
- C. Refinish all luminaire's trim, poles and support brackets, where finish has been damaged.
- D. Clean and all LED luminaires (new and old), used during construction for construction lighting, before substantial completion.

3.5 DEMONSTRATION AND TRAINING

- A. Refer to Section 26 05 00.
- B. Perform the lighting demonstration, in accordance with paragraph 1.10 of this Section, witnessed by the Owner's Representative and the Engineer:
 - 1. The entire facility lighting system shall be observed to verify:
 - a. Luminaires are properly focused and aimed.
 - b. Switching functions are in accordance with the Contract Documents and verify all:
 - 1) Time clock operation.
 - 2) Programmable lighting control operations.

3.6 PROTECTION

- A. Refer to Section 26 05 00.

3.7 SCHEDULES

- A. Refer to the Luminaire Schedules as indicated on the Drawings.

END OF SECTION