LAKEHAVEN WATER AND SEWER DISTRICT

FEDERAL WAY, WASHINGTON

SPECIFICATIONS

AND

BIDDING REQUIREMENTS

for the construction of the

REDONDO WWTP PRIMARY AND SECONDARY CLARIFIER REHABILITATION PROJECT

****

ISSUE FOR BID

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JACOBS

Bellevue, Washington

August 2026

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Andrew Perez

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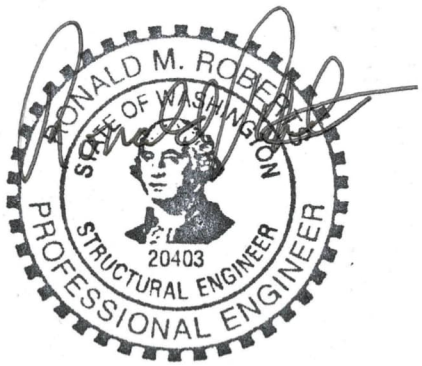

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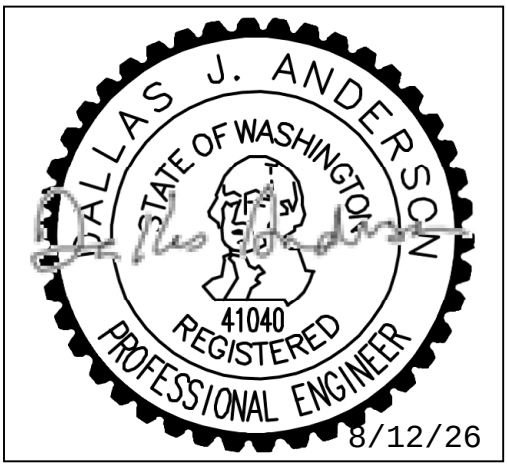

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SPECIFICATIONS

SECTION 01 11 00

DESCRIPTION OF WORK

PART 1 - GENERAL

1.01 SUMMARY

A. This Section summarizes the Work, identifies known projects in the vicinity, and further defines Construction Document language and approach.

B. The Work consists of furnishing all labor, materials, supplies, equipment, services, transportation, permits, shop drawings, and submittals required by the Contract Documents to prescribe a fully functional and completed Work. Omissions from the Contract Documents of details of Work that are necessary to carry out the intent of the contract shall not relieve the Contractor from performing the omitted Work.

C. The arrangement of equipment shown on Drawings is based upon information available at the time of design and is not intended to show exact dimensions conforming to a specific manufacturer. Drawings are, in part, diagrammatic. Some features of the illustrated equipment installation may require revision to meet actual submitted equipment installation requirements; these may vary significantly from manufacturer to manufacturer. In determining the cost of installation, include these differences as part of the bid proposal. Specified structural supports, foundations, connected piping, valves, and electrical conduit may have to be altered to accommodate the equipment actually provided. No additional payment will be made for such alterations.

1.02 WORK COVERED BY CONTRACT

A. The Work of this Contract generally includes the following:

1. Removal and preservation of the fiberglass roof panels above the primary and secondary clarifiers.

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2. Removal and preservation of the odor control and ventilation ductwork suspended from the roof panels of the primary clarifier buildings.
3. Removal and replacement of the odor control and ventilation ductwork suspended from the roof panels of the secondary clarifier building.
4. Demolition of the square circular clarifier mechanisms for the primary and secondary clarifiers to include:
    a. Mechanism, center column, feedwell, and clarifier drive.
    b. Rake arm, scum baffle and scum skimmer.
    c. Walkway to the central column including handrails.
    d. Scum box and associated piping.
    e. Effluent launder and associated structural supports.
5. Rehabilitation of concrete surfaces in the primary and secondary clarifiers, as needed.
6. Rehabilitation of structural steel surfaces in the secondary clarifiers, as needed.
7. Replacement of structural steel beam for the primary clarifier buildings.
8. Furnishing and installing new square circular clarifier mechanisms for the primary and secondary clarifiers to include:
    a. Mechanism, center column, feedwell and clarifier drive.
    b. Rake arm and scum skimmer.
    c. Walkway to the center column including handrails.
    d. Scum box and associated piping.
    e. FRP effluent launder and associated structural supports.
    f. New anchors.
    g. All associated electrical work.

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9. Reinstallation of the fiberglass roof panels above the primary and secondary clarifiers including new gaskets.

10. Reinstallation of the odor control and ventilation ductwork suspended from the roof panels of the primary clarifiers.

11. Furnishing and installing new odor control and ventilation ductwork suspended from the roof panels in the secondary clarifier building.

12. Testing and start-up of the new mechanisms.

13. Accomplishment of Work in the Contract Documents shall meet all requirements of the Contract including timeframes specified in the General Conditions/Agreement.

14. The above description is not intended to be complete. The Work to be completed is provided for in the Contract Documents. The summary in this section is not intended to relieve the Contractor of the responsibility for reading and understanding the Contract Documents.

15. Federal, State and Local Laws, Statutes and Regulations are not individually referenced. This provision incorporates by reference the latest version of statutes, laws and regulations. In case of conflict between the requirements of the Specifications and requirements of the statutes and regulations, the Contractor shall bring them to the attention of the Owner's representative. Lacking a specific response, the more stringent shall control. In no case can this Contract be interpreted to override statutes and regulations of governing authorities.

    a. National and industry codes cited, such as IBC, NEC, NFPA, shall include amendments and supplements by the authority having jurisdiction whether stated or not.

1.03 WORK UNDER OTHER CONTRACTS

A. Work performed at the Site by other contractors:

1. N/A.

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B. Cooperate with all other contractor work forces. Carry out Work under this project in a way that will minimize interference and delay for all forces involved. The Owner will resolve any disagreements that may arise among the contractors, or the Contractor and the Owner, over the method or order of doing the Work.

1.04 CONSTRUCTION DOCUMENT LANGUAGE

A. “Plant” is defined as the Redondo Wastewater Treatment Plant.

B. “Furnish” and “Supply and Install” are used interchangeably and share the same definition of provide in accordance with the Contract Documents.

C. Specifications are written mostly in imperative and streamlined form; this imperative language is directed to the Contractor. Additionally, the words "shall be" shall be included by inference where a colon (:) is used within sentences or phrases.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 11 20

ASBESTOS AND LEAD INFORMATION

PART 1 - GENERAL

1.01. SUMMARY

A. This section provides information pursuant to 29 CFR 1926.1101, WAC 296-62-077, and all other regulations requiring reporting of asbestos and lead containing materials.

B. The reports are of investigations of piping, painted surfaces, building, and structural materials. The reports do not apply to lead or asbestos that may be found in soils, vegetation, or other environments.

C. The following report is available for review from the Owner upon request:

1. PacRim # 18590 dated August 13, 2026.

1.02. QUALITY ASSURANCE

A. REFERENCE STANDARDS: 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. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Contract.

REFERENCE	TITLE
AHERA	(Federal) Asbestos Hazard Emergency Response Act
29 CFR 1926.1101	Safety and Health Regulations for Construction: Asbestos
WAC 296-62-077	Occupational Health Standards: Asbestos, Tremolite, Anthrophyllite, and Actinolite
WAC 296-65	WISHA Asbestos Standards
WAC 296-155-176	Safety Standards for Construction Work - Lead

1.03. ASBESTOS INSPECTION

A. The Owner has determined to the best of its ability that the proposed construction areas under this Contract and the materials therein do not contain asbestos. As per a Limited Asbestos Report on August 10, 2026 by Pacific Rim Environmental Inc. No

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asbestos containing materials were found. A copy of the report (PacRim #18590) is available upon request.

1.04. LEAD INSPECTION

A. The Owner has not investigated the proposed construction areas under this Contract and the materials for lead.

1.05. CONTRACTOR'S RESPONSIBILITIES

A. Notify all employees and subcontractors of the contents of this section.

B. Should suspect material not identified in this section be encountered, immediately suspend all work that could disturb said material and notify the Owner who will implement the proper action. Do not proceed with work that could disturb the material until authorized by the Owner, in writing, to do so.

C. Take the necessary precautions for compliance with Local, State, and Federal regulations.

D. Use of asbestos containing material in new construction is prohibited.

1.06. OWNER'S RESPONSIBILITIES

A. Upon notification by the Contractor of the existence of suspect material not identified in this section, the Owner will have said material inspected and analyzed for the presence of asbestos or lead, as required. The inspection and analytical work will meet the requirements as specified within this section, as may be applicable.

B. If the results of the inspection and analysis confirm the presence of asbestos in the suspect material, the Owner will take the necessary actions for compliance with 29 CFR 1926.1101. After compliance is obtained, the Owner will notify the Contractor in writing so that work suspended as specified within this section can proceed.

C. If the results of the inspection and analysis confirm the presence of lead in the suspect material, the Owner will take the necessary actions for compliance with WAC 296-155-176. After compliance is obtained, the Owner will notify the Contractor in writing so that work under this Contract can proceed.

D. If the result of the inspection and analysis confirms the suspect material is free of asbestos and/or lead, the Owner will notify the Contractor in writing that the suspended work can proceed.

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PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 12 16

CONSTRUCTION MILESTONES AND CONSTRAINTS

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies project milestones, construction sequencing requirements, Work restrictions, and constraints. To include the following:

1. Physical work requiring a clarifier to be offline is limited to the Dry Season as noted in Article Definitions.
2. Only one (1) clarifier (of the four (4) total clarifiers: two (2) primary and two (2) secondary) can be offline at a time for Contractor to work in.
3. The clarifiers will be rehabilitated in the following order:
    a. Secondary Clarifier No. 1.
    b. Secondary Clarifier No. 2.
    c. Primary Clarifier No. 1.
    d. Primary Clarifier No. 2.
4. Roof panels must be removed before the respective wire ropes internal to the roof panels can be removed. Wire ropes much be reinstalled and tensioned before respective roof panels can be reinstalled.
5. Demolition in a clarifier cannot begin until the new clarifier equipment has arrived onsite.

1.02. DEFINITIONS

A. Method of Procedure (MOP): A detailed document prepared and submitted by the Contractor to request process shutdowns, utility tie-ins, and work in areas that may result in unanticipated outages, flow diversions, or limited treatment capacity to accommodate execution of the Work.

B. Dry Season: May 1 through September 30.

C. Wet Season: October 1 through April 30.

D. Low Flow Time Period: Generally, 1:00 a.m. to 8:00 a.m. Owner may designate other low flow periods for specific outage requests made by Contractor.

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E. Peak Flow Events: Any day when instantaneous Plant flow exceeds ten (10) mgd.

1.03. SUBMITTALS

A. Procedures: Section 01 33 00.

B. Pre-Mop Meeting: Meet with Owner before submitting an MOP to discuss the nature of the shutdown, diversion, or tie-in, and to gather any information necessary to complete the MOP.

C. Submit MOP no later than 28 calendar days prior to the proposed start date. MOPs must have final approval from the Owner at least fourteen (14) calendar days prior to beginning the work. Include the following:

1. Start and end dates and times.
2. Buildings, facilities, or locations on site where work will be performed.
3. Description of work to be accomplished. Provide details on process isolation, work sequencing, safety, how activity will be completed within the constraints, and impacts to processes, facilities, and utilities.
4. When the duration of the needed facility shutdown exceeds the specified allowable outage duration, prepare an outage mitigation plan describing measures that Contractor will implement to mitigate the impact to Plant operations.
5. Detailed work plan including sequence and timing of events, resources required to complete activity, spill prevention plan, and contingency plans.
6. Tasks that need to be completed by Owner.
7. Critical equipment and tools required including, but not limited to, temporary piping, valves, pumping equipment, generators, temporary ventilation, temporary lighting, cranes, hoists, lifts, bulkheads, etc.
8. Services and systems that may be affected by the activity including, but not limited to, potable water, treatment processes, HVAC, fire protection, SCADA, standby power, telecom, utilities, storm drainage, safety equipment, sanitary drainage, etc.
9. Contractor's primary and secondary points of contact and phone numbers prior to and during activity.

D. Include anticipated MOPs in Baseline Progress Schedule and monthly Progress Schedule updates specified in Section 01 32 16.

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E. Include MOPs as an agenda item for the construction progress meetings specified in Section 01 31 19.

F. Obtain "No Exceptions Taken" review action no less than fourteen (14) days prior to work.

1.04. ACTIVITIES REQUIRING DEVELOPMENT AND SUBMITTAL OF A MOP

A. Activities requiring a MOP include, but are not limited to:

1. New tie-ins to existing utilities and existing structures.
2. Mechanical modifications to existing piping and existing equipment.
3. Demolition of existing facilities.
4. Bulkhead installation in existing channels and basins.
5. Shutdowns, diversions, and tie-ins to existing facilities.
6. Power and utility interruptions and tie-ins.
7. Switch over between existing and temporary and between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
8. Process modifications requiring interruption of operating processes or utilities.

1.05. GENERAL CONSTRAINTS

A. The existing Plant continuously treats wastewater in compliance with National Pollutant Discharge Elimination System (NPDES) permit requirements. Treatment process disruptions could result in the spillage or discharge of raw or partially treated wastewater into Puget Sound. The NPDES permit and state law allow the State of Washington Department of Ecology to impose civil penalties up to $10,000 per day for violation of a term, condition, or requirement of the NPDES permit. Additionally, injunction and civil penalties of up to $37,500 per day may be applied by the Environmental Protection Agency (EPA) or the State of Washington. Bypassing untreated and partially treated wastewater to surface waters or drainage courses is prohibited. Penalties imposed on the Owner as a result of any bypass caused by the Contractor and legal fees and other expenses to the Owner resulting directly or indirectly from the bypass, shall be borne in full by the Contractor.

B. Plant operation and shutdown constraints presented herein do not include all items affecting completion of the Work, but are intended to describe those constraints known

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to be necessary to minimize disruption of the existing facilities and to ensure NPDES permit compliance.

C. Sequence, schedule, and coordinate work in and around the activities of other contractors on the site to avoid obstruction of work access and interference with, or delay of, the work of other contractors on the site.

D. Provide temporary pumping, piping, power (including portable generators as required), lighting, controls, instrumentation, communication systems, and safety devices required to comply with the constraints specified in this Section.

E. Confirm required equipment, materials, and labor will be on site a minimum of three (3) days before commencing any work covered in a MOP.

F. Establish temporary erosion and sediment controls prior to commencing any clearing, grading, or excavation that may result in discharges to waters of the State.

G. Conduct work in a manner that allows safe use of any recreational trails.

H. Owner retains the authority to terminate any scheduled shutdown on the day of the scheduled shutdown.

1.06. PLANT ACCESS

A. Conduct work in a manner that maintains use of Plant roadways around the site for the duration of the project.

B. If access to parking spaces is obstructed by construction activities, provide temporary parking areas as close as practicable to the impacted spaces.

1.07. UTILITY SHUTDOWNS AND LIMITATIONS

A. Limitations on utility shutdowns and disruptions are as follows. All shutdowns and disruptions require submittal and approval of a MOP unless otherwise specified:

1. Information Technology (IT) Communications: Outages of up to one (1) hour on weekdays and six (6) hours on weekends are allowed. Required mitigation measures may include establishing temporary IT network communications.

2. Plant SCADA Network: Outages of up to one (1) hour are allowed. Required mitigation measures may include establishing temporary SCADA network communications.

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3. Plant PLC Remote I/O (RIO) Network: Outages of up to eight (8) hours are allowed. Required mitigation measures may include establishing temporary RIO network communications.
4. Plant Phones: No outages are allowed on weekdays between 6:00 a.m. and 6:00 p.m. Outages of up to twelve (12) hours are allowed during weekends.
5. Process Water (C2 and C3 Systems): Shutdowns of the process water systems shall be limited to two (2) hours. Potential mitigation measures include short-duration shutdowns, storing process water in an offline basin, a portable tank with re-pressurization pump, temporarily connecting to alternate water sources with backflow prevention as necessary, etc.
6. Tank Drainage System: Shutdowns of up to eight (8) hours allowed. Longer shutdowns may be allowed with an approved MOP.
7. Natural Gas: Between June 15 and September 15, natural gas outages of up to twenty-four (24) hours are allowed once (1) per week. No outages allowed the remainder of year. To the greatest extent possible, coordinate outages with the Plant's planned shutdowns to minimize operational impacts. Contractor is responsible for coordinating outages with Puget Sound Energy and shall comply with outage restrictions and schedule constraints imposed by Puget Sound Energy.
8. Digester Gas: Shutdowns of up to 24 hours are allowed between June 15 and September 15. Digester gas shutdowns are limited to one (1) every seven (7) days to allow processes to stabilize between shutdowns.
9. Existing Low Pressure Air: Two (2) hour shutdown, once per week.
10. High Pressure and Instrument Air: No shutdown without an approved MOP that considers impacts to process equipment.
11. Potable Water (C1):
    a. Fire Sprinkler Systems: Mitigate all shutdowns. Mitigations measures may include shutting down facilities or providing an alternative water source.
    b. Other Potable Water Services: No potable water disruptions between 6:00 a.m. and 6:00 p.m., Monday through Friday. No restrictions outside of these hours, except that shutdown of only one (1) facility at a time is allowed.
12. Sanitary Sewer Service: No sanitary sewer disruptions between 6:00 a.m. and 6:00 p.m., Monday through Friday. No restrictions outside of these hours, except that shutdown of only one (1) facility at a time is allowed.

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13. Electrical Power:

    a. Power shutdown to process areas is allowed during daily low flow periods as defined in this Section. Shutdowns of two (2) hours or longer, or shutdowns that impact operation of the Plant's UV disinfection system or Headworks, require mitigation measures with consideration for continued operation of the facilities impacted by the shutdown.

    b. Standby generators are required any time the Plant electrical generators are not available for use.

    c. Any planned outage of the 15 kV electrical distribution system requires a portable generator at the UV Disinfection 480V switchgear and Headworks.

    d. 15 kV system outages are not allowed during Peak Flow Events or when meeting NPDES permit requirements cannot be reasonably assured.

1.08. GENERAL PROCESS FACILITY SHUTDOWNS AND LIMITATIONS

A. Primary and Secondary Clarifiers:

1. During the Dry Season, one (1) total clarifier may be removed from service of the four available clarifiers which include two (2) primary and two (2) secondary. During the Wet Season, no clarifiers may be removed from service at any time.

2. The odor control ductwork and supply air ductwork for the primary clarifiers may be isolated and taken offline for the given offline primary clarifier.

3. The odor control and supply air ductwork for the secondary clarifiers may be taken offline only for the offline secondary clarifier only. Because the ductwork is shared across both clarifiers and because the two secondary clarifiers share a common roof and building, temporary partitioning between the clarifiers and temporary ductwork will be necessary to keep the odor control system online for Secondary Clarifier No. 1 when Secondary Clarifier No. 2 is offline.

B. Aeration Basins: N/A.

C. UV System: N/A.

D. Outfall: N/A.

E. Digesters: N/A.

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1.09. PROJECT SPECIFIC CONSTRAINTS

A. Tank Drain Pump Station: N/A.

B. Primary Clarifiers: Article General Process Facility Shutdowns and Limitations.

C. Boiler/Heat Loop: N/A.

D. Aeration Basin: N/A.

E. RAS Pumping Station 1/Existing WAS Pumping: N/A.

F. Secondary Clarifiers: See Article General Process Facility Shutdowns and Limitations.

G. Solids Thickening Facility: N/A.

H. Digesters: N/A.

I. Electrical: N/A.

J. SCADA Programming: N/A.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 14 19

USE OF SITE

PART 1 - GENERAL

1.01. REQUIREMENTS

A. Regular construction working hours are 7:00 a.m. to 4:00 p.m., excluding weekends and District holidays. Contractor may be allowed to work on weekends if approved in advance by the Owner. All work shall comply with the City of Des Moines noise ordinance as described in the City of Des Moines Municipal Code Section 18.185. Work hours may be extended upon approval by the Owner.

B. Institute a site security program to manage Plant access for the Project duration. Implement a system of ID badges and colored hard hats, vests, or other clothing that will clearly identify, by organization, all personnel as being authorized to be on site. At a minimum, this system shall separately identify employees of the Contractor, employees of subcontractors, Owner, and visitors.

C. Without limitation, no unescorted visitors are allowed site access.

D. Delivery personnel are the Contractor’s responsibility and must check in with the Contractor upon entering the site.

E. Traffic control, site access, and parking in accordance with Section 01 55 00.

F. Contractor is not permitted to use the Owner's existing facilities, restrooms, offices, conference rooms, telephones, natural gas, and parking areas without prior written authorization from the Owner. 120V electrical power for tools may be used with prior authorization from Owner on a case-by-case basis and if such use does not impact Plant maintenance and operation functions.

G. Temporary Utilities:

1. Owner will consider requests from the Contractor to make connection to Plant power, natural gas, potable water, and sanitary sewers for temporary utility service for Contractor’s facilities on a case-by-case basis.
2. A MOP shall be prepared prior to making any utility tie-in in accordance with Section 01 12 16.

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3. Owner reserves the right to disconnect utility service temporarily or permanently at its sole discretion.

H. Supply any and all tools necessary to complete the project. The Owner will not loan tools and/or equipment.

1.02. SPECIAL PRECAUTIONS

A. Take special precautions to protect operating mechanical equipment, power supply and distribution equipment, and instrumentation equipment from exposure to weather, concrete dust, debris, dirt, and water during the construction period.

B. Existing facilities contain classified areas as defined by the National Electrical Code; areas where insufficient oxygen may be present to sustain life; areas defined as confined spaces in Washington Administrative Code (WAC) Title 296, Part M; and hazardous areas as defined by the International Fire Code containing substances including, but not limited to, asbestos, lead, methane, and hydrogen sulfide and where corrosive chemicals are present. The Contractor shall be responsible for employing means and methods that are compatible with the space classifications, occupancy limitations, and/or WAC requirements that exist.

C. In areas that are presently unclassified, or where there are no limitations regarding space use, or where there are no hazardous substances or oxygen deficiency present, work within this Contract and other contracts may create areas with such limitations. In such cases, the Contractor shall be responsible for notifying the Owner at least ten (10) days before such limitations are created. Notification shall specifically indicate the type, extent, duration, and other pertinent information.

D. Ventilate and monitor all enclosed spaces and spaces exposed to or adjacent to sewage or sewage solids to ensure that such spaces do not present a hazard to the persons working in these areas. Special hazards that may be encountered include lack of sufficient oxygen to sustain life, methane, and hydrogen sulfide.

1.03. ALLOWABLE LOADING

A. Contractor shall not load nor permit any part of any structure to be loaded in any manner that will compromise the structural integrity, nor shall Contractor subject any part of the work or adjacent property to stresses or pressures that will compromise the structural integrity.

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PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.01. SUMMARY

A. Scope:

1. Base the Contract Sum on the material and equipment described in the Contract Documents without consideration of possible substitutions, approved equals, or deviations. Where indicated in the Contract Documents, an Approved Equal or Substitution of material or equipment may be furnished or used if acceptable to the Owner. Application for such acceptance will not be considered until after the Effective Date of the Contract.
2. Where products or materials are listed in the Contract Documents, the design is based on the product or material listed first. Other products or manufacturers identified are considered to be functionally equivalent to the first product or manufacturer identified, but may still be considered a substitution if changes in related work are required for installation. Manufacturers identified are believed to be capable of producing products compliant with the Contract Documents. Nevertheless, do not construe this statement as an endorsement of a particular manufacturer's product, nor shall it be construed that a named manufacturer's standard product complies with the Contract Documents.

1.02. QUALITY ASSURANCE

A. It is the Contractor's responsibility to ensure that substituted products and materials can be incorporated and perform in accordance with the Contract Documents and to obtain written approval from the Owner in advance before utilizing substituted products and materials.

B. To the greatest extent possible for each unit of Work, provide products, materials, and equipment of a singular generic kind from a single source.

C. Where more than one option is available for a product, material, or equipment, select the option that is compatible with other products, materials, or equipment. Compatibility is a basic requirement of product, material, and equipment selections.

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1.03. CONSTRUCTION DIFFERING FROM THE CONTRACT DOCUMENTS

A. GENERAL: Identify all construction differing from the Contract Documents during the submittal process defined in Section 01 33 00. Acceptance is at the Owner's sole discretion and the decision regarding acceptance or rejection shall be final. Contractor shall not assume acceptance at any time prior to the rendering of a written decision by the Owner. Any deviation, proposed Approved Equal, or proposed Substitution not identified on the submittal is not accepted or approved, regardless of any subsequent submittal action by the Owner, and shall not relieve the Contractor from complying with the original Construction Document requirements.

B. DEVIATIONS:

1. Definition: A minor change to a specified material, procedure, or product proposed by the Contractor, or an omission of a required item from a submittal, that does not fully conform to the requirements specified, but conforms to dimensional, operational, and maintenance requirements and can be shown to accomplish the functional and operational and maintenance cost performance of the specified item.

2. In the submittal, annotate all deviations from the Contract Documents.

C. APPROVED EQUAL:

1. Definition: An item of material or equipment proposed by the Contractor that has the same function, quality, durability, appearance, strength, and design characteristics equal to that named that meets the requirements of the Specification and is sufficiently similar so that no change in related work is required. The item of material or equipment shall reliably perform at least equally well for the function imposed by the design concept of the completed work as a functioning whole.

2. Clearly mark on the Submittal Transmittal Form 01 33 00-A.

D. SUBSTITUTION:

1. Definition: An item of significant difference in materials, equipment, means, method, technique, dimension, sequence, or procedure that functionally meets the Contract Documents requirements, but does not meet the Specification(s), and is equal to or better than the specified item.

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2. Submit a request for substitution with the submittal. Use Form 01 33 00-A; address and complete all items in the form. Include complete specifications for the item including procurement, operational and maintenance, and cost data.
3. Substitutions authorized only by Change Order Proposal.

E. SPECIAL WARRANTY: Owner may require a Special Warranty, at Contractor's expense, for any substitute.

F. OWNER'S COST REIMBURSEMENT: Owner will record costs incurred in evaluating a proposed substitute. Whether or not Owner approves a substitute item, Contractor shall reimburse Owner for the cost of evaluating each proposed substitute. Contractor shall also reimburse Owner for making changes in the Contract Documents resulting from the acceptance of each proposed substitute.

G. TESTING: Provide all testing and data in support of any proposed substitute or "Approved Equal" at Contractor's expense.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01. SUMMARY

A. This section includes the administrative and procedural requirements for executing a change in the Work as herein specified and further described in the General Conditions.

1.02. PRELIMINARY REQUIREMENTS

A. Prior to submitting the first Change Order Request (COR) or responding to the first Change Order Proposal (COP), submit a breakdown of wage rates. The breakdown shall show:

1. Basic wage rate (based on L&I Intent to Pay Prevailing Wages).
2. Fringe Package (based on L&I Intent to Pay Prevailing Wages).
3. FUI (Federal Unemployment Insurance).
4. FICA (Federal Insurance Compensation Act).
5. Medicare.
6. SUI (State Unemployment Compensation Act).
7. WC (Workers Compensation).

B. Submit verification of the above rates if requested by Owner.

C. Prior to submitting first Change Order Request (COR) or responding to first Change Order Proposal (COP) that involves equipment owned by the Contractor, the Contractor shall submit a list of all equipment anticipated to be used on the Project. Contractor shall provide the hourly rate based on the Equipment Watch Rental Rate Blue Book and as modified by the current AGC/WSDOT Agreement or other sources as referenced in the General Conditions.

1.03. WORK CHANGE MECHANISMS

A. INITIATING A CHANGE:

1. CHANGE ORDER PROPOSALS: Changes may be initiated by Owner through a Change Order Proposal (COP) submitted to Contractor. Such a request is for information and

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pricing only and is not an instruction to execute changes, nor to stop work in progress unless issued as a field order. Proposal will include:

a. Detailed description of changes, products, and location of modification in Project (first part of COP, "Request").

b. Supplementary or revised drawings or specifications.

c. Projected time span for making change. Statement as to whether overtime work is, or is not, authorized.

d. An updated Construction Progress Schedule may be requested if the COP impacts the existing Construction Progress Schedule.

2. CHANGE ORDER REQUESTS: Changes may be initiated by the Contractor through a Change Order Request (COR). Initiate changes by submitting a letter to Owner requesting a Work Change Directive or Change Order be issued. Include in the letter the following:

a. Description of proposed changes.

b. Reason for making changes.

c. A specific period of time during which requested price will be considered valid.

d. Effect on Contract Sum and Contract Time.

e. Documentation supporting any change in Contract Sum or Contract Time, as appropriate.

f. Statement as to why proposed change is not covered in Contract Documents.

g. Include date the Work is to be complete.

B. EXECUTING A CHANGE:

1. FIELD ORDERS: In situations where minor changes to the work are needed that do not materially change the terms of the Contract, the Owner may directly order a change to the Work by a written Field Order signed by the Owner.

2. WORK CHANGE DIRECTIVES:

a. In situations where time is of the essence or an emergency condition exists, and when the time required to price and execute a Change Order would impact the Project, the Owner may directly order a change to the Work by a written Work Change Directive signed by the Owner. Work Change Directives issued in emergency conditions will only be issued on an agreed lump sum price or time and material. Upon satisfactory submittal by the Contractor and approval by the Owner of supporting cost data, a Change Order will be executed if changes to

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the Contract Time or Contract Sum are required to accommodate the change in work.

b. The Owner, at the Owner's sole discretion, may issue a Work Change Directive in lieu of a Change Order for changes that are funded through the project force account. Such a change may modify the Contract work, but would not change the Contract Sum or Contract Time.

3. CHANGE ORDERS: In situations where the change alters the Contract Sum or Contract Time, the Owner will issue a Change Order. All Change Orders require review and approval by the Owner's Board of Commissioners. As such, the Contractor should expect the Change Order approval process to take several weeks at a minimum.

C. CHANGE ORDER PROPOSALS AND PRICING REQUESTS:

1. The cost of the change shall be marked up in accordance with the General Conditions. No additional markups shall be allowed.
2. Contractor shall provide all backup pricing documentation for a change on the forms found in Section 01 31 30. These forms or format shall also be the only acceptable documentation for all subcontractors. The forms consist of the following:
   a. Contractor Breakdown Summary.
   b. Subcontractor Breakdown Summary.
   c. Cost Breakdown.
   d. Provide all other supporting documentation as required to substantiate the requested costs such as invoices for rental equipment, freight cost, etc.
   e. Total cost and time shall be brought forward to the COR form and signed and dated by Contractor.

D. CHANGE ORDER AUTHORIZATION:

1. All Change Order Requests will be reviewed by Owner and must be approved by signature of the Owner. All approved requests will be incorporated into a Change Order.
2. Upon signature and execution by Owner, the Work Change Directives and Change Orders alter the Contract Time and Contract Sum as indicated.
3. Contractor may only request payment for changes in the Work against an approved Work Change Directive or Change Order.

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4. If the Owner disapproves a Change Order Request, the reason for disapproval will be stated. A request for a revised COR or cancellation of the COR will be shown.

E. CORRELATION WITH CONTRACTOR'S SUBMITTALS:

1. Application of Payment forms shall record each Work Change Directive or Change Order as a separate item of work. Do not include a Work Change Directive or Change Order on the applications until the fully executed Work Change Directive or Change Order is received from the Owner with the adjusted Contract Sum.
2. Revise Construction Progress Schedule to reflect changes in Contract Time.
3. Upon completion of Work Change Directive or Change Order Work, enter pertinent modifications in Project Record As-Built Documents.

F. DISTRIBUTION: Upon authorization of a Work Change Directive or Change Order, Owner will transmit one (1) signed copy to the Contractor. (See Change Order Proposal forms in Section 01 31 00).

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 29 00

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01. SUMMARY

A. This section specifies requirements for determining Contractor payments as herein specified and further described in the General Conditions.

1.02. PREREQUISITES FOR FIRST APPLICATION FOR PAYMENT

A. PREVAILING WAGE FORMS: Submit approved Statement of Intent to Pay Prevailing Wages form prior to commencing the Work (See General Conditions). The Owner will not make payment on an Application for Payment until the Contractor has filed with the Department of Labor and Industries (L&I) an approved copy of the form for the Contractor and every Subcontractor of every tier that performed Work during the payment period and are included in an Application for Payment. The form shall list every classification of laborer, worker, or mechanic employed by the Contractor and Subcontractors. No exceptions.

B. SCHEDULE OF VALUES: Submit and receive approval of the Schedule of Values allocating the Total Bid before submitting the first Application for Payment. The approved Schedule of Values shall be used by the Owner as the basis for progress payments. Payment for Work shall be made only for and in accordance with those items included in the Schedule of Values.

C. SUBCONTRACTOR LIST: Submit a list of all contracted Subcontractors and major material suppliers. Update list monthly with additional information from current subcontract awards.

D. RETAINAGE: Retainage or retainage bond must be established with Owner prior to first application for payment. Retainage requirements are specified in the General Conditions.

1.03. SCHEDULE OF VALUES

A. Make sum of total scheduled costs equal to the Total Bid.

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B. Schedule shall be listed in tabular form and include the following:

1. Schedule item numbers.
2. Schedule item descriptions.
3. Unit cost description, bid quantity, bid unit cost, bid total amount per item. No individual item on the Schedule of Values shall be more than $25,000.00 as specified in the General Conditions.
4. Estimated quantities for previous period, current application period, and total to date per item.
5. Amount previously billed, amount billed this period, total amount billed, and percent completion per item.
6. For items on which progress payments will be requested for materials or equipment purchased/fabricated/delivered but not yet installed, show "initial value" for payment request and "value added" for subsequent stage(s) of completion on that unit of Work.
7. Breakdown mechanical and electrical systems or phases with material and labor as separate items.
8. If allowances are utilized, show each allowance as a discrete line item.
9. Round figures to nearest dollar amount.
10. Include a proportional amount of Contractor’s overhead and profit for each item.
11. Major Specified cost items, which are not directly a cost of actual Work-in-place, such as distinct temporary facilities, mobilization and/or demobilization, Contract Closeout and Construction Progress Schedule prep, and monthly updates shall be shown as separate items.

C. If progress payments will be requested for materials or equipment stored either on or offsite, show the following:

1. Cost of the materials, delivered and unloaded, with taxes paid.
2. Total installed value.

D. Payment requirements for mobilization and demobilization are specified in the General Conditions.

E. Coordinate items of the Schedule of Values so that there is a corresponding item in the Construction Progress Schedule.

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F. Change Orders and Work Change Directives are to be added as separate items to the Schedule of Values as they are approved by the Owner.

G. Revise as requested by Owner.

1.04. DRAFT APPLICATION FOR PAYMENT

A. Submit a draft Application for Payment for approval. The cutoff date shall be five (5) calendar days prior to actual application or as otherwise agreed. Include projected costs to the end of the month in the pay request. Provide the following documents: (Draft documents may be marked by hand.)

1. Application and Certificate for Payment shall be on EJCDC Form C-620. A Microsoft Excel version of this form will be provided to the Contractor upon request. Fill in required information.

a. Mechanical and Electrical Subcontractor's draft monthly payment requests shall be submitted for review and comment prior to Owner's review and comment of Contractor's draft Application for Payment.

b. List Change Orders approved prior to submission date individually, last on the form. Use Owner's Change Order designation and description, similar to an original component item of Work. Do not bill for Change Order Proposals until an APPROVED Change Order or Work Change Directive has been received incorporating the proposal.

2. Prevailing Wage Certificate.

3. Stored Materials: Requests for payment on materials stored shall be for materials properly stored on the Project site. In addition to the requirements of the General Conditions, payment for materials stored off-site shall be at the sole option of the Owner and comply with conditions stipulated by Owner. These conditions may include, but are not limited to:

a. Invoice from Supplier.

b. Insurance or Bond to cover total loss of material and time impact.

c. Contractor and its bonding company accepts total responsibility for the stored materials.

4. Monthly Progress Schedule updates.

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B. The following shall be reviewed and approved by Owner prior to approval of the draft Application for Payment:

1. Project Record Drawings for completeness and accuracy.
2. Construction Progress Schedule Monthly Updates.
3. Contractor Quality Control Reports.
4. Mechanical and Electrical Subcontractors payment requests.

1.05. APPLICATION FOR PAYMENT

A. The Contractor shall submit the Application for Payment after including a response to the Owner's comments on the draft application.

B. Contractor is cautioned to carefully check all extensions, totals, and required information for accuracy before formal submittal.

C. Applications are to be signed by a responsible officer of Contractor. No photocopies of signature permitted.

D. Application for Payment shall include invoices for materials stored off-site.

E. Certified Payroll shall be submitted weekly to the Owner.

F. When Owner finds Application for Payment properly completed and correct, they will sign and transmit the Application for Payment for processing.

G. If Owner finds the Application for Payment improperly or incorrectly executed, an annotated copy will be returned for resubmittal.

H. Only minor corrections are allowed on original, with approval of Owner.

1.06. PRIOR TO APPLICATION FOR FINAL PAYMENT

A. Application for a FINAL pay request will be accepted for processing only after satisfactory completion of the following:

1. Application and Certificate for Payment on Contract.
2. Invoices for materials stored off-site.
3. Final Completion achieved per Section 01 77 00, Closeout Procedures.
4. Final Schedule of Values "Total Bid" submitted.

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1.07. MEASUREMENT OF QUANTITIES

A. Work completed under the Contract shall be measured according to the standards of weights and measures recognized by the U.S. Bureau of Standards.

B. The method of measurement and computations to be used in determination of quantities of material furnished and of Work performed under the Contract will be those methods generally recognized as conforming to good engineering practice.

C. Structures will be measured according to neat lines indicated on Drawings or as altered to fit field conditions. No payment will be made for length, width, or depth, in excess of that indicated on Drawings or specified for any construction, unless otherwise approved by the Owner in writing.

D. Items that are measured by the linear foot, such as pipe, will be measured parallel to the base or foundation upon which such items are placed.

E. In computing volumes of excavation (when part of a unit price project component), the average end area method, based on horizontal measurements, or other acceptable methods, will be used. If the excavation is incidental or part of a lump sum bid item, no additional payments will be made.

F. The term "each," when used as an item of payment, will mean complete payment for the Work described in the payment item in the Contract Documents. The Work described is not intended to be exhaustive.

G. The term "lump sum," when used as an item of payment, will mean complete payment for the Work described in the Contract Documents, including all necessary fittings and accessories, and required testing completed.

H. The term “complete in place,” means the completion of the Contract item or portions thereof as determined by the Owner including the furnishing of all materials, equipment, tools, labor, and Work incident thereto, unless otherwise specified.

I. Contingent unit price items Work is Work not shown on Drawings and shall be performed only at the direction of the Owner.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

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PART 3 - EXECUTION

3.01. MOBILIZATION/DEMOBILIZATION (BID ITEM NO. 1)

A. Payment: Payment for Mobilization/Demobilization (Bid Item No. 1) will be made at the lump sum price stated in the Bid Schedule. The lump sump price for Bid Item No. 1 shall include all costs associated with mobilizing and demobilizing personnel, equipment, supplies, offices, and other facilities necessary for the Work; measurements and surveying; coordination, connection, and service changes for temporary and permanent electrical, water, and sewer utilities; permits required to complete the Work; third party testing; miscellaneous start-up costs; insurance for the Project; construction scheduling (including updates); Record Drawings; final deliverables; final clean-up; and demobilization. See also Section 55 of the General Conditions.

B. Measurement: Bid Item No. 1 shall be paid for as a lump sum.

1. Bid Items No. 1 shall be paid for a lump sum in accordance with Section 55 of the General Conditions.
2. Obtaining a site for the Contractor's mobilization, storage of materials, and other general operations shall be the responsibility of the Contractor. All costs associated with securing sites shall be included in the other bid items on the Project and no other compensation will be made for this time or expense.

3.02. PRIMARY CLARIFIERS #1 AND #2 – DEMOLITION (BID ITEM NO. 2)

A. Payment: Primary Clarifiers #1 and #2 – Demolition (Bid Item No. 2) will be made at the lump sum price stated in the Bid Schedule. The lump sum price for Bid Item No. 2 shall include all costs associated with demolition and salvage of any and all structures, equipment, appurtenances, or other components of the Work that are not explicitly part of other Bid Items stated herein. The lump sum price shall include all necessary Work, equipment, materials, labor, and incidentals for the following demolition and salvage activities at Primary Clarifiers #1 and # 2: removal and salvaging of fiberglass roofing panels and foul air duct Work for reinstallation after installation of in-tank components, demolition of the structural steel roof beam, demolition of existing effluent troughs and their associated wall supports including anchors, demolition of existing Primary Clarifier rake arms, center column mechanisms, feed wells, drives and platforms, demolition of the existing scum boxes, scum baffles, scum skimmers and associated piping, demolition of the existing pipes through the walls to the flanges in the Primary pump room, demolition of the return piping, demolition of the existing (material) blades and adjustable squeegees, demolition of existing Primary Clarifier walkways to the center columns, demolition of existing electrical elements, removal and salvage of the

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perimeter lighting fixtures, demolition of grout topping slabs on tank floors, and any other demolition or salvage activities required to complete the Work that are not explicitly listed in this Bid Item, except for crack injection, concrete, steel, cast-in-place anchors, epoxied, or expansion anchors, or joint sealant repair Work described in Bid Items 10 through 21.

B. Measurement: Bid Item No. 2 shall be paid for as a lump sum. Progress payments will be made in accordance with the submitted and approved Schedule of Values.

3.03. PRIMARY CLARIFIERS #1 AND #2 – MECHANICAL (BID ITEM NO. 3)

A. Payment: Primary Clarifiers #1 and #2 – Mechanical (Bid Item No. 3) will be made at the lump sum price stated in the Bid Schedule. The lump sum price for Bid Item No. 3 shall include all necessary Work, equipment, materials, labor, and incidentals for furnishing and installing the new square circular mechanisms, scum skimmers, scum boxes, feedwells, walkways to center columns, handrail, and associated stainless steel supports, furnishing and installing new FRP effluent troughs, associated stainless steel supports and anchors, and reinstallation of the foul air ductwork removed under Bid Item No. 2. All Work required to complete all mechanical and directly associated Work except for demolition, electrical, and structural Work listed in Bid Item No. 2, 4, and 5, and crack injection, concrete, steel, cast-in-place anchors, epoxied, or expansion anchors, or joint sealant repair Work described in Bid Item No. 10 through 21.

B. Measurement: Bid Item No. 3 shall be paid for as a lump sum. Progress payments will be made in accordance with the submitted and approved Schedule of Values.

3.04. PRIMARY CLARIFIERS #1 AND 2 – ELECTRICAL (BID ITEM NO. 4)

A. Payment: Primary Clarifiers #1 and #2 – Electrical (Bid Item No. 4) will be made at the lump sum price stated in the Bid Schedule. The lump sum price for Bid Item No. 4 shall include all necessary Work, equipment, materials, labor, and incidentals for furnishing and installing new electrical equipment and components as specified including perimeter lighting and any required supports and anchors, and reinstallation of electrical equipment and components removed under Bid Item No. 2. All Work required to complete all electrical and directly associated Work except for demolition, mechanical, and structural Work listed in Bid Item No. 2, 3, and 5, and crack injection, concrete, steel, cast-in-place anchors, epoxied, or expansion anchors, or joint sealant repair Work described in Bid Item No. 10 through 21.

B. Measurement: Bid Item No. 4 shall be paid for as a lump sum. Progress payments will be made in accordance with the submitted and approved Schedule of Values.

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3.05. PRIMARY CLARIFIERS #1 AND #2 – STRUCTURAL (BID ITEM NO. 5)

A. Payment: Primary Clarifiers #1 and #2 – Structural (Bid Item No. 5) will be made at the lump sum price stated in the Bid Schedule. The lump sum price for Bid Item No. 5 shall include all necessary Work, equipment, materials, labor, and incidentals for furnishing and installing the new structural steel roof beam and reinstalling the roof panels removed under Bid Item No. 2. All Work required to complete all structural and directly associated Work except for demolition, mechanical, and electrical Work listed in Bid Item No. 2, 3, and 4, and crack injection, concrete, steel, cast-in-place anchors, epoxied, or expansion anchors, or joint sealant repair Work described in Bid Item No. 10 through 21.

B. Measurement: Bid Item No. 5 shall be paid for as a lump sum. Progress payments will be made in accordance with the submitted and approved Schedule of Values.

3.06. SECONDARY CLARIFIERS #1 AND #2 – DEMOLITION (BID ITEM NO. 6)

A. Payment: Secondary Clarifiers #1 and #2 – Demolition (Bid Item No. 6) will be made at the lump sum price stated in the Bid Schedule. The lump sum price for Bid Item No. 6 shall include all costs associated with demolition and salvage of any and all structures, equipment, appurtenances, or other components of the Work that are not explicitly part of other Bid Items stated herein. The lump sum price shall include all necessary Work, equipment, materials, labor, and incidentals for the following demolition and salvage activities at Secondary Clarifiers #1 and # 2: removal and salvaging of fiberglass roofing panels, as needed, and removal of foul air duct Work for replacement after installation of in-tank components, demolition of existing effluent troughs and their associated wall supports including anchors, demolition of existing Secondary Clarifier rake arms, center columns, mechanisms, feed wells, drives and platforms, demolition of the existing scum boxes, scum baffles, scum skimmers and associated piping, demolition of the existing blades and adjustable squeegees, demolition of existing Secondary Clarifier walkways to the center columns, demolition of existing electrical elements, demolition of grout topping slabs on tank floors, and any other demolition or salvage activities required to complete the Work that are not explicitly listed in this Bid Item, except for crack injection, concrete, steel, cast-in-place anchors, epoxied, or expansion anchors, or joint sealant repair Work described in Bid Item No. 10 through 21.

B. Measurement: Measurement: Bid Item No. 6 shall be paid for as a lump sum. Progress payments will be made in accordance with the submitted and approved Schedule of Values.

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3.07. SECONDARY CLARIFIERS #1 AND #2 – MECHANICAL (BID ITEM NO. 7)

A. Payment: Secondary Clarifiers #1 and #2 – Mechanical (Bid Item No. 7) will be made at the lump sum price stated in the Bid Schedule. The lump sum price for Bid Item No. 7 shall include all necessary Work, equipment, materials, labor, and incidentals for furnishing and installing the new square circular mechanisms, scum skimmers, scum boxes, feedwells, walkways to center columns, handrail, and associated stainless steel supports, furnishing and installing new FRP effluent troughs, associated stainless steel supports and anchors, and reinstallation of the foul air ductwork removed under Bid Item No. 6. All Work required to complete all mechanical and directly associated Work except for demolition, electrical, and structural Work listed in Bid Item No. 6, 8, and 9, and crack injection, concrete, steel, cast-in-place anchors, epoxied, or expansion anchors, or joint sealant repair Work described in Bid Item No. 10 through 21.

B. Measurement: Bid Item No. 7 shall be paid for as a lump sum. Progress payments will be made in accordance with the submitted and approved Schedule of Values.

3.08. SECONDARY CLARIFIERS #1 AND #2 – ELECTRICAL (BID ITEM NO. 8)

A. Payment: Secondary Clarifiers #1 and #2 – Electrical (Bid Item No. 8) will be made at the lump sum price stated in the Bid Schedule. The lump sum price for Bid Item No. 8 shall include all necessary Work, equipment, materials, labor, and incidentals for furnishing and installing new electrical equipment and components as specified including any required supports and anchors, and reinstallation of electrical equipment and components removed under Bid Item No. 6. All Work required to complete all electrical and directly associated Work except for demolition, mechanical, and structural Work listed in Bid Item No. 6, 7, and 9, and crack injection, concrete, steel, cast-in-place anchors, epoxied, or expansion anchors, or joint sealant repair Work described in Bid Item No. 10 through 21.

B. Measurement: Bid Item No. 8 shall be paid for as a lump sum. Progress payments will be made in accordance with the submitted and approved Schedule of Values.

3.09. SECONDARY CLARIFIERS #1 AND #2 – STRUCTURAL (BID ITEM NO. 9)

A. Payment: Secondary Clarifiers #1 and #2 – Structural (Bid Item No. 9) will be made at the lump sum price stated in the Bid Schedule. The lump sum price for Bid Item No. 9 shall include all necessary Work, equipment, materials, labor, and incidentals for reinstalling the roof panels removed under Bid Item No. 6. All Work required to complete all structural and directly associated Work except for demolition, mechanical, and electrical Work listed in Bid Item No. 6, 7, and 8, and crack injection, concrete, steel,

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cast-in-place anchors, epoxied, or expansion anchors, or joint sealant repair Work described in Bid Item No. 10 through 21.

B. Measurement: Bid Item No. 9 shall be paid for as a lump sum. Progress payments will be made in accordance with the submitted and approved Schedule of Values.

3.10. CRACK INJECTION (BID ITEM NO. 10)

A. Payment: Crack Injection (Bid Item No. 10) will be made at the linear feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection. The linear feet price for Bid Item No. 10 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning to allow for concrete condition assessment, containment and removal of all debris generated by Bid Item No. 10, and Work as shown in Detail 1 on Drawing S-03.

B. Measurement: Bid Item No. 10 shall be paid for as the number of linear feet repaired per Detail 1 on Drawing S-03. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 10, the quantity shall be assumed to be 50 linear feet. For the purpose of determining the payment for Bid Item No. 10, the quantity shall be the actual quantity of Work to the nearest 0.1 linear feet, repaired per Detail 1 on Drawing S-03.

1. The District does not warrant that any repairs per Detail 1 on Drawing S-03 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 10, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.11. SHALLOW SPALL REPAIR WITHOUT REBAR EXPOSED (BID ITEM NO.11)

A. Payment: Shallow Spall Repair without Rebar Exposed (Bid Item No. 11) will be made at the square feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection. The square feet price for Bid Item No. 11 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning to allow for concrete condition assessment, containment and removal of all debris generated by Bid Item No. 11, and Work as shown in Detail 2 on Drawing S-03.

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B. Measurement: Bid Item No. 11 shall be paid for as the number of square feet repaired per Detail 2 on Drawing S-03. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 11, the quantity shall be assumed to 10 square feet. For the purpose of determining the payment for Bid Item No. 11, the quantity shall be the actual quantity of Work to the nearest 0.1 square feet, repaired per Detail 2 on Drawing S-03.

1. The District does not warrant that any repairs per Detail 2 on Drawing S-03 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 11, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.12. SHALLOW SPALL REPAIR WITHOUT REBAR EXPOSED (BID ITEM NO.12)

A. Payment: Shallow Spall Repair without Rebar Exposed (Bid Item No. 12) will be made at the square feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection. The square feet price for Bid Item No. 12 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning to allow for concrete condition assessment, containment and removal of all debris generated by Bid Item No. 12, and Work as shown in Detail 3 on Drawing S-03.

B. Measurement: Bid Item No. 12 shall be paid for as the number of square feet repaired per Detail 3 on Drawing S-03. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 12, the quantity shall be assumed to be 10 square feet. For the purpose of determining the payment for Bid Item No. 12, the quantity shall be the actual quantity of Work to the nearest 0.1 square feet, repaired per Detail 3 on Drawing S-03.

1. The District does not warrant that any repairs per Detail 3 on Drawing S-03 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 12, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

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3.13. DEEP SPALL REPAIR WITHOUT DAMAGED REBAR REPAIR (BID ITEM NO.13)

A. Payment: Deep Spall Repair without Damaged Rebar Repair (Bid Item No. 13) will be made at the square feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection. The square feet price for Bid Item No. 13 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning to allow for concrete condition assessment, containment and removal of all debris generated by Bid Item No. 13, and Work as shown in Detail 4 on Drawing S-03.

B. Measurement: Bid Item No. 13 shall be paid for as the number of square feet repaired per Detail 4 on Drawing S-03. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 13, the quantity shall be assumed to be 10 square feet. For the purpose of determining the payment for Bid Item No. 13, the quantity shall be the actual quantity of Work to the nearest 0.1 square feet, repaired per Detail 4 on Drawing S-03.

   1. The District does not warrant that any repairs per Detail 4 on Drawing S-03 will be identified during the inspection.
   2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 13, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.14. DEEP SPALL REPAIR WITH DAMAGED REBAR REPAIR (BID ITEM NO.14)

A. Payment: Deep Spall Repair with Damaged Rebar Repair (Bid Item No. 14) will be made at the square feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection. The square feet price for Bid Item No. 14 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning to allow for concrete condition assessment, containment and removal of all debris generated by Bid Item No. 14, and Work as shown in Detail 5 on Drawing S-03.

B. Measurement: Bid Item No. 14 shall be paid for as the number of square feet repaired per Detail 5 on Drawing S-03. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 14, the quantity shall be assumed to be ten (10) square feet. For the purpose of determining the payment for Bid Item No. 14, the quantity shall be

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the actual quantity of Work to the nearest 0.1 square feet, repaired per Detail 5 on Drawing S-03.

1. The District does not warrant that any repairs per Detail 5 on Drawing S-03 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 14, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.15. STEEL REPAIR – TYPE 1 (BID ITEM NO.15)

A. Payment: Steel Repair – Type 1 (Bid Item No. 15) will be made at the square feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection and the roof panels are removed at Secondary Clarifiers #1 and #2. The square feet price for Bid Item No. 15 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning and steel cleaning to allow for concrete and steel condition assessment, containment and removal of all debris generated by Bid Item No. 15, and Work as shown in Detail 1 on Drawing S-04.

B. Measurement: Bid Item No. 15 shall be paid for as the number of square feet of steel repaired to the limits of the region to be Blast Cleaned and repaired per Detail 1 on Drawing S-04. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 15, the quantity shall be assumed to be ten (10) square feet. For the purpose of determining the payment for Bid Item No. 15, the quantity shall be the actual quantity of Work to the nearest 0.1 square feet, repaired per Detail 1 on Drawing S-04.

1. The District does not warrant that any repairs per Detail 1 on Drawing S-04 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 15, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.16. STEEL REPAIR – TYPE 2 (BID ITEM NO.16)

A. Payment: Steel Repair – Type 2 (Bid Item No. 16) will be made at the square feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping

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grout are removed and the existing concrete is cleaned for inspection and the roof panels are removed at Secondary Clarifiers #1 and #2. The square feet price for Bid Item No. 16 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning and steel cleaning to allow for concrete and steel condition assessment, containment and removal of all debris generated by Bid Item No. 16, and Work as shown in Detail 2 on Drawing S-04.

B. Measurement: Bid Item No. 16 shall be paid for as the number of square feet of steel repaired to the limits of new steel cover plate and repaired per Detail 2 on Drawing S-04. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 16, the quantity shall be assumed to be ten (10) square feet. All welding preparation, preheat and welding shall be incidental to Bid Item No. 16. For the purpose of determining the payment for Bid Item No. 16, the quantity shall be the actual quantity of Work to the nearest 0.1 square feet, repaired per Detail 2 on Drawing S-04.

1. The District does not warrant that any repairs per Detail 2 on Drawing S-04 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 16, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.17. STEEL REPAIR – TYPE 3 (BID ITEM NO.17)

A. Payment: Steel Repair – Type 3 (Bid Item No. 17) will be made at the square feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection and the roof panels are removed at Secondary Clarifiers #1 and #2. The square feet price for Bid Item No. 17 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning and steel cleaning to allow for concrete and steel condition assessment, containment and removal of all debris generated by Bid Item No. 17, and Work as shown in Detail 3 on Drawing S-04.

B. Measurement: Bid-Item No. 17 shall be paid for as the number of square feet of steel repaired to the limits of the new steel plate and per Detail 3 on Drawing S-04. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 17, the quantity shall be assumed to be ten (10) square feet. All welding preparation, preheat and welding shall be incidental to Bid Item No. 17. For the purpose of determining the

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payment for Bid Item No. 17, the quantity shall be the actual quantity of Work to the nearest 0.1 square feet, repaired per Detail 3 on Drawing S-04.

1. The District does not warrant that any repairs per Detail 3 on Drawing S-04 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 17, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.18. STEEL REPAIR – TYPE 4 (BID ITEM NO.18)

A. Payment: Steel Repair – Type 4 (Bid Item No. 18) will be made at the square feet price stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection and the roof panels are removed at Secondary Clarifiers #1 and #2. The price for Bid Item No. 18 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning and steel cleaning to allow for concrete and steel condition assessment, containment and removal of all debris generated by Bid Item No. 18, and Work as shown in Detail 4 on Drawing S-04.

B. Measurement: Bid Item No. 18 shall be paid for by the pounds of steel placed to the limits of the new steel section (rod, wide flange section, tube section, channel or similar) and repaired per Detail 4 on Drawing S-04. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 18, the quantity shall be assumed to be 100 pounds finished cut weight. All welding preparation, preheat and welding shall be incidental to Bid Item No. 18. For the purpose of determining the payment for Bid Item No. 18, the quantity shall be the actual quantity of Work to the nearest 0.1 pounds, repaired per Detail 4 on Drawing S-04.

1. The District does not warrant that any repairs per Detail 4 on Drawing S-04 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 18, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

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3.19. CORRODED CAST-IN-PLACE ANCHOR REPAIR (BID ITEM NO.19)

A. Payment: Corroded Cast-In-Place Anchor Repair (Bid Item No. 19) will be made at the price as stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection and the roof panels are removed at Primary and Secondary Clarifiers #1 and #2. The price for Bid Item No. 19 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning and steel cleaning to allow for concrete and steel condition assessment, containment and removal of all debris generated by Bid Item No. 19, and Work as shown in Detail 1 on Drawing S-05.

B. Measurement: Bid Item No. 19 shall be paid for by the number of Corroded Cast-In Place Anchors replaced per Detail 1 on Drawing S-05. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 19, the quantity shall be assumed to be ten (10) Corroded Cast-In-Place Anchor repaired. For the purpose of determining the payment for Bid Item No. 19, the quantity shall be the actual quantity of corroded cast-in-place anchors, repaired per Detail 1 on Drawing S-05.

   1. The District does not warrant that any repairs per Detail 1 on Drawing S-05 will be identified during the inspection.
   2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 19, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.20. CORRODED EPOXIED OR EXPANSION ANCHOR REPAIR (BID ITEM NO.20)

A. Payment: Corroded Epoxied or Expansion Anchor Repair (Bid Item No. 20) will be made at the price as stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection and the roof panels are removed at Primary and Secondary Clarifiers #1 and #2. The square feet price for Bid Item No. 20 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning and steel cleaning to allow for concrete and steel condition assessment, containment and removal of all debris generated by Bid Item No. 20, and Work as shown in Detail 2 on Drawing S-05.

B. Measurement: Bid Item No. 20 shall be paid for by the number of Corroded Cast-In Place Anchors replaced per Detail 2 on Drawing S-05. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of

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determining the bid amount for Bid Item No. 20, the quantity shall be assumed to be ten (10) Corroded Epoxied or Expansion Anchor repaired. For the purpose of determining the payment for Bid Item No. 20, the quantity shall be the actual quantity of corroded epoxied or expansion anchors, repaired per Detail 2 on Drawing S-05.

1. The District does not warrant that any repairs per Detail 2 on Drawing S-05 will be identified during the inspection.
2. The District does not warrant that the actual quantity of Work, completed under Bid Item No. 20, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

3.21. JOINT SEALANT REPAIR (BID ITEM NO.21)

A. Payment: Joint Sealant Repair (Bid Item No. 21) will be made at the price as stated in the Bid Schedule. The actual quantity of the Work required is not known at this time and will be determined after the existing rotating assembly and sloping topping grout are removed and the existing concrete is cleaned for inspection and the roof panels are removed at Primary and Secondary Clarifiers #1 and #2. The lineal foot price for Bid Item No. 21 shall include all necessary Work, equipment, materials, labor, and incidentals for concrete cleaning and steel cleaning to allow for concrete and steel condition assessment, containment and removal of all debris generated by Bid Item No. 21, and Work to match the details and materials of the sealants removed from the original construction.

B. Measurement: Bid Item No. 21 shall be paid for by actual quantity of lineal feet of polysulfide joint sealant repaired per Detail 3 on Sheet S-05. Progress payments will be made in accordance with the submitted and approved Schedule of Values. For the purpose of determining the bid amount for Bid Item No. 21, the quantity shall be assumed to be 100 lineal feet of polysulfide joint sealant. For the purpose of determining the payment for Bid Item No. 21, the quantity the quantity shall be the actual quantity of lineal feet of polysulfide joint sealant, repaired.

1. The district does not warrant that any repairs of polysulfide joint sealant will be identified during the inspection per Detail 3 on Sheet S-05.
2. The district does not warrant that the actual quantity of Work, completed under Bid Item No. 21, will be the same as, more than or less than the assumed quantity used as the basis of the bid.

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3.22. BONDS (BID ITEM NO. 22)

A. Payment: Payment for Bonds (Bid Item No. 22) will be made at the lump sum price stated in the Bid Schedule. The lump sump price for Bid Item No. 22 shall include all costs associated with Contractor bonds. See also the General Conditions.

B. Measurement: Bid Item No. 22 shall be paid for as a lump sum.

1. Bid Items No. 22 shall be paid for a lump sum in accordance with the General Conditions.

3.23. FORCE ACCOUNT (BID ITEM NO. 23)

A. Payment: A bid allowance of $400,000.00 is established for performance of force account Work as directed by the Owner. The Owner does not warrant expressly or by implication that the actual amount paid for force account Work will correspond to the $400,000.00 allowance. Payment will be made based on the Work performed and the corresponding costs as authorized in writing by the Owner. A description of the force account Work and breakdown of associated costs must be received at least seven (7) calendar days prior to the cutoff for the current payment period to be considered for inclusion in the request for payment for that period.

B. Measurement: Each authorized force account item shall be paid for as an individual lump sum. Progress payments will be made in accordance with the authorized amount and associated approved cost breakdown.

END OF SECTION

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SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01. GENERAL COMMUNICATION

A. The Owner will designate contact information in writing.

B. Telephone communication and correspondence shall be between Contractor and Owner or Owner's Representative.

C. Subcontractors: Do not contact the Engineer directly. Transmit problems or questions in writing using the Request for Information (RFI) form (see RFI form in Section 01 31 30) through Contractor to Owner.

D. In case of an EMERGENCY call 911 and contact the Owner.

E. Provide an electronic document control system for construction communication with the Contractor, Owner, and Engineer per Section 01 31 23.

1.02. CORRESPONDENCE

A. Address all correspondence to Owner and the Owners Representative.

B. All correspondence to and from Contractor shall include the Owner.

1.03. REQUEST FOR INFORMATION (RFI)

A. When field conditions or Contract Documents require clarification or verification by the Owner, a written RFI is to be submitted per the following:

1. Identify the nature and location of each clarification/verification using the RFI form supplied by Owner (see Section 01 31 30). Provide as a minimum the following information:
    a. Project name and number.
    b. Date.
    c. Date response required by.
    d. RFI number.

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e. Subject.

f. Initiator of the question.

g. Area and Location.

h. Drawing reference.

i. Specification Section and paragraph reference.

j. Descriptive text with attached drawing markup or sketch.

k. Contractor's suggested resolution of issue.

l. Space for reply on same page as question.

m. Single subject matter, one (1) item each - architectural, civil, structural, mechanical, electrical.

2. Number each RFI sequentially beginning with #0001. Only one question per RFI. Also, they may be identified as GEN, MECH, ELEC, by sequential numbers.

a. Cost of the materials, delivered and unloaded, with taxes paid.

b. Total installed value.

B. Route RFIs consistent with Section 01 31 23.

C. CLARIFICATIONS: May be discussed on-site or by telephone with the Owner. Incorporate the essence of a discussion on to an RFI Form. RFI responses that modify or change the Work will be authorized only by Change Order or Field Order as appropriate.

1.04. NON-CONFORMANCE REPORT (NCR)

A. REFERENCE DOCUMENT: Non-conformance Report (NCR)--see NCR form in Section 01 31 30.

B. NON-CONFORMING WORK: Work found defective or not complying with the Contract Documents is defined hereunto and in the General Conditions as Non-conforming Work.

C. PROCEDURE: If, after an oral discussion or written notifications, the Contractor fails to correct Work that does not conform to the Contract Documents, a Non-conformance Report will be issued. Upon receipt of NCR, Contractor shall take immediate action to resolve the Work to the Owner's satisfaction and approval or remove and replace with

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conforming Work, at Contractor's expense and no increase in Contract Time. Corrective actions for non-conforming work shall be discussed at construction progress meetings.

1.05. MONTHLY REPORTS

A. MANAGEMENT REPORT: Develop, on a monthly basis, a concise monthly report and present same to the Owner along with the monthly payment request. The report will include as a minimum:

1. Executive Summary.
2. Areas of Concern.
3. Action Items.
4. Progress for the Period.
5. Cost Summary.
6. Change Order Summary.
7. Submittal Summary.
8. MOP Log.
9. RFI Summary.
10. Safety Summary.
11. Disputes/Potential Claims Summary.
12. Quality Assurance and Non-conformance Summary.

B. Progress for Period shall include:

1. An updated CPM schedule.
2. When requested by the Owner, a detailed narrative describing the progress of the work and shall include:
    a. Milestones completed, major equipment deliveries and problems arising during the month, and any impact on the schedule.
    b. Projection of the work anticipated during the coming month, including indicating activities ahead of, on, and behind schedule.
    c. Identification of changes in logic tied to the CPM Schedule and describing the impacts resulting from these changes.

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3. Obtain and submit supplier(s) and subcontractor(s) consensus of monthly Updated Schedule when major logic or milestone changes occur.
4. Attach schedule files to report.

C. Cost Summary shall include a summary of cost projection that indicates cost-to-date of the construction, cost-to-completion, as well as cost-at-completion and include:

1. Bid Package Summary Report showing all Packages, Budgets, Bid Amounts, and Dates of Future Package Bidding.
2. A timed, scaled Cash Flow Report by month, based on the Updated Schedule. When requested by the Owner, the Cash flow diagram shall reflect the schedule cost loading and including early and late cash flow projections.

D. Dispute/Potential Claims Summary: Present on a monthly basis, a listing of disputes/potential claims. As part of this presentation, evaluate the merit of each issue and present a recommendation for mitigation.

1.06. COORDINATION

A. GENERAL COORDINATION:

1. Coordinate with Work of other sections to ensure that all fixtures, devices, switches, outlets, ducts, pipes, and similar items can be installed as shown without modifications to framing. Provide all blockouts, raceways, and similar framing as required.
2. Anticipate interrelationship of all Subcontractors and their relationship with the total Work.
3. Resolve differences or disputes between Subcontractors and materials suppliers concerning coordination, interference, or extent of Work. Contractor's decisions, if consistent with Contract Document requirements, shall be final.
4. The Contractor shall be in charge of this Contract and the Project, as well as directing and scheduling of all Work. Final responsibility for performance, interface, and completion of Work and Project shall be the Contractor's.
5. Cooperation with other contractors during the term of this Project may be required within the building or other adjacent locations to the construction limits of this Project. The Contractor is to cooperate with the Owner in coordination of all work to prevent impact to this or other Owner sponsored construction projects.

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6. Any cost for supplemental Building Information Modeling (BIM) needed for construction planning, coordination, sequencing, and quality control shall be borne by the Contractor.

B. SPECIAL COORDINATION:

1. Schedule and coordinate renovation and tie-in to the existing Plant with the Owner to minimize impact to plant operation.

C. LAYOUT DRAWINGS:

1. Prepare detailed layout drawings to a larger scale than the Drawings in areas where the Work is of sufficient complexity to warrant additional detailing. This shall apply to all Mechanical and Electrical Rooms. Submit layout drawings for review before commencing shop fabrication or field erection.
   a. Coordinate the Work to provide adequate clearances for installation and maintenance of equipment.
   b. Arrange pipes, ducts, raceways, and equipment to permit ready access to valves, cocks, traps, starters, motors, and control components.
   c. Arrange raceways, wiring, and equipment to permit ready access to switches, motors, and control components. Doors and access panels shall be kept clear.

D. MECHANICAL AND ELECTRICAL COORDINATION:

1. Resolve all “tight” or restricted conditions involving Work of various sections in advance of installation.
2. If necessary, at no increase in Contract Sum and before Work proceeds, submit supplementary drawings showing all Work in “tight” areas.

E. JOB SITE FIELD MEASUREMENTS AND TEMPLATES:

1. Obtain field measurements required for accurate fabrication and installation of Work included in the Contract Documents. Exact measurements are the Contractor’s responsibility.
2. Furnish or obtain templates, patterns, and setting instructions as required for installation of all Work. Verify in field.

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PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 31 19

PROJECT MEETINGS

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies administrative and procedural requirements for meetings during construction in addition to the requirements specified elsewhere in the Contract Documents.

B. Contractor and Subcontractor representatives attending meetings must be qualified and authorized to act on behalf of their firms.

C. The Owner's Construction Manager is required to provide an electronic document control system for construction communication with the Contractor and Owner (see Section 01 31 23). Distribute meeting minutes per the electronic document control system.

1.02. PRECONSTRUCTION MEETING

A. Owner will schedule a meeting to be held prior to the Contractor mobilizing and beginning any Work. This meeting is to review Contract Documents administration requirements and mobilization procedures. One (1) preconstruction meeting will be scheduled for each design package.

B. MEETING LOCATION: To be determined.

C. PARTICIPANTS SHALL INCLUDE:

1. Contractor's Project Manager, Superintendent, CQC Representative, and Safety and Health Officer.
2. Owner and Project Manager.
3. Engineer.
4. Owner's Maintenance and Operation Staff, as appropriate.
5. Others, including major Subcontractors, as appropriate.

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D. OWNER WILL:

1. Administer the meeting.
2. Record and distribute copies of minutes within seven (7) days of meeting to all meeting participants.

E. AGENDA: Discussion will pertain to detailed information, such as:

1. The Work – including, but not limited to:
   a. Scheduling and phasing requirements.
   b. Contractor's use of premises.
   c. Special conditions and coordination.
   d. Security.
2. Communications – including, but not limited to:
   a. Change and persons authorized to direct changes.
   b. Requests for Information (RFI), field decisions, and clarifications.
   c. Non-Conformance Reports.
   d. Hazard communication.
   e. Project meetings.
3. Contractor's Site Specific Safety Plan.
4. Administrative and procedural requirements including, but not limited to:
   a. Contract modification.
   b. Progress payment.
   c. Submittals - including Contractor's Construction Progress Schedule.
   d. Electronic Communications.
   e. Apprentice and Journey Level Worker Utilization Reporting, if required.
5. Owner testing and inspection.
6. Contractor Quality Control.
7. Temporary Facilities and Controls including, but not limited to:
   a. Deliveries and storage.
   b. Temporary utilities and enclosures.

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c. Security procedures.

d. Noise and vibration control.

e. Cutting, patching, and field engineering.

f. Utility shutdowns.

g. Contractor parking.

h. Housekeeping and waste management.

8. Closeout Procedures – including Project Record documents.

F. Contractor shall conduct a like meeting, covering the same body of information, with each Subcontractor's project manager and foreman supervising the Work prior to the performance of any work on site by that Subcontractor.

1. Provide Owner copies of meeting minutes prepared by the Contractor with each Subcontractor, when requested by Owner.

1.03. CONSTRUCTION PROGRESS MEETINGS

A. FREQUENCY: Weekly.

B. MEETING LOCATION: Virtually, or as mutually agreed.

C. PARTICIPANTS SHALL INCLUDE:

1. Contractor's Project Manager, Superintendent, CQC Representative, and Safety and Health Officer, as appropriate.
2. Owner and Project Manager.
3. Engineer.
4. Owner's Operation and Maintenance Staff from Plant, as appropriate.
5. Others, as appropriate.

D. CONTRACTOR SHALL:

1. Administer the meetings.
2. Provide schedules, logs, and other construction activity data in support of the issues discussed and recorded in meeting minutes.
3. Record and distribute copies of minutes prior to the next meeting.

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E. OWNER WILL:

1. Review meeting minutes and ascertain that the Work is in accordance with the Contract Documents and the Construction Progress Schedule.

F. AGENDA: Discussion will pertain to items, such as:

1. Review and approve minutes of previous meeting noting exceptions, if any.
2. Review Work progress since previous meeting.
3. Review plans for progress during subsequent Short Interval Schedule work period.
   a. Identify pending meetings.
   b. Discuss safety activities and Job Hazards Analysis.
4. Discuss field observations, problems, and conflicts:
   a. Identify problems impeding the Construction Progress Schedule.
5. Review Quality Control.
   a. Non-conformance reports - discuss corrective Work actions.
6. Review Submittal Schedules and RFIs - present methods to expedite as required.
7. Review off-site fabrication and delivery schedules.
8. Review proposed changes in the Work and substitution requests for:
   a. Timely processing.
   b. Effect on Construction Progress Schedule and on completion date.
   c. Effect on any other contracts of the Project.

1.04. CQC WORK PLAN MEETINGS

A. Meet with Owner to discuss Quality Control Procedures specified in Section 01 45 00.

B. MEETING LOCATION: Contractor's field office or as mutually agreed.

C. PARTICIPANTS SHALL INCLUDE:

1. Contractor's Project Manager, Superintendent, CQC Representative, and Safety and Health Officer, as appropriate.
2. Owner and Project Manager.
3. Engineer.

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4. Owner's Operation and Maintenance Staff from Plant, as appropriate.
5. Others, as appropriate.

D. CONTRACTOR SHALL:

1. Administer the meetings.
2. Provide schedules, logs, and other construction activity data in support of the issues discussed and recorded in meeting minutes.
3. Record and distribute copies of minutes prior to the next meeting.

E. OWNER WILL:

1. Review meeting minutes and ascertain that the Work is in accordance with the Contract Documents.

F. AGENDA: Discussion will pertain to items, such as:

1. Review and approve minutes of previous meeting noting exceptions, if any.
2. Review Work progress since previous meeting.
3. Discuss field observations, problems, and conflicts.
4. CQC administrative procedures.
5. Work sequence and duration.
6. Testing, inspections, and approvals records.
7. Fabrication and installation procedures, on-site and off-site.
8. Field constructed mock-ups.
9. Review off-site fabrication and delivery schedules.

1.05. PREINSTALLATION MEETINGS

A. Preinstallation meetings shall be held prior to the Contractor or Subcontractors beginning work on each definable feature of the Work identified in the Contract Documents and as required by the Owner. Notify Owner at least ten (10) working days in advance of each preinstallation meeting. Meeting examples include, but not by way of limitation:

1. Site clearing and excavation.
2. Demolition and remediation.

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3. Site utilities.
4. Landscaping and restoration.
5. Concrete.
6. Masonry.
7. Structural Steel.
8. Exterior cladding systems.
9. Water and moisture proofing.
10. Roofing.
11. Doors, frames, and hardware.
12. Finishes, as appropriate.
13. Equipment.
14. Mechanical and Electrical systems as appropriate.
15. High Voltage.
16. Fire Alarm.
17. Communications.
18. Specialty items.
19. Others, as required.

B. Meeting location: Contractor’s field office, or as mutually agreed.

C. PARTICIPANTS SHALL INCLUDE:

1. Contractor's Project Manager, Superintendent, CQC Representative, and Safety and Health Officer, as appropriate.
2. Subcontractor’s project manager or foreman supervising the Work, as appropriate.
3. Owner.
4. Owner’s Engineering/Design Consultants and subconsultants, as appropriate.
5. Owner’s Operation and Maintenance Staff from Plant, as appropriate.
6. Others, as appropriate.

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D. AGENDA:

1. Review Preinstallation CQC Work Plan (see Section 01 45 00).
2. Review Contract requirements.
3. Materials - available and ready for use.
4. Submittals.
5. Persons responsible for the Work.
6. Tests - required tests, testing criteria, who samples, and how often.
7. Work sequence, shut downs, outages, and MOPs.
8. Safety procedures and requirements.
9. Substrate - criteria for substrate.
10. Other items as appropriate.

E. CONTRACTOR SHALL:

1. Administer the meeting.
2. Record and distribute copies of minutes within seven (7) days of each meeting to all meeting participants.

1.06. CHANGE ORDER MEETINGS

A. Change Order meetings shall be held to review and resolve any change order proposals, change order requests, or other change order issues pertaining to Contract Modification. Meetings shall be held bi-weekly or as needed until all Change Order Proposals are resolved.

B. MEETING LOCATION: To be determined.

C. PARTICIPANTS SHALL INCLUDE:

1. Contractor's Project Manager or cost estimator, as appropriate.
2. Owner.
3. Engineer.
4. Others, as appropriate.

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D. CONTRACTOR SHALL:

1. Record and distribute copies of minutes within seven (7) days.

E. OWNER WILL:

1. Administer the meeting.

F. AGENDA: Discussion will pertain to items such as:

1. Review of Change Order Proposals, scope, estimated costs.
2. Negotiation of prices for Change Order Proposals.

1.07. COMMISSIONING MEETINGS

A. Commissioning meetings shall occur weekly during the facility start-up and commissioning phase of the Work.

B. MEETING LOCATION: To be determined.

C. PARTICIPANTS SHALL INCLUDE:

1. Contractor's Startup Manager, as Specified in Section 01 75 00, and Superintendent, as appropriate.
2. Subcontractor(s) representative(s), as appropriate.
3. Owner.
4. Engineer.
5. Owner’s Maintenance and Operation Staff, as appropriate.
6. Others, as appropriate.

D. THE CONTRACTOR SHALL:

1. Record and distribute copies of minutes prior to the next meeting.

E. OWNER WILL:

1. Administer the meeting.
2. Ascertain that the Project commissioning processes and information provided is in accordance with the Contract Documents.

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F. AGENDA: Discussion will pertain to items such as:

1. Coordination of Work of applicable trades (e.g., balancing, electrical, controls, communications wiring connectivity).
2. Scheduling of systems shut down(s) and switch over(s).
3. Startup and functional performance tests acceptance criteria.
4. Code and ordinance inspections/approvals.

1.08. SPECIAL MEETINGS

A. Special meetings may be called at the discretion of the Owner or Contractor for the purpose of coordinating specific information or resolving special issues.

B. MEETING LOCATION: Contractor's on-site field office, unless otherwise agreed.

C. Contractor shall record minutes and distribute copies within three (3) days.

1.09. POST CONSTRUCTION WARRANTY MEETING

A. Meet with the Owner approximately ten (10) months after the date of Substantial Completion to inspect the Work and to prepare punch list of warranty items requiring appropriate manufacturers and subcontractors.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 31 23

ELECTRONIC COMMUNICATIONS

PART 1 - GENERAL

1.01. SUMMARY

A. This section specifies administrative and procedural requirements for electronic communications and information distribution for the Owner and Contractor to use in support of the Work of the Contract Documents. The intent of the Owner is to accelerate information transfer among all parties and to improve collaboration and coordination of information and transferred materials to the mutual benefit of all parties.

B. The Owner's Construction Manager is responsible for providing an electronic communication and information database management system (ECIMS) that the project team, including the Owner, Engineer, Contractor, subcontractors, and suppliers have access to at no additional cost to the project team members. The Owner's Construction Manager is also responsible for providing training in the use of the system to the project team.

C. The ECIMS system (SharePoint) shall be provided by the Owner's Consultant/Construction Manager for use by the Owner, subcontractors, and suppliers. At a minimum this software will be used to manage:

1. Correspondence.
2. Meeting Minutes.
3. Requests for Information.
4. Submittals, O&M Manuals.
5. Applications for Payment.
6. Change Order Requests.
7. Change Order Proposals.
8. Change Orders.
9. Team Change Memo.
10. Design Variation Memos.
11. Document Control Log to include Design and Specification Revisions.

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12. Daily Field Reports and Construction Photos.
13. Third Party Test and Inspection Reports.
14. Quality Control Inspection Reports.
15. Nonconformance Reports.
16. Monthly Reports And Progress Photos.
17. Utility Shutdown Requests.
18. Safety Reports.
19. Final Inspection "Punch List" Reports.
20. Copies of the schedule and reports per Section 01 32 16.
21. Startup and Commissioning.
22. 3D/4D Models.
23. Site Logistics Plans.
24. Site Specific Safety Plans.
25. Integrated Work Plans.
26. As-Built Documents.
27. Contract Documents.
28. Community Outreach.
29. Any other pertinent documents.

D. The Contractor is responsible for scanning all Contractor or Subcontractor documents that are not provided in electronic format and entering them into the ECIMS.

1.02. ADMINISTRATIVE REQUIREMENTS

A. SYSTEM ACCESS: The Contractor will provide access to the ECIMS to the project team including the Owner, Engineer, subcontractors, and suppliers. The ECIMS shall be a web-based software accessible anywhere the user has internet access.

B. SYSTEM USERS: The Owner and Owner's Construction Manager are required to control access to the ECIMS. The Contractor shall provide the Owner's Construction Manager with a list of all Contractor and Subcontractor users.

C. DOCUMENTS REQUIRING SIGNATURES: All documents requiring signatures for approval prior to implementing action, as stipulated in other sections of the Contract Documents,

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shall also be required by this Section. Electronic data transfer will serve to expedite preliminary concurrence of information only. Receipt of "hard copy" signature on forms is required prior to implementing action or work as the conditions may require. Scanned copies of documents with original signatures will be acceptable, provided original documents are submitted within seven (7) days of execution.

D. EQUIPMENT AND SOFTWARE REQUIREMENTS: The Contractor's project field office is required to have broadband Internet with a minimum of one gigabyte/second bandwidth per Section 01 50 00.

E. INFORMATION INPUT: The Owner and Contractor are responsible for entering information and data into ECIMS and shall coordinate with the responsibilities of the same parties as specified in all other sections within the Contract Documents.

PART 2 - PRODUCTS (NOT APPLICABEL TO THIS SECTION)

A. A web-based SharePoint site will be created and hosted by the Owner for use as the ECIMS. Access will be provided to the Contractor and it will feature a folder structure for document sharing for all construction documents.

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 31 30

STANDARD FORMS

Forms listed below and included in this section are referenced from other sections.

Form No.	Title
01 33 00-A	Submittal Transmittal Form
01 75 00-A	Equipment Test Report Form
01 78 23-A	Operation and Maintenance Transmittal Form
01 78 23-B	Equipment Record Form
01 78 23-C	Asset Management Data Field Form
01 78 23-D	Spare Parts Record Form
01 78 23-E	Maintenance Schedule Form
01 78 43-A	Spare Parts Release Form
09 90 00-A	Coating System Inspection Checklist
26 05 00-A	Wire and Cable Resistance Test Data Form
26 05 00-B	Installed Motor Test Data Form
26 05 00-C	Motor Control Center Test Form
26 05 00-F	Protective Relay Test Form
26 05 84-A	Motor Data Form
46 05 13-A	Manufacturer's Installation Certification Form
46 05 13-B	Manufacturer's Instruction Certification Form
44 24 13-C	Unit Responsibility Certification Form
46 05 29-A	Rigid Equipment Mount Installation Inspection Checklist
APPENDIX A	LAKEHAVEN CONSTRUCTION FORMS
	Request for Information
	Non-Conformance Report
	Change Order Request
	Contractor's Application for Payment

END OF SECTION

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Submittal No.: _____ Unifier Record No.: _____

Submittal Description: _____

Spec Section/Name: _____

Equipment Numbers: _____

	Routing	Sent	Received
OWNER: Lakehaven Water and Sewer District	Contractor/Owner		
PROJECT:	Owner/Reviewer		
	Reviewer/Owner		
CONTRACTOR:	Owner/Contractor		
SUBCONTRACTOR: N/A			

We are sending you: ☐ Attached ☐ Under separate cover via _____
☐ proposed substitution, documentation attached.

Remarks: _____

Item	Copies	Area(s)	Description (including manufacturer and drawing/detail numbers, as appropriate)	Review Action *	Returned By Initials/Firm	Review Comments Attached

* 1 = No exceptions taken | 2 = Make corrections noted | 3 = Amend and resubmit | 4 = Rejected | 5 = Receipt acknowledged

Contractor, certify either A or B:

☐ A. We have verified that the material or equipment contained in this submittal meets all the requirements specified, including coordination with all related work (no exceptions).

☐ B. We have verified that the material or equipment contained in this submittal meets all the requirements specified, except for the attached deviations.

No.	Deviation

Certified by: _____
Contractor Signature Date

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NOTE: This example equipment test report is provided for the benefit of the Contractor and is not specific to any piece of equipment to be installed as a part of this project. The example is furnished as a means of illustrating the level of detail required for the preparation of equipment test forms for this project.

CITY OF SAMPLE

EXAMPLE WATER TREATMENT PLANT STAGE IV EXPANSION PROJECT

ABC Construction Company, Inc., Contractor

EQUIPMENT TEST REPORT

Equipment Name: Sludge Pump 2
Equipment Number: PS25202
Specification Ref: 43 23 57
Location: East Sedimentation Basin Gallery

	Contractor		Owner	
	Verified	Date	Verified	Date
PRE-OPERATIONAL CHECKLIST				
Mechanical:				
Lubrication				
Alignment				
Anchor Bolts				
Seal Water System Operational				
Equipment Rotates Freely				
Safety Guards				
Valves Operational				
Hopper Purge Systems Operational				
Sedimentation Tank/Hopper Clean				
O&M Manual Information Complete				
Manufacturer's Installation Certificate Complete				
Electrical (Circuit Ring-out and High-pot Tests):				
Circuits:				
Power to MCC 5				
Control to HOA				
Indicators at MCC:				
Red (Running)				
Green (Power)				
Amber (Auto)				
Indicators at Local Control Panel				

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	Contractor		Owner	
	Verified	Date	Verified	Date
Wiring Labels Complete				
Nameplates:				
MCC				
Control Station				
Control Panel				
Equipment Bumped for Rotation				
Piping Systems				
Cleaned and Flushed:				
Suction				
Discharge				
Pressure Tests				
Temporary Piping Screens in Place				
Instrumentation and Controls				
Flowmeter FE2502F Calibration				
Calibration Report No.				
Flow Recorder FR2502G Calibrated Against Transmitter				
VFD Speed Indicator Calibrated Against Independent Reference				
Discharge Overpressure Shutdown Switch Calibration				
Simulate Discharge Overpressure Shutdown				
FUNCTIONAL TESTS				
Mechanical				
Motor Operation Temperature Satisfactory				
Pump Operating Temperature Satisfactory				
Unusual Noise, etc.?				
Pump Operation: 75gpm/50psig				
Measurement:				
Flow				
Pressure:	Test Gauge Number:			
Alignment Hot				
Dowelled In				
REMARKS:				
Electrical				
Local Switch Function				
Runs in *HAND*				
No Control Power in *OFF*				
Timer Control in *AUTO*				
Overpressure Protection Switch PS2502C Functional in Both *HAND* and *AUTO*				
Overpressure Protection Switch PS2502C Set at 75psig				

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	Contractor		Owner	
	Verified	Date	Verified	Date
PLC 2500 Set at 24-hour Cycle, 25 min *ON*				
OPERATIONAL TEST				
48-hour continuous test. Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, overpressure protection remains functional, hour meter functional.				

RECOMMENDED FOR BENEFICIAL OCCUPANCY:

Contractor: _____ Date: _____

ACCEPTED FOR BENEFICIAL OCCUPANCY:

Owner: _____ Date: _____

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Date: _____ Submittal No. _____

To: _____ Contract No. _____

_____ Spec. Section: _____

_____ Submittal Description: _____

_____

Attention: _____ From: _____

	Contractor		Owner	
	Satisfactory	N/A	Accept	Deficient
HARD COPY O&M MANUALS				
1. Table of Contents				
2. Equipment Record Forms				
3. Manufacture Information				
4. Vendor Information				
5. Safety Precautions				
6. Operator Prestart				
7. Startup, Shutdown, and Post Shutdown Procedures				
8. Normal Operations				
9. Emergency Operations				
10. Operator Service Requirements				
11. Environmental Conditions				
12. Lubrication Data				
13. Preventive Maintenance Plan and Schedule				
14. Troubleshooting Guides and Diagnostic Techniques				
15. Wiring and Control Diagrams				
16. Maintenance and Repair Procedures				
17. Removal and Replacement Instructions				
18. Spare Parts and Supply List				
19. Corrective Maintenance Manhours				
20. Parts Identification				
21. Warranty Information				
22. Personnel Training Requirements				
23. Testing Equipment and Special Tool Information				
ELECTRONIC O&M MANUALS				
1. Searchable PDF File				
2. Content Matches Hard Copy				
3. Index with Hyperlinks to Individual Section				
4. Bookmarks to Individual Sections				

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	Contractor		Owner	
	Satisfactory	N/A	Accept	Deficient
5. Scanned Drawings Provided with Individual Bookmarks and Annotations and Identified in the Index				
ASSET MANAGEMENT DATA				
1. Equipment Record Form 01 78 23-B Completed				
2. Asset Management Field Data Form 01 78 23-C Completed				

Remarks: _____

_____

_____

_____

_____ _____

Contractor's Signature Date

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Equipment Description		**Equipment Location**	
Equipment No.	Shop Drawing No.	Date Installed	Cost
Manufacturer (MFR)		MFR Contact	
MRF Address			Phone
Vendor		Vendor Contact	
Vendor Address			Phone

MAINTENANCE REQUIREMENTS	D	W	M	Q	S	A	HOURS
LUBRICANTS: RECOMMENDED:							
ALTERNATIVE:							
MISC NOTES:							

ELECTRICAL NAMEPLATE DATA			
EQUIP			
MAKE			
SERIAL NO.		ID NO.	
MODEL NO.		FRAME NO.	
HP	V	AMP	HZ
PH	RPM	SF	DUTY
CODE	INSL CL	DES	TYPE
NEMA DES	C AMB	TEMP RISE	RATING
MISC			
MECHANICAL NAMEPLATE DATA			
EQUIP			
MAKE			
SERIAL NO.		ID NO.	
MODEL NO.		FRAME NO.	
HP	RPM	CAP	SIZE
TDH	IMP SZ	BELT NO.	CFM
PSI	ASSY NO.	CASE NO.	
MISC			

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Equipment Data Field	By Contractor	Required *	Input	Example
Equipment ID	X	1		P23DSLPCN403
Area	X	1		P23
System	X	1		DSL
Equip Type	X	1		PCN
Description	X	1		Digester #4 Recirculation Pump
Location	X	1		Digester Pump Room
Service Status	X	1		ACTV/ABDN/DLTD
Project Name	X	1		2015 Plant Expansion
Design Package	X	1		3
Size	X	1		30
Unit of Measure	X	1		HP
Manufacturer	X	1		Wemco Pumps
Model Number	X	1		Wem-omatic 30
Serial Number	X	1		234569
Subunit of		1		P23DIGTNK004
P&ID #	X	1		25.08
Elect. Drawing #	X	2		23E01
Instr. Drawing #	X	2		I-403
Other Drawing #s		2		23P04
Normal Position		2		Running
Operation Notes		2		Run to Recirculate Digester 4
Purchase Cost	X	1		$15,634.00
Warranty Expires	X	1		11/30/2016
Manufactured Date	X	2		05/24/2014
Purchase Date	X	2		08/18/2015
Installed Date	X	1		11/30/2015
PLC Cabinet	X	2		CCR233
Motor Control Center	X	2		MCC235
MCC Bucket	X	2		4C
Power Lighting Panel	X	2		L-239
Panel Circuit Breaker	X	2		17
Motor/Oper: Make/Model	X	2		Baldor / Ecotech 432
Specification Number	X	1		23 40 13
Submittal Number	X	1		43A
Former Equipment ID		2		P09DSLPCN003
In Criticality Model		1		Y/N
* REQUIRED for ALL Equipment		1		
* REQUIRED as Applicable		2		

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PROJECT			
DESIGN PACKAGE			
SPECIFICATION SECTION			
SPECIFICATION TITLE			
MANUFACTURER (MFR)		MFR CONTACT	
MFR ADDRESS		MFR PHONE	
VENDOR		VENDOR CONTACT	
VENDOR ADDRESS		VENDOR PHONE	

EQUIPMENT NUMBER(S):	EQUIPMENT NAME(S):

SPARE PARTS						
PART NO.	PART NAME	MFR	COST	LONG LEAD TIME *	QUANTITY	
					SPECIFIED	REC. BY MFR

* Long Lead Time = Parts requiring more than four (4) weeks from time of order to delivery.

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Equipment Number: _____

Equipment Name: _____

Type of Work	Schedule Type	Calendar Interval	Calendar Type	Usage Interval	Usage of Unit Measure	Cycle From	Cycle To	Task Short Description	Task

LEGEND:	Type of Work	ELEC = Electrical Type of Work; MECH = Mechanic Performing Work; INSTR = Instrumentation Type of Work
	Schedule Type	USAGE = Usage-based Maintenance; CALENDAR = Calendar-based Maintenance
	Calendar Interval	The number of time units between scheduled work orders (e.g., '4' Months)
	Calendar Type	Units of time between scheduled work orders (e.g., DAYS, WEEKS, MONTHS)
	Usage Interval	The number of units between scheduled work orders (e.g., '10,000' hours)
	Usage Unit of Measure	Units of measure between scheduled work orders (e.g., hours, revolutions, cycles, etc.)
	Cycle From	For seasonal schedules, indicates the first month/day of the year this schedule is valid for work orders to be created.
	Cycle To	For seasonal schedules, indicates the last month/day of the year this schedule is valid for work orders to be created; cycle date ranges crossing over the December-January boundary are valid.
	Task Short Description	Short description of tasks
	Task	Work to be performed

See next page for examples.

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EXAMPLE 1:

Equipment Number: P13HPAPC0001
Equipment Name: AIR COMPRESSOR

Type of Work	Schedule Type	Calendar Interval	Calendar Type	Usage Interval	Usage of Unit Measure	Cycle From	Cycle To	Task Short Description	Task
MECH	CALENDAR	6	MONTHS						1. Perform normal tour checks and operations. 2. Change compressor crankcase oil. 3. Clean air intake valve. 4. Check air dryer, automatic condensate drains, and air tank for proper operation. Clean condenser coils and cover grills. 5. Inspect belt alignment and condition. Adjust or replace belts as required. 6. Check for corrosion and scale on water cooled units. 7. Clean heat exchange surfaces. 8. Check accuracy of gauges with calibrated test gauge. 9. On two stage compressor, check intermediate pressure. 10. Test relief valves, replace if leaking or the relief range is incorrect. Do no readjust safety relief valves in the field. 11. Check operation of compressor unloaders, repair or replace if not loading and unloading properly. 12. Check compressor suction and discharge valves for proper operation. Replace leaking valves. 13. Check cut in and cut out of compressor pressure controller, readjust if necessary for proper air pressure requirements. Do not exceed ASME maximum tank pressure. 14. Check to make sure belt guard is installed prior to putting air compressor back in service. 15. No pressure vessel is to have its hand hole or man hole covers removed unless the vessel is at atmospheric pressure.

EXAMPLE 2:

Equipment Number: P13HPAPC0001
Equipment Name: AIR COMPRESSOR

Type of Work	Schedule Type	Calendar Interval	Calendar Type	Usage Interval	Usage of Unit Measure	Cycle From	Cycle To	Task Short Description	Task
MECH	USAGE			10,000	HOURS				1. Notify Operator of shutdown. 2. Follow Lock Out-Tag Out procedures. 3. Replace drum trunnion assembly.

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Project Name: _____ Design Package: _____

Project No. _____ Place of Delivery: _____ Date: _____

Pallet Number	Container Number	Spec. **Section**	Equipment Number	**Spare Part Description**	Price

_____ _____

Contractor's Signature Date

_____ _____

Owner's Signature Date

C: Maintenance Supervisor
Operations Supervisor

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Area or Structure to be Coated: _____

Coating System (From 09 90 00): _____ Date: _____

Coating Type: _____

Coating System Manufacturer (CSM): _____

Coating System Applicator: _____

General Contractor: _____

STEP 1: Completion of Cleaning and Substrate Decontamination Prior to Vapor Blast Cleaning.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 2: Installation of Protective Enclosure of Structure or Area and Protection of Adjacent Surfaces or Structures NOT TO BE COATED.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 3: Completion of Ambient Condition Control in Structure or Building Area and Acceptance of Ventilation System in Structure or Area as it Applies to Application and Curing Requirements for the Coating System.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 4: Completion of Surface Preparation for Concrete and Metallic Substrates to be Coated.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

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STEP 5: Completion of Primer Application.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 6: Completion of Concrete Repairs If Required and Related Surface Preparation Rework Prior to Coating System Application.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 7: Completion of Concrete Filler/Surface Application to Concrete.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 8: Completion of First Finish Coat Application and of Coating System Detail Treatment at Transitions or Terminations.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 9: Completion of Second Finish Coat Application and of Coating System Detail Treatment at Transitions or Terminations.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 10: Completion of Full and Proper Cure of Coating System.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

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STEP 11: Completion of Adhesion Testing of Cured Coating System on Concrete and Metallic Substrates and Acceptance of Holiday (Continuity) Testing of Coating System on Concrete and Metallic Substrates.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 12: Completion of Localized Repairs to Coating System Following Adhesion and Continuity Testing.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

STEP 13: Final Acceptance of Coating System Installation Including Final Cleanup of the Work Site Complying with Specification Requirements and the CSM's Quality Requirements.

Representing	Print Name	Signature	Date
Contractor			
Coating System Applicator			

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Wire or Cable No.: _____ Temperature, DegF: _____

Location of Test	**Insulation Resistance,** Megohms
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

CERTIFIED: _____ _____
Contractor's Representative Date

WITNESSED: _____ _____
Owner Date

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Motor Equipment Number: _____ Date of Test: _____

Equipment Driven: _____

MCC Location: _____

				Ambient Temperature:		DegF	
Resistance:							
Insulation Resistance Phase to Ground Megohms:							
Phase A:		Phase B:		Phase C:			
Current at Full Load:							
Phase:				Current, Amps:			
Phase:				Current, Amps:			
Phase:				Current, Amps:			
Thermal Overload Device:	Manufacturer/Catalog No.			Amperes:			
Circuit Breaker (MCP) Setting:							

Motor Nameplate Markings:

Mfr:		Mfr Model:		Frame:		HP:	
Volts:		Phase:		RPM:		Service Factor**	
Amps:		Frequency:		Ambient Temperature Rating:		DegC	
Time Rating:				Design Letter **			
	(NEMA 1-10.35)				(NEMA MG-1.16)		
Code Letter:				Insulation Class:			

** Required for 3-Phase Squirrel Cage Induction Motors Only.

CERTIFIED: _____ _____

Contractor's Representative Date

WITNESSED: _____ _____

Owner Date

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Equipment No.: _____ Ambient Room Temperature: _____

Location: _____

A. MECHANICAL CHECK:

All bolted connections either bus to bus or cable to bus shall be torqued to the manufacturer's recommendations.

B. ELECTRICAL TESTS:

1. Measure insulation resistance of each bus section phase to phase and phase to ground for one (1) minute using a megohmmeter at 1000 volts.

Test Results (Megohms)			
Phase		Phase	
A-GRD		A-B	
B-GRD		B-C	
C-GRD		C-A	

2. Set the circuit breaker in the starter unit to comply with the requirements of NECm Article 430-52 and Table 430-152.

3. Motor overload heater elements shall be sized and installed based on the actual nameplate full load amperes of the motor connected to the starter.

CERTIFIED: _____ _____
Contractor's Representative Date

WITNESSED: _____ _____
Owner Date

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Location: _____

Switchgear Breaker No.: _____

Protective Relay Description: _____

The protective relays shall be tested in the following manner:

1. Each protective relay circuit shall have its insulation resistance tested to ground.

2. Perform the following tests on the specified relay setting:

    a. Pickup parameters on each operating element.

    b. Timing test shall be performed at three (3) points on the time dial curve.

    c. Pickup target and seal in units.

Sign and record results. Provide a copy in accordance with Section 26 05 00.

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Equipment Name: _____ Equipment No(s). _____

Project Site Location: _____

Nameplate Markings:

Mfr:		Mfr Model:		Frame:		Horsepower:	
Volts:		Phase:		RPM:		Service Factor:	
FLA:		LRA:		Frequency:		Amb. Temp. Rating:	DegC
Time Rating:				Design Letter:			
		(NEMA 1-10.35)				(NEMA MG-1.16)	
KVA Code Letter:				Insulation Class:			

The following information is required for explosion-proof motors only:

A. Approve by UL for installation in Class_____, Div_____, Group_____.

B. UL frame temperature code _____ (NEC Tables 500-8B).

The following information is required for all motors 1/2 horsepower and larger:

A. Guaranteed minimum efficiency: _____
(Paragraph 26 05 84 2.04.G.)

B. Nameplat or nominal efficiency: _____

Data Not Necessarily Marked on Nameplate:

Type of Enclosure:				Enclosure Material:		
Temperature Rise:	DegC (NEMA MG1-12.41,42)					
Space Heater Included?	☐ Yes	☐ No	If Yes:	Watts	Volts	
Type of Motor Winding Over-Temperature Protection, if specified.						

Provide information on other motor features specified.

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Contract No. _____ Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment Item: _____

The undersigned representative for the manufacturer of the equipment item described above hereby certifies that he/she has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations and that the trial operation of the equipment item has been satisfactory.

Comments: _____

_____

_____

_____

_____

MANUFACTURER:	CONTRACTOR:
_____	_____
Signature of Authorized Representative	Signature of Authorized Representative
_____	_____
Print or Type Name	Print or Type Name
_____	_____
Print or Type Title	Print or Type Title
_____	_____
Date	Date

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Contract No. _____ Specification Section: _____

Equipment Name: _____

Contractor: _____

Manufacturer of Equipment Item: _____

The undersigned manufacturer certifies that a service engineer has instructed the wastewater treatment plant operating personnel in the proper maintenance and operation of the equipment designated herein.

Operations Checklist (Check Appropriate Spaces):	
Startup procedure reviewed.	
Shutdown procedure reviewed.	
Normal operation procedure reviewed.	
Other:	
Maintenance Checklist (Check Appropriate Spaces):	
Described normal oil changes (frequency).	
Described special tools required.	
Described normal items to be reviewed for wear.	
Described preventive maintenance instructions.	
Described greasing frequency.	
Other:	

MANUFACTURER:

_____
Signature of Authorized Representative

_____
Print or Type Name

_____
Print or Type Title

_____
Date

CONTRACTOR:

_____
Signature of Authorized Representative

_____
Print or Type Name

_____
Print or Type Title

_____
Date

_____
Signature of Owner

_____
Date

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(Project Title)

CERTIFICATE OF UNIT RESPONSIBILITY

For Specification Section: _____

_____

(Section Title)

In accordance with Section 44 42 24, the undersigned manufacturer of driven equipment ("manufacturer") accepts unit responsibility for all components of equipment furnished to the Project under specification Section_____, and for related equipment manufactured under Sections_____,_____, and_____.

We have reviewed the requirements for all sections referencing this section, including but not limited to drivers, supports for driving and driven equipment, and all other specified appurtenances to be furnished to the Project by manufacturer. And, we have further reviewed, and modified as necessary, the requirements for associated variable speed drives and motor control centers. We hereby certify that all specified components are compatible and comprise a functional unit suitable for the specified performance and design requirements whether or not the equipment was furnished by us. We will make no claim nor establish any condition that problems in operation for the product provided under this specification Section_____ are due to incompatibility of any components covered by this Certificate of Unit Responsibility. Nor will we condition or void any warranty for the performance of the product of this specification Section_____due to incompatibility of any components covered under this Certificate of Unit Responsibility.

Our signature on this Certificate of Unit Responsibility does not obligate us to take responsibility for, nor to warrant the work quality or performance of related equipment provided by others under specification Sections_____,_____, and_____. Our obligation to warranty all equipment provided by us shall remain unaffected.

_____
Notary Public

_____
Commission Expiration Date

Seal:

_____
Name of Corporation

_____
Address

By: _____
Duly Authorized Official

_____
Legal Title of Official

Date: _____

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LAKEHAVEN WATER AND SEWER DISTRICT
(PROJECT NAME)

Equipment Tage No.: _____ Date: _____

Grout Product Name and Type: _____

Grouting System Manufacturer: _____

Grouting Application Contractor: _____

General Contractor: _____

Step 1: **Verify Equipment Anchor Installation Conformance to Equipment Pad Details:**

Name: _____ Date: _____
Contractor Representative

Name: _____ Name: Owner
Millwright

Step 2: **Completion of Cleaning and Concrete Substrate Preparation Prior to Grouting:**

Name: _____ Date: _____
Contractor Representative

Name: _____ Name: Owner
Grouting Contractor Representative

Name: _____
Grout Manufacturer's Technical Rep.

Step 3: Equipment Leveling:

Name: _____ Date: _____
Contractor Representative

Name: _____ Name: Owner
Millwright

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Step 4: **Installation of Protection of Adjacent Surfaces or** Structures:

Name: _____ Date: _____
Contractor Representative

Name: _____ Name: Owner
Grouting Contractor Representative

Name: _____
Grout Manufacturer's Technical Rep.

Step 5: **Preparation and Construction of Forms and Epoxy Grout Filling Standpipes**:

Name: _____ Date: _____
Contractor Representative

Name: _____ Name: Owner
Grouting Contractor Representative

Name: _____
Grout Manufacturer's Technical Rep.

Step 6: **Completion of Ambient Condition Control in Structure or Building Area and Acceptance of Ambient Conditions as They Apply to Application and Curing Requirements for the Grouting** System:

Name: _____ Date: _____
Contractor Representative

Name: _____ Date: _____
Grouting Contractor Representative

Name: _____ Date: _____
Grout Manufacturer's Technical Rep.

Name: _____ Date: _____
Owner

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Step 7: **Epoxy Grout Installation**:

Name: _____ Date: _____
Contractor Representative

Name: _____ Name: Owner
Grouting Contractor Representative

Name: _____
Grout Manufacturer's Technical Rep.

Step 8: **Completion of Full and Proper Cure of Epoxy Grout**:

Name: _____ Date: _____
Contractor Representative

Name: _____ Date: _____
Grouting Contractor Representative

Name: _____ Date: _____
Grout Manufacturer's Technical Rep.

Name: _____ Date: _____
Owner

Step 9: **Completion of** Localized Repair of Grout Voids:

Name: _____ Date: _____
Contractor Representative

Name: _____ Date: _____
Grouting Contractor Representative

Name: _____ Date: _____
Grout Manufacturer's Technical Rep.

Name: _____ Date: _____
Owner

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Step 10: **Final Acceptance of Grouting System Installation** Including Final Cleanup of the Work Site **Complying with All Specification Requirements and the GSM's Quality Requirements**:

Name: _____ Date: _____
Contractor Representative

Name: _____ Date: _____
Grouting Contractor Representative

Name: _____ Date: _____
Grout Manufacturer's Technical Rep.

Name: _____ Date: _____
Owner

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APPENDIX A

Lakehaven Construction Forms

REQUEST FOR INFORMATION (RFI)

Project Name:_____ RFI No._____

Contract No._____ Date:_____

To:_____ **From:** _____

_____ _____

Attn: _____

Subject:	Reply Req'd By:
Dwg./Spec. No.	Detail/Section No.
Problem/Recommended Solution:	
Submitted By:	Date:
Distribution:	

Response:		
Response Prepared By:	Date:	COP Req'd: **[ ]** Yes **[ ]** No
Distribution:		

NOTE: This is not a notice to proceed with work involving additional cost and/or time. Notification must be given in accordance with the Contract Documents, if any response causes any change to the Contract Documents.

Non-Conformance Report (NCR)

Project Name: CCRWWTP Headbox Rehabilitation Report **NCR No.** _____

Contract No. _____ Date: _____

Contractor:

Subject Specification:

Dwg. Ref.

Item of Non-Conformance/Corrective Action Required

Reported By_____ Date _____

Contractor Response, Proposed Approach and Schedule

Contractor Signature_____ Date_____

Proposed corrective action: **[ ] Approved** **by** _____ **Date** _____

[ ] Not Approved

Verification of corrective action completed by _____ **Date** _____

This notice is not authorization for a change in Contract Sum or Contract Time. Notification must be given in accordance with the Contract Documents to assert a claim for equitable adjustment.

Change Order Request (COR)

Change Order Request No: 01

(Not a Change Order)

Project Name:

Project Owner:

Engineer's Project No:

Owner's Project No. (If applicable):

Contractor:

Regulatory Agency Project No. (If applicable):

Initiated by: (Name of Requestor) **Date:** 06/10/2025

ATTENTION:

The following change in the contract on this project is proposed. Please provide your proposed price for the cost of this change.

1) A breakdown of cost SHALL be provided upon request by the Owner or Engineer.
2) the Owner.

DESCRIPTION OF PROPOSED CHANGE:

Name of Requestor

All work shall be in accordance with the terms, stipulations, and conditions of the original Contract Documents. If the work herein provided for is Approved by Change Order, the time of completion will be:

[ ] Increased [ ] Decreased [ ] Unchanged

by _____ calendar days.

This change will: [ ] Add [ ] Deduct [ ] Not Change

ENGINEER'S RECOMMENDATION:

[ ] Recommend Acceptance

[ ] Do Not Recommend Acceptance

By: Engineering Firm

Date

Owners Action:
[ ] Accepted [ ] Not Accepted

By: Owner

Progress Estimate – Lump Sum Work

Contractor's Application for Payment

Owner: _____ Owner's Project No.: _____

Engineer: _____ Engineer's Project No.: _____

Contractor: _____ Contractor's Project No.: _____

Project: _____

Contract: _____

Application No.: _____ Application Period: From _____ to _____ Application Date: _____

A	B	C	D	E	F	G	H	I
			Work Completed					
Item No.	Description	Scheduled Value ($)	(D + E) From Previous Application ($)	This Period ($)	Materials Currently Stored (not in D or E) ($)	Work Completed and Materials Stored to Date (D + E + F) ($)	% of Scheduled Value (G / C) (%)	Balance to Finish (C - G) ($)
Change Orders								
						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
						-		-
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						-		-
						-		-
						-		-
	Change Order Totals	$ -	$ -	$ -	$ -	$ -		$ -
Original Contract and Change Orders								
	Project Totals	$ -	$ -	$ -	$ -	$ -		$ -

Progress Estimate – Unit Price Work

Contractor's Application for Payment

Owner: _____ Owner's Project No.: _____

Engineer: _____ Engineer's Project No.: _____

Contractor: _____ Contractor's Project No.: _____

Project: _____

Contract: _____

Application No.: _____ Application Period: From _____ to _____ Application Date: _____

A	B	C	D	E	F	G	H	I	J	K	L
		Contract Information				Work Completed					
Bid Item No.	Description	Item Quantity	Units	Unit Price ($)	Value of Bid Item (C X E) ($)	Estimated Quantity Incorporated in the Work	Value of Work Completed to Date (E X G) ($)	Materials Currently Stored (not in G) ($)	Work Completed and Materials Stored to Date (H + I) ($)	% of Value of Item (J / F) (%)	Balance to Finish (F - J) ($)
Change Orders											
					-		-		-		-
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					-		-		-		-
				Change Order Totals	$ -		$ -	$ -	$ -		$ -
Original Contract and Change Orders											
				Project Totals	$ -		$ -	$ -	$ -		$ -

Stored Materials Summary

Contractor's Application for Payment

Owner:
Engineer:
Contractor:
Project:
Contract:

Owner's Project No.:
Engineer's Project No.:
Contractor's Project No.:

Application No.: _____ Application Period: From _____ to _____ Application Date: _____

A	B	C	D	E	F	G	H	I	J	K	L	M
						Materials Stored			Incorporated in Work			
Item No. (Lump Sum Tab) or Bid Item No. (Unit Price Tab)	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Description of Materials or Equipment Stored	Storage Location	Application No. When Materials Placed in Storage	Previous Amount Stored ($)	Amount Stored this Period ($)	Amount Stored to Date (G+H) ($)	Amount Previously Incorporated in the Work ($)	Amount Incorporated in the Work this Period ($)	Total Amount Incorporated in the Work (J+K) ($)	Materials Remaining in Storage (I-L) ($)
								-			-	-
								-			-	-
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					Totals	$ -	$ -	$ -	$ -	$ -	$ -	$ -

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies administrative and procedural requirements for schedule software, Baseline Schedule preparation, monthly Progress Schedule, contemporaneous period schedule analysis, submittal schedule, and short interval schedules.

B. As used in this Section, “Progress Schedule” refers collectively to “Baseline Progress Schedule” and “monthly Progress Schedule updates.”

1.02. SCHEDULE SOFTWARE

A. The Contractor shall use Microsoft Project as the scheduling software for this project.

B. Total Float is defined as the lesser amount of time between the earliest start date and the latest start date or between the earliest finish date and the latest finish date of an activity on the Progress Schedule. Float is not for the exclusive use of either the Contractor or the Owner unless otherwise identified in the Contract Documents.

1. Extensions of time for contract performance will be granted only to the extent that equitable time adjustments to the affected activity or activities exceed the total float time along the affected paths of the currently approved Progress Schedule at the time a Work Change Directive or Change Order was issued for the change.

C. All Progress Schedule submittals, including monthly Progress Schedule updates, will be reviewed jointly by the Owner and the Contractor. Such review of the Contractor's schedules shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the Work in a timely manner.

1.03. PROGRESS SCHEDULE

A. Within fourteen (14) calendar days after Contract execution, or on the date of the preconstruction conference (whichever is earlier), the Contractor shall prepare and submit to the Owner, for review and comment, a preliminary Progress Schedule utilizing a Critical Path Method (CPM) logic, based on the Contract Documents. The Owner will

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review the preliminary schedule for conformance with the Contract Documents and provide comments within fourteen (14) days of receipt from the Contractor. The Contractor shall respond to all comments and provide the Owner a Baseline Progress Schedule within fourteen (14) days of receipt of the Owner's comments.

B. Once the Baseline Progress Schedule is submitted to the Owner, the Progress Schedule shall be formally established as the baseline file within the Contractor's scheduling software. This baseline file shall not be modified without the Owner's written approval.

C. The Baseline Progress Schedule shall be the basis that the Contractor shall use to plan, organize, and execute the Work; record and report actual performance and progress through updates; and show how the Contractor plans to complete all remaining Work. The initial Baseline Progress Schedule shall be cost-loaded. Alternately, a cash flow analysis for the entirety of the project could be provided in lieu of a cost-loaded schedule. The Baseline Progress Schedule and monthly Progress Schedule updates shall be the basis for consideration and analysis of requests for time extensions as specified below. The schedule shall be in the form of an activity oriented precedence network diagram and Gannt chart.

D. The Baseline Progress Schedule and monthly Progress Schedule updates shall be constructed to show the order in which the Contractor proposes to carry out the Work and to indicate the restrictions of access to and availability of work area; availability and use of manpower, materials, equipment; and include all activities of trade contractors, equipment vendors, suppliers, and Negotiated Support Services expenses. The Progress Schedule shall incorporate contractually specified limitations and restrictions and contractually specified milestones. Construction activities shall match or be correlated with the pay items in the approved Schedule of Values. The Progress Schedule shall be prepared in sufficient detail with the assignment and coding of all activities by the Contractor and Subcontractors in consideration of, but not limited to, the following Work activities:

1. Access and availability to the Project Site, including road closures.
2. Interfaces and dependencies with preceding, concurrent, and succeeding contractors, if applicable.
3. The type of work to be performed and labor trades involved.
4. All procurement, manufacture, fabrication (both on-site and off-site), and delivery activities for all major materials and equipment.
5. Preparation and submission of submittals, shop drawings and material samples.
6. Approval by the Owner of shop drawing and material sample submittals.

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7. Shutdowns of existing Owner's equipment and utility services.
8. Required delivery dates of Owner furnished equipment and materials, if applicable.
9. Other Owner activities, non-work periods, and constraints.
10. Testing and commissioning activities, including submission and approval of test results.
11. Approvals required by regulatory agencies or other third parties, including obtaining an Occupancy Permit.
12. Coordination for Owner's occupancy including Owner's cleaning, Owner-furnished equipment, and furnishings installations.
13. Planning for phased occupancy by the Owner with intermediate completion dates.
14. Contractor's preliminary cleaning and final cleaning operations.
15. Contractor's Final Punch List Report, Owner's Final Inspection (Punch List), Contractor's corrections, and Owner's re-inspection.
16. Substantial Completion and Final Completion activities and milestones and Final Acceptance.

E. The activities defined in the Progress Schedule shall represent the planned durations in anticipation of normal manpower and equipment utilization in durations of whole working days. No activity durations shall exceed 21 calendar days. If approved by the Owner, longer durations may be allowed for non-construction activities such as procurement, delivery, or submittal activities. All durations shall be determined based upon resource planning under contractually defined on site work conditions. In calculating activity durations, normal inclement weather shall be considered. The Contractor shall schedule the Work to minimize the effect of adverse weather. The Contractor shall also protect the work site from the effects of adverse weather or take other necessary measures such that the Work can be completed within the time established in the Contract Documents and include these provisions in the schedule as appropriate.

F. Schedule activity identification codes shall not be alphanumeric unless approved by Owner.

1. Activity Description: Provide adequate information to readily identify each activity up to 48 characters in the general descriptive format: action, item, location (i.e., Install Steel Studs 3rd Floor).

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2. Activity Codes: The Contractor shall develop and provide a complete, efficient, and understandable Work Breakdown Structure (WBS) code to submit to the Owner for review and approval. In addition to the WBS, activity codes may be created and assigned a conventional WBS scheme; activity codes shall be used in lieu of the WBS.
3. The Critical Path shall be clearly indicated on all diagrams submitted. An activity is critical when it is part of the longest duration pathway(s) through the CPM network or when its total float is less than or equal to zero.
4. At the Owner's request, furnish a written narrative of the Contractor's determination of durations for particular activities. Such explanation may include the number of crews, crew composition, number of shifts per day, number of hours in a shift, number of work days per week, construction equipment, material quantities, etc.
5. At the Owner's request, a written explanation shall be provided for a lead and lag relationship and for a constrained date. These logic constraints shall be disallowed unless a compelling reason exists for their use.
6. Clearly identify activities that are planned to be conditioned by use of overtime, double shifts, or work on weekends or holidays.
7. Schedule Status Report: Each submittal involving graphical and/or tabular reports produced using CPM shall be accompanied by a Schedule Statistics Report. Include listing of activities with open ends, out-of-sequence progress, constraints, the schedule calculation modes (retained; contiguous, or interruptible), and other statistics that are normally a part of this report.

G. When requested by the Owner, activities in the monthly Baseline Progress Schedule submittals shall be cost-loaded and manpower-loaded (if required by the Owner). The estimated costs to perform each Work activity shall be assigned to each activity as specified by the scheduling software. No activity costs shall be assigned to manufacture or delivery activities unless approved by the Owner.

1. When requested, the Contractor shall provide the Owner with a formula to convert cost-loaded activities to manpower requirements, if activities are manpower-loaded. This formula shall be based upon a percentage allocation of the cost loading for labor costs and an average hourly labor cost for the Project.
2. Contractor may request and Owner may approve, at its sole discretion, an alternative resource-loading plan if it is evaluated equally beneficial.

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H. Tabular reports required by this Section shall be prepared by the scheduling software. Reports shall contain a listing of the activities required for the type of report being prepared. Each activity shall include the following information:

1. Activity Code.
2. Activity Description.
3. Original and remaining durations in work days.
4. Early start and finish dates.
5. Actual start and finish dates (as applicable for monthly update reports).
6. Late start and finish dates.
7. Free and total float in work days.
8. Percentage of activity completed.
9. The budgeted cost, if cost-loaded.
10. Assigned activity codes.
11. Predecessor and successor activity numbers.
12. Leads/Lags on activity relationships.
13. Activities with constraints.
14. Reportable milestone activities, as agreed with Owner.

I. The Contractor shall prepare computer-generated tabular reports as part of the initial schedule submission and for each monthly update thereafter as follows:

1. A list of the “nearly critical” [Total Float is equal to or less than five (5) days] activities, sorted by activity number with predecessor and successor relationships.
2. The Short Interval Schedule.
3. Other reports that the Owner and Contractor may negotiate as the Project evolves.

J. Submit the Contractor's Progress Schedule, monthly, in the following quantities:

1. One (1) copy of a Microsoft Project generated detailed network diagram displaying all activities in a time scaled format with their logical relationships. The network need not be confined to a single sheet but shall be printed on either C or D drawing size. The Contractor shall provide both a PDF copy and a Microsoft Project (.mpp extension) copy of the schedule.

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2. Copies of the schedule and reports shall be posted on electronic communication and information management system (ECIMS) per Section 01 31 23.

K. CERTIFICATION: Submit certification that each Subcontractor and major equipment supplier has participated in, reviewed, and concurs with the Construction Progress Schedule and the associated cost data as it relates to their Work.

1.04. MONTHLY PROGRESS SCHEDULE UPDATES

A. The Contractor is required to prepare and submit monthly Progress Schedule updates to participate in monthly schedule update meetings with the Owner as described below.

1. Timely submission of updates is of significant and crucial importance to the management of the Project. Lack of, or late receipt of, updates diminishes their value to the Owner. If a monthly Progress Schedule update is not submitted to and reviewed with the Owner prior to the Contractor submitting its monthly Application for Payment, the monthly Schedule of Values amount for Progress Schedule updates may, at the Owner's sole judgment and discretion, be reduced from the Specified General Conditions by a unilateral Change Order (see Section 01 26 00).

B. The Contractor shall prepare monthly Progress Schedule updates to reflect work progress achieved since the previous update. Historical performance data and/or records shall not be changed without approval of the Owner.

C. The Contractor shall, in a second and subsequent report, incorporate any logic and duration changes that represent its revised planning, provided all such changes are identified and submitted to the Owner for comment in the narrative report required herein this Section.

D. The Contractor shall use and maintain a fixed end date when generating the required reports and diagrams for the Owner as specified by this Section. The fixed end date shall be the Substantial Completion date. The fixed end date will be adjusted in subsequent updates only to reflect approved time extensions incorporated by Change Order.

E. The Project shall be rescheduled each reporting period with:

1. An updated data date.
2. Actual start/finish dates.

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3. Percent complete.
4. Remaining durations (for each activity in the “status” or “current” file).

F. Show changes occurring since the previous schedule submission, such as:

1. Any major changes in scope.
2. Activities modified since previous submission including, but not limited to, logic changes.
3. Revised projections for progress and completion, as applicable.
4. Any other identifiable changes.

G. Account for all inclement weather days, major events, and similar excusable, noncompensable delays, during which little or no work is progressed and which are acknowledged by the Owner, in the period within which the events occur. The Contractor may account for such delays within the Contemporaneous Period Schedule Analysis and the Progress Schedule update by treating the events as it would a typical holiday at the calendar function of the software. By whatever method the Contractor chooses to account for such delays and events, a narrative description providing specific weather data and other information substantiating the delay shall be included with the narrative report specified in this Section.

H. The Construction Progress Meetings shall be held prior to the Owner’s review and comment of the Contractor’s monthly draft Application for Payment, unless otherwise approved by Owner.

1. The Contractor shall provide copies of two (2) tabular reports:
   a. A total float report clearly indicating the current critical path through Substantial Completion.
   b. A report of activities sorted by early start dates commencing with the previous update and including all updated activities during the previous month. Actual progress of the previous month will be recorded and incorporated into the update.
2. The Contractor and Owner will review these reports and will discuss any differences or issues raised. No Contract Time will be modified unless directed by an approved change order.

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1.05. SUBMITTAL SCHEDULE

A. GENERAL: Within ten (10) days following the Owner's receipt of the Baseline Progress Schedule, the Contractor shall prepare and submit to the Owner a complete schedule of work related submittals based on the Progress Schedule, as required by the Contract Documents ("Submittal Schedule"). Correlate Submittal Schedule with the listing of principal Subcontractors.

B. FORM: Prepare Submittal Schedule in chronological sequence of submittals. Show category of submittal; name of Subcontractor; generic description of work covered; related specification section numbers; activity or event code on the Progress Schedule baseline file; unique Master Submittal List number as described in Section 01 33 00; scheduled date for first submission; and blank columns for actual date of submittal, re-submittal, and final release or acceptance by the Owner. The Submittal Schedule shall be prepared in sufficient detail and in consideration of, but not limited to, the following:

1. Preparation and submission of shop drawings, layout drawings, product data, material samples, and mock-ups.
2. Review times for large and complex submittals that are anticipated to require more than 21 working days of review time.

C. Update the Submittal Schedule monthly and submit to Owner.

1.06. RECOVERY SCHEDULE

A. When the activities on the critical path or the completion milestones appear to be ten (10) working days beyond the contract time, the Engineer/Owner/CM may request the Contractor to provide a Recovery Schedule demonstrating how the Contractor will recover the lost time so that the Work will be completed within the Contract Time.

B. Provide the Recovery schedule within ten (10) working days after requested by the Engineer/Owner/CM.

C. Activities will be added or the durations modified to reflect the changes to the work.

D. The Engineer/Owner/CM will review and provide comments to the Contractor on the Recovery Schedule within five (5) working days.

E. Incorporate the Engineer/Owner/CM comments into the Recovery Schedule within five (5) working days.

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F. After acceptance by the Engineer/Owner/CM, the Recovery Schedule shall be used for future Schedule Updates.

G. CPM time-scaled network diagram as described for the Baseline Schedule:

1. Do not change the description of an activity number.

a. Any activity added to the schedule shall have a new activity number and description.

b. If activities are deleted, the deleted activity number(s) will not be used again.

H. Provide a narrative with an explanation of the changes in logic and/or activity durations.

1.07. SHORT INTERVAL SCHEDULE

A. SHORT INTERVAL SCHEDULE: Prepare and update weekly a four (4)-week Short Interval Schedule. Show previous week of actual progress (planned vs. actual performance). Forecast three (3) weeks of start and completion dates for each activity, task, or event in comparison to the Progress Schedule.

1. Activities in the Short Interval Schedule shall relate directly to activities in the Progress Schedule.

B. Format for the Short Interval Schedule shall be submitted to the Owner for approval. The format shall include comment annotation as necessary.

C. Copies of the Short Interval Schedule shall be provided at the weekly progress meetings and will be used as a basis for discussion of progress and planned work at the meetings.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 32 33

PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies progress photographs to be provided for preconstruction, during construction, and post-construction.

1.02. SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. Preconstruction, construction, and post-construction photographs.

PART 2 - PRODUCTS

2.01. PHOTOGRAPHS

A. Photographs shall be taken with a minimum of sixteen (16) mega-pixels. Photographs shall be in color and a minimum resolution of 2256x1496 at 300 ppi.

B. Upload, maintain, and organize the photographs monthly on the electronic communication and information database management system (ECIMS) specified in Section 01 31 23 into folders Area with subfolders by Year and Month. Assign each photo a file name that includes location by area, direction, short description, and date.

PART 3 - EXECUTION

3.01. GENERAL

A. Photographs shall be taken at locations designated by the Owner.

B. PHOTOGRAPHER: Experienced in construction photography.

C. Video images may be acceptable for certain operations. Confirm with Owner.

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3.02. PRECONSTRUCTION PHOTOGRAPHS

A. Provide preconstruction photographs prior to commencement of work on the site. Provide exposures of the area where the work is to take place as designated by the Owner.

3.03. CONSTRUCTION PHOTOGRAPHS

A. Provide construction photographs during the progress of the work. Take monthly exposures starting one (1)month after the start of construction and continuing as long as the work is in progress.

B. Take photographs of each feature and site area as designated by the Owner.

3.04. POST-CONSTRUCTION PHOTOGRAPHS

A. Take the number of exposures specified until Final Acceptance of the Work. Locations to be designated by the Owner.

3.05. REQUIRED NUMBER OF PHOTOGRAPHS

A. For the work of this Contract, provide minimum number of monthly photographs as follows:

Category	Number of Photos
Preconstruction	50
Construction (Monthly)	20 per Area under active construction
Post-construction	50

END OF SECTION

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01. SUMMARY

A. This Section includes administrative and procedural requirements for submittals. Submittals include but are not limited to:

1. Manufacturer’s information.
2. Shop drawings.
3. Test procedures.
4. Test results.
5. Samples and Mockups.
6. Requests for substitutions.
7. Miscellaneous work-related submittals.
8. Mechanical, electrical, and instrumentation systems.
9. Fabricated items.
10. Piping and raceway details.

1.02. CONTRACTOR RESPONSIBILITIES

A. Furnish all drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, and manufacturer's installation and other instructions as specified in the Contract Documents to fully demonstrate that materials and equipment to be furnished and the methods of work comply with the provisions and intent of the Contract Documents.

B. Ensure the accuracy and completeness of the submittal information.

C. Verify the proposed material and equipment conform to the requirements of the Contract Documents. Cross out extraneous materials.

D. Material, products, equipment, and methods of work shall be as described in the submittal.

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E. Ensure there is no conflict with other submittals. Notify the Owner where a submittal may affect the work of another submittal.

F. Ensure coordination of submittals among the suppliers, related crafts, subcontractors, and with the planned work.

G. Coordinate submittals with other work so that work will not be disrupted or delayed. Coordinate and schedule different categories of submittals so that one will not be delayed for lack of coordination with another.

H. Coordinate submittals among subcontractors and suppliers, including those submittals subject to unit responsibility requirements as specified in individual equipment, material, system, and component specifications.

I. Certify verification of field conditions, compliance with the Contract Documents, and review of the submittal prior to submission for review on each submittal.

J. No time extension will be allowed because of failure to properly schedule or coordinate submittals.

K. Designate the location and/or intended purpose for each submitted item. Approval of a submittal shall not constitute approval for application or use anywhere other than as designated in the submittal. Submittal review comments are only applicable for the location or intended purpose identified for each submittal item.

L. The Owner may reject the submittal for reasons including, without limitation, lack of legibility, lack of coordination, poor organization, ambiguity, or incompleteness.

M. If requested by the Owner, the Contractor and key subcontractors and suppliers will participate in pre-submittal meetings for critical project submittals. The purpose of pre-submittal meetings is to confirm the requirements and intent of the specification in order to facilitate submittal review by the Owner. Participation in this meeting shall not relieve the Contractor of its responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Owner.

1.03. SUBMITTAL CATEGORIES

A. Submittal requirements listed in specifications are categorized based on the use of the information during the project, the type of review procedures applied during review,

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and the subsequent actions available to the Contractor based on the response to the review.

1. ACTION SUBMITTALS: Action Submittals require review and response by the Owner: a) before the Contractor proceeds with incorporating the equipment, materials, products, or procedure addressed in a submittal into the work or b) if submittals cannot be prepared until the subject Work is completed (i.e., test reports, welding certifications, etc.), prior to Substantial Completion. Review comments for Action Submittals, and the subsequent actions of the Contractor based on the review comments shall conform to REVIEW ACTION requirements specified in this Section.
2. INFORMATIONAL SUBMITTALS: Informational Submittals require review by the Owner to verify that the information has been furnished as specified. If the information has been furnished as specified, the submittal will be returned marked "RECEIPT ACKNOWLEDGED." If the information has not been furnished as specified, the submittal will be returned marked "REJECTED" and resubmittal is required.

1.04. SUBMITTAL PROCEDURES

A. Owner will review submittal information and indicate review action only for the limited purpose of checking for conformance between the information given and the design concept expressed in the Contract Documents. Review of submittals by Owner does not relieve Contractor of any Construction Document requirements.

B. Coordinate submittal transmittal for related elements of work to ensure there will be no delay in processing due to the need to review submittals concurrently for coordination.

1. For the purpose of tracking submittal review times, the review duration shall begin on the date when all related and required submittal materials necessary to conduct the submittal review are logged in the ECIMS. Owner reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
2. For product substitution see Section 01 25 00.
3. Prioritize submittals when transmitting several submittals at once.
4. Submittal sequencing should coincide with Section 01 32 16.
5. A review duration of twenty-one (21) calendar days is allowed for each submittal, from the time of receipt by the Owner to the time of return to the Contractor.

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a. Contractor may request expedited review of "hot" submittals, in which case the Owner's goal will be to complete the review within ten (10) calendar days, unless a different review time is agreed to at the time of submittal. Contractor and Owner agree that requests for expedited submittal reviews will be made judiciously and that expedited reviews will be performed subject to the availability of the Owner's resources.

b. A review duration of more than twenty-one (21) calendar days will be allowed for large and complex submittals, particularly those that require review by multiple engineering disciplines. Identification of submittals that are considered to be large and complex will be made jointly by the Owner and Contractor and identified in the submittal schedule specified in Section 01 32 16.

C. SUBMITTAL PREPARATION: All contents of the submittal are to be in an electronic searchable PDF format with bookmarks for subsection, unless otherwise approved by the Owner.

1. Include the following information on the submittal transmittal form for processing and recording action taken:

a. Project name and date, including Owner's project number.

b. Name of Contractor and Subcontractor.

c. Name of supplier and name of manufacturer.

d. Construction package.

e. Number and title of appropriate specification section.

f. Drawing number and detail references, as appropriate.

2. Provide approximately 4-inch x 5-inch space to record Owner's action stamp on hard copy submittals.

D. SUBMITTAL COMPLETENESS: Submittals without all required information are not acceptable and may be returned marked "REJECTED."

1. When required to provide a copy of the specification, include a copy of the applicable section with each paragraph check marked to indicate compliance or noted to indicate requested deviations. Check marks denote full compliance with a whole paragraph. If deviations from the specifications are requested, each deviation shall be underlined and identified by a number in the margin referenced to a detailed written explanation. The remaining portions of the paragraph not underlined will signify compliance with the requirement. Failure to submit a copy

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of the marked-up specification section, along with justification(s) for any requested deviations, will be sufficient cause for rejection of the entire submittal with no further consideration.

E. SUBMITTAL TRANSMITTAL: Package each submittal appropriately and transmit from Contractor to Owner electronically through the ECIMS (Section 01 31 23). Submittals received from sources other than Contractor will be returned without action.

1. Submittals shall be accompanied by a Submittal Transmittal Form (provided in Section 01 31 30) and posted in the ECIMS (Section 01 31 23). Equipment numbers shall be listed on the Submittal Transmittal Form for items being submitted. A unique number identified in the Master Submittal List shall be noted on the transmittal form accompanying each item submitted. Submittal numbers shall be as proposed by the Contractor and agreed to by the Owner. Submittals by subcontractors shall be numbered sequentially with a letter assigned for resubmittals (e.g., A being the original submittal and B, C, or D being the 1st, 2nd, and 3rd resubmittals, respectively).
2. Address no more than one (1) topic or related topics on a single transmittal. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole. No multiple-section submittals allowed unless previously approved by the Owner.
3. Record relevant information, deviations, and requests for data, including minor variations and limitations from the Contract Documents.
4. Submit shop drawings, samples, and mock-ups as specified in the Contract Documents. Submit one (1) bookmarked electronic copy in a searchable pdf format approved by the Owner; number of copies is noted in parentheses.
    a. Shop Drawings: One (1) marked up PDF will be returned to the Contractor when the review is completed.
    b. Samples: Two (2) samples.
    c. Mockups: As required by individual equipment specifications.
    d. Demonstrations: As required to facilitate installation and inspection.
    e. Reference applicable mechanical and electrical specifications for additional submittal requirements.
5. Submit samples of actual colors or materials. Deliver all submittal samples to the onsite office of the Owner's Construction Manager.

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6. In the event of the need to "revise and resubmit" a submittal, resubmit same, clearly identifying deviations from previous submittal content. Unless approved by the Owner, prior to making a resubmittal, the resubmittal shall be a complete, stand-alone submittal with corrections, revisions, and new information clearly identified.
7. Although the Contractor is responsible for ensuring that all provisions of this heading are achieved, the cost of the submittals may be included in subcontract bid packages.

F. Changes to submittals that require a stamp and signature by a licensed engineer or other certification shall be resubmitted with the requisite stamp and signature or certification prior to transmittal.

G. If the Contractor proposes to provide material, equipment, products, or work methods that deviate from the project manual, it shall indicate so under "deviations" on the transmittal form accompanying the submittal.

1.05. SAMPLES AND MOCKUPS

A. Submit samples and mock-ups in accordance with the Contract Documents. Samples may include partial sections of components; cuts or containers of materials; color range sets; and swatches showing color, texture, and pattern.

1. Package samples to facilitate review. Include the following with the Submittal Transmittal Form:
   a. Generic description of the sample.
   b. Sample source.
   c. Product name or name of manufacturer.
   d. Compliance with recognized standards.
   e. Master Submittal List number.
   f. Availability and delivery time.
   g. Specification section.

B. Submit samples and mock-ups before installation of the Work. Review by the Owner does not relieve the Contractor of any requirement of the Contract Documents. Where variation in color, pattern, texture, or other characteristics are inherent in the material, submit not less than four (4) units to show variation range.

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C. Where samples are for selection of appearance characteristics from a range of standard choices, submit a full set of choices for the material or products.

D. Maintain sets of approved samples and mockups at the Project Site, for quality comparisons throughout the course of construction.

E. Demolish and remove all samples and mockups prior to Final Completion.

F. Although the Contractor is responsible for ensuring that all provisions of this paragraph are achieved, the cost may be included in subcontract bid packages.

1.06. REVIEW ACTION

A. Owner will review each submittal, indicate action, and return promptly.

B. Approval of submittals does not release Contractor from a proper installation, compliance with applicable codes, or coordination of the Work.

C. The Owner will mark each submittal with a uniform, self-explanatory action identification consistent with the review actions defined below. Portions of the submittal may have different review actions. Contractor may proceed only with portions or elements designated Code 1 or Code 2.

1. Code 1 – "NO EXCEPTIONS TAKEN" – This code is assigned when there are no notations or comments on the submittal. When returned under this code, the Contractor may release the equipment and/or material for manufacture.
2. Code 2 – "MAKE CORRECTIONS NOTED" – This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
3. Code 3 – "AMEND AND RESUBMIT" – This code is assigned when notations or comments are extensive enough to require a resubmittal of the package or designated portions of the package. This resubmittal is to address all comments, omissions, and non-conforming items that were noted. A review code "3" does not allow implementation of the work covered by the submittal until the information in the submittal has been revised, resubmitted, and returned with a review action of either Code "1" or Code "2."
4. Code 4 – "REJECTED" – This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package, revised to bring the submittal into conformance. It may be necessary to

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resubmit using a different manufacturer/vendor to meet the Contract Documents. A review code “4” does not allow implementation of the work covered by the submittal until the information in the submittal has been revised, resubmitted, and returned with a review action of either Code "1" or Code "2”.

5. Code 5 – “RECEIPT ACKNOWLEDGED” – This code is assigned to acknowledge receipt of a submittal that is not subject to the Owner’s review and approval and is being filed for information purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans and Health and Safety plans. No further submittal activity is required by the Contractor for the submitted items if the submittal is marked “RECEIPT ACKNOWLEDGED.”

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 35 13

SPECIAL PROJECT PROCEDURES

PART 1 - GENERAL

1.01. SUMMARY

A. Work specified in this section includes special procedures regarding hazardous facilities, cultural resources, and endangered species protection.

1.02. QUALITY ASSURANCE

A. REFERENCE STANDARDS:

1. 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.
2. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Contract. 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
16 USC 470	National Historic Preservation Act of 1966
36 CFR Part 800	Protection of Historic and Cultural Properties
RCW Chapter 27.44	Indian Graves and Records
RCW Chapter 27.53	Archaeological Sites and Resources
RCW Chapter 68.08	Human Remains

1.03. HAZARDOUS FACILITIES

A. Take appropriate precautions in working near or with potential hazard; protect health and safety of the worker, public, and property.

B. Such potential hazards include, but are not limited to:

1. Storage and conveyance of:
   a. Petroleum products.

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2. Electric conductors without concentric neutral conductors or other grounded metal shields or sheaths, either exposed or directly buried or in duct or conduit.
3. Electric conductors with potential to ground of more than 300 Volts.
4. Duct work not completed and not yet connected to a fan. The Contractor shall ventilate each section of uncompleted duct work to purge any explosive vapors that might have collected during a non-construction period.
5. Wastewater and sludge.
6. Confined spaces.
7. Classified spaces.

1.04. CULTURAL RESOURCES

A. The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800, which provide for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called “cultural resources”), and the Revised Code of Washington.

B. Conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources. A Change Order will be issued for delays resulting from such cultural resources investigations.

C. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. Immediately notify Owner of the discovery.
2. The Owner will Suspend the Work, directing the Contractor to cease all construction operations at the location of such potential cultural resources find.
3. Such Work Suspension Directive shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the U.S. Army Corps of Engineers.

D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the U.S. Army Corps of Engineers, the Owner will extend the duration of the Work Suspension Directive in writing and the Contractor shall continue suspension of Work at the location of the find.

E. The Owner will select the archaeologist and pay for the services.

F. Resume work at the written direction of Owner.

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1.05. ENDANGERED SPECIES PROTECTION

A. Comply with Section 7 of the Endangered Species Act.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 35 23

PROJECT SAFETY REQUIREMENTS

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies minimum requirements for safety on the construction site including, but not limited to, Contractor responsibility for creating and maintaining a safe jobsite, Contractor safety program submittals, Contractor safety requirements, Contractor safety reporting, fire safety requirements, and hazard communication.

B. The Contractor is responsible for compliance with all applicable laws and regulations regarding safety whether noted in this section or not. Furthermore, the Contractor is responsible for creating and maintaining a safe working environment on the Project Site whether the requirements of this Section address a particular situation or not.

C. Refer to the General Conditions for additional provisions related to safety precautions.

1.02. CONTRACTOR RESPONSIBILITY

A. The Contractor shall be solely and completely responsible for conditions of the construction site, including safety of all persons and property, during performance of the Work. The Contractor shall maintain the Project Site and perform the Work in a manner that meets or exceeds statutory and regulatory requirements for the provision of a safe place to work and that minimizes safety risks to personnel of the Contractor, Subcontractors, Owner, general public, or other parties. This obligation shall apply continuously and not be limited to normal working hours.

1. The Contractor shall ensure that all Contractor and Subcontractor personnel are provided sufficient training and shall take such actions as are necessary to maintain a safe environment on the construction site. Such training and actions shall include, but not be limited to, ensuring that such employees are familiar with governing construction safety requirements and the requirements for compliance with applicable regulations. The Contractor shall monitor the jobsite to ensure that employees do not create unsafe conditions for other, and shall notify employees of the requirement to alert the Contractor to any potential health or safety hazard affecting themselves or others and to comply with the provisions of the Site Specific Safety Plan.

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2. The Contractor shall establish and communicate clear expectations to its employees and its Subcontractors (and their employees) of their obligation to notify any party concerning an observed unsafe or unhealthy act or any pending hazard.
3. The Contractor shall conduct weekly on-site safety meetings, or greater frequency as appropriate, that shall be mandatory for all employees.

B. Designate an on-site individual to be the Safety and Health Officer who is qualified and authorized to supervise and enforce compliance with the Contractor's Site Specific Safety Plan during the performance of the Work. The Contractor is responsible to ensure that all necessary monitoring equipment, protective clothing, and other supplies are available to implement the Plan.

1. Minimum requirements for the Contractor's Safety and Health Officer shall include:
   a. Minimum three (3) years' experience as a safety professional and/or ten (10) years' experience working in the trade for which they will be responsible.
   b. OSHA 30 trained.
   c. The ability to provide all basic training needed for the trade for which they will be responsible.
   d. First Aid / CPR certified.
   e. Documented evidence of expertise in safety requirements of the trade for which they will be responsible.
2. Subcontractors shall be required to provide dedicated, non-working Safety Professional(s) to the project. Subcontractor's safety professional(s) shall participate as part of the team of safety support for the project. The Contractor shall have full approval authority over the subcontractor's Safety Professional(s).
3. Subcontractor shall provide safety professional support based upon the number of craft hours worked on the project each week. The formula to be applied shall require that the safety professional(s) dedicate time to the project such that his/her hours on the project site equal a minimum of two (2)% of the subcontractor's craft hours each week on the project. In no event shall the safety professional dedicate less than four (4) hours on site each week when subcontractor's work is in progress. The safety professional(s) hours spent on the project site shall parallel the hours worked by subcontractor's craft.
   a. Example No. 1 – A 3-person craft crew working forty (40) hours will require a safety professional on the project site no less than four (4) hours during the same time period.

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b. Example No. 2 – A 10-person craft crew working fifty (50) hours will require a safety professional on the project site no less than ten (10) hours during the same time period.

c. Example No. 3 – A 60-person craft crew working forty (40) hours will require a safety professional on the project site no less than 48 hours during the same time period. In this example, a second safety professional must be approved and dedicated to the project.

C. SAFETY VIOLATIONS: In the event of WISHA violations, by the Contractor or any of its suppliers or Subcontractors of any tier, or unsafe practices involving imminent danger to personnel of the Owner, Contractor, Subcontractors, or others, the Contractor shall immediately inform the Owner of the violation and correct the hazardous situation causing the violation prior to any Work continuing in the affected area. If such violations exist and corrective actions have not been taken by the Contractor, Owner may order Contractor to stop work, to be followed up in writing the same day, until satisfactory corrective action has been taken per the General Conditions.

1.03. CONTRACTOR SAFETY PROGRAM AND PLAN SUBMITTALS

A. Company Safety Program: Prior to performing any work on the site, the Contractor shall submit a copy of its Company Safety Program to the Owner. The Company Safety Program shall contain, at a minimum, the following elements:

1. Organizational Structure: Include names of individuals who will perform safety duties, titles, work assignments, authority, and reporting relationships.

2. Training Program: Who, how, and when training is provided; method of employee training concerning safety rules and procedures; and training in use of protective equipment.

3. Protective Equipment: List of personal protective equipment to be provided to employees.

4. Accident Prevention and Loss Control Plan: Work site inspection and hazard correction procedures; disciplinary procedures for safety infractions; and accident response, investigation, and reporting procedures.

B. SITE SPECIFIC SAFETY PLAN: Prior to performing any work on the site, the Contractor and each of their Subcontractors shall review the Contract Documents and the Contractor shall develop and submit a copy of a Site Specific Safety Plan to the Owner. The Site Specific Safety Plan shall be tailored to the unique issues of the Project and the

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specific types of hazards likely to be encountered, be in compliance with WISHA and all other regulatory requirements, and contain, at a minimum, the following elements:

1. APPLICATION OF COMPANY SAFETY PROGRAM: The Site Specific Safety Plan shall address how the following elements from the Company Safety Program will be specifically applied and modified in addressing unique issues related to the Project: organizational structure, training program, protective equipment, and accident prevention and loss control plan.
2. EMERGENCY PROCEDURES: The Site Specific Safety Plan shall outline accident response and emergency procedures and shall include a map and directions to the nearest hospital or urgent care facility for its employees.
3. SPECIFIC HAZARDS: The Site Specific Safety Plan shall address, as applicable, the following, and other specific hazards for the Project:
    a. Excavation and rescue plans.
    b. Overhead hazards/flying objects.
    c. Open flame/Hot Work.
    d. Hazardous materials and chemical exposure (asbestos, lead, PCB, mercury, mold, etc.).
    e. Digester Gas Flares.
    f. Safety issues related to Owner's "prior Occupancy."
    g. Working over water.
    h. Rigging/Aerial lifts and forklifts.
    i. Electrical safety.
    j. Scaffolding and personnel lifts.
    k. Noise and dust.
    l. Lockout/Tagout and control of hazardous energy.
    m. Work in confined spaces.
    n. Housekeeping and safe access.
    o. Silica.
    p. Fall prevention.

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1.04. CONTRACTOR SAFETY REQUIREMENTS

A. SAFETY TRAINING: Contractor shall provide construction site orientation for all employees (including Subcontractor and Owner) to become familiar with the Site Specific Safety Plan prior to commencing work. Contractor shall, on a weekly basis, perform safety training on hazards specific to the phase of work for all employees. These meetings shall be mandatory for all construction employees.

1. Subjects should include site specific safety issues and procedures and discussion of corrections resulting from any violation in safety procedures. A log of subjects covered and a copy of the attendance records of each meeting shall be submitted to the Owner on the day the meeting occurs.

B. RESPIRATORY EQUIPMENT: Any personnel performing work requiring the use of respiratory protective equipment shall be fully trained in the use of such equipment. Contractor must have a respiratory protection program and ensure that all workers wearing respirators have medical clearance and fit testing, as appropriate for the type of respirators used.

C. PERSONAL PROTECTIVE EQUIPMENT: Contractor shall ensure all construction personnel are equipped with and utilize Personal Protective Equipment in accordance with Labor and Industries standards. As a minimum requirement, all personnel working on the construction site shall be required to use approved hardhats, reflective outerwear, safety glasses, gloves, and appropriate work footwear.

D. FIRST AID: The Contractor shall maintain at the Project Site field office, or other well-known place at the Project Site, all materials necessary for giving first aid to the injured (e.g., a first aid kit) and shall establish, publish, and make known to all employees procedures for ensuring immediate removal to a hospital or a doctor's care, persons who may have been injured on the construction site. Construction personnel shall not work on the construction site before the Contractor has established and made known procedures for removal of injured persons to a hospital or a doctor's care. If the Contractor’s and/or any Subcontractor’s work crew consist of five (5) or more employees, the Contractor shall ensure that at least one (1) of such employees has a valid and effective first aid card.

E. SAFETY WALK-THROUGH: In addition to WISHA requirements, Contractor shall conduct a safety walk-through of the Project with the Owner a minimum of once a month during the course of construction. If a safety manager is required for any Subcontractor, the safety manager shall also attend the safety walk-through. Contractor shall: a) maintain a written record of the hazards and unsafe practices noted during the walk-through and

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provide copies to the Owner as requested, b) ensure that corrective action is taken to eliminate the items recorded, and c) maintain copies of all inspections performed by other competent individuals on the construction site during the course of construction.

F. JOB HAZARDS ANALYSIS: The Contractor shall plan daily work considering procedures with the potential for personnel injury and implement appropriate practices to avoid injuries with focus on engineering controls, personal protective equipment needs, and mitigation for exposure to cuts and lacerations. At each construction progress meeting, the Contractor shall present its plan for addressing hazards likely to be encountered in the next week. The Contractor will develop and implement a program requiring task planning at the foreman level.

G. CONTRACTOR REQUIRED DRUG AND ALCOHOL ABUSE POLICY: The Contractor shall be responsible for all testing requirements.

1.05. CONTRACTOR SAFETY REPORTING

A. REPORTING INJURIES AND INCIDENTS: Contractor shall immediately notify the Owner of any injury or incident to personnel on the construction site. Contractor shall conduct an immediate investigation with an emphasis on preventative actions and lessons learned. The Contractor shall document the investigation and submit a copy to the Owner within 24 hours of the incident. Contractor shall report on a monthly basis the total number of hours worked on-site by Contractor and its employees and Subcontractors and the total number of recordable incidents and lost time accidents.

B. REPORTING POTENTIALLY SERIOUS HAZARDS: Contractor shall immediately notify the Owner of any potentially serious hazard to personnel on the construction site. Contractor shall conduct an immediate investigation and submit a report to the Owner within 24 hours of becoming aware of the potentially serious hazard. The report shall describe the potentially serious hazard, the results of the Contractor's investigation, and any steps the Contractor has taken to prevent an injury or incident from occurring based on the potentially serious hazard.

C. EMERGENCY PROCEDURES:

1. Emergencies requiring ambulance, fire department, or police assistance shall call emergency services (fire and police) at 911.
2. Should the Contractor find it necessary to call for non-emergency police assistance or protection in the exercise of its responsibilities on the Project, call the Des Moines Police Department at 206-878-2121.

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1.06. CONSTRUCTION FIRE SAFETY

A. Site pull stations are connected to the Plant SCADA system, not directly to the fire department.

B. Conform to Chapter 14 “Fire Safety During Construction and Demolition” of the International Fire Code, as locally amended, and any additional provisions as outlined herein for precautions against fire, flammable and combustible liquids, flammable gases, explosive materials, fire protection, fire reporting, fire fighting access, means of egress, standpipes, fire sprinklers, and roofing operations.

C. “HOT WORK” PROCEDURES:

1. Contractor shall establish a system of documentation and control for "hot work" activities, which include the use of portable gas, grinding, or arc welding equipment; the storage of flammable materials (e.g., propane, butane, compressed gasses); cutting and welding activities; and roofing/hot tar kettle work. Post Hot Work Permits in an accessible and conspicuous location.
2. Notify Owner fourteen (14) days prior to requiring a “hot work” permit. Owner will acquire “hot work” permit from FM Global, as appropriate.
3. Conduct operations in a manner that is fire-safe for the work area and adjacent areas.
4. Maintain the premise clear of rubbish, debris, or other materials constituting a potential fire hazard. The local fire code is incorporated herein by reference; adhere to all applicable provisions as determined by the authority having jurisdiction.
5. Whenever practical, perform cutting and welding operations off-site.
6. Prior to conducting "hot work" activities, ensure all of the following fire safety precautions have been taken.
    a. Cutting and/or welding equipment must be thoroughly inspected and found to be in good repair and free of damage or defects.
    b. A multi-purpose dry chemical, portable fire extinguisher must be located such that it is immediately available to the Work and is fully charged and ready for use.
    c. At least one (1) fire alarm pull station or means of contacting the fire department (i.e., site telephone) must be immediately available and accessible to person(s) conducting the cutting/welding operation.

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d. Floor areas under and at least 35 feet around the cutting/welding operation must be swept clean of combustible and flammable materials.

e. All construction equipment fueling activities and fuel storage must be located at least 35 feet away from cutting/welding operations.

f. Fire resistant shields (fire retardant plywood, flameproof tarpaulin, metal, etc.) must cover combustible floors.

g. Provide combustible and finished surfaces, equipment, electrical cables, and personnel with protection to prevent damage or injury from molten metal, falling sparks, and welding arcs.

h. Spark/slag catchers (fire retardant plywood, flameproof tarpaulin, metal, etc.) must be suspended below any elevated cutting/welding operation.

i. All floor and wall openings must be covered to prevent sparks/slag from traveling to other unprotected area.

j. Containers in or on which cutting/welding will take place must be purged of flammable vapors.

D. FIRE SYSTEMS SHUTDOWNS, IMPAIRMENTS, AND FIRE WATCH:

1. Where it is necessary to shut down existing fire alarm systems or suppression systems for switch-over purposes, or any other reason that leaves the building unprotected, the Contractor shall provide a continuous Owner-approved “fire watch” during the shutdown in accordance with the following and as required by applicable regulations and AHJ unless: a) the Contractor provides an Owner-approved temporary equivalent system or b) obtains a specific exception from the Owner.

   a. Person(s) assigned to a "fire watch” must be trained in the use of the portable fire extinguisher.

   b. Fire watch personnel must have an immediate means of providing notification to the fire department (e.g., cellular phone, land-line phone, and/or two-way radio to a continuously staffed position) and the Des Moines Police Department.

   c. Continuous rounds to cover all areas of the building where the fire protection system is out of service are required every fifteen (15) minutes.

      1) Exception: During the hours a “B” occupancy building is occupied, building occupants performing their duties, including construction personnel, may

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act as a fire watch in lieu of a designated "fire watch" when approved in writing by the Owner.

a) A "fire watch" is required at all times in unoccupied areas.

b) Other building code occupancy types may be allowed this exception when approved in writing by the Owner.

d. A plan, which includes a method to notify all occupants, is required in occupied buildings.

e. Maintain a log of the rounds to include the name of person performing the "fire watch," the hours worked including start and stop times, and comprehensive notes.

f. Provide fourteen (14) days written notification to the Owner requesting approval for fire protection system shutdown or functional impairment; receipt of written approval from the Owner is required before any system shutdown or functional impairment.

1) Notify the local fire department. (South King Fire). The number to report out of service systems and equipment is 253-839-6234.

2. The Contractor shall work in cooperation with the Owner to identify fire alarm initiating devices in and adjacent to the Project Site that may activate from construction activities (work that creates dust, smoke, steam, heat, etc.) and develop a plan to temporarily cover, remove, or disable through programming these devices to eliminate the potential for false alarms.

a. The Owner may authorize in writing some devices to be disabled for the duration of the Work or for a particular activity without requiring a continuous "fire watch" for one shift or several days depending on circumstances.

b. ONLY OWNER PERSONNEL SHALL DEACTIVATE OR DISABLE EXISTING FIRE DETECTION AND SUPPRESSION SYSTEMS, unless the Contractor is specifically authorized by the Owner to do so in writing.

E. FIRE ALARM/SUPPRESSION SYSTEMS FALSE ACTIVATION OR DISCHARGE: Most existing Owner buildings have active fire detection and suppression systems. If proper procedures as outlined in the Contract Documents are not followed to ensure the unnecessary activation or deactivation of these systems, the Owner may at its sole discretion impose an emergency response charge on the Contractor for each occurrence and require a "fire watch" at the Contractors cost.

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F. FIRE EXTINGUISHERS REQUIRED FOR CONSTRUCTION: Provide multipurpose dry chemical portable fire extinguishers for the Work in accordance with the International Fire Code Chapter 14, as locally amended, and as required by WISHA and other applicable regulations. Existing building fire extinguishers or extinguishers provided by the Contract Documents for the Project do not alleviate Contractor's responsibility to provide temporary fire extinguishers for the Work.

1. Contractor shall inspect and re-certify all Owner fire extinguishers provided for the Project and used for construction at Substantial Completion.

G. EXISTING FIRE SEPARATIONS: Existing fire separations, including floor-to-floor separations, shall not be impaired by construction activities.

H. OCCUPANT EGRESS IN EXISTING BUILDINGS: The Contractor shall not block active exits, exit hallways, exit corridors, and the exit access to a public way, and they are to remain free of construction materials, equipment, and rubbish at all times, unless approved by Owner.

I. EMERGENCY ACCESS: Outdoor storage and staging operations and construction fencing shall not impede, restrict, or narrow fire fighting access, including roads or lanes, or present a fire exposure to existing buildings. A minimum of twenty (20) feet of roadway width must be maintained for all onsite fire roads or lanes. Provide adequate separation between buildings and construction trailers and sheds. Coordinate emergency access changes with emergency services.

1. Access to emergency services including, but not limited to, fire hydrants, fire department connections, fire command centers, fire alarm panels, valves, and similar equipment and systems for emergency vehicles and emergency response personnel must be kept free and unobstructed at all times, unless specifically approved by the Owner.
2. Temporary obstruction of emergency access may be allowed for special cases (e.g., crane hoist, etc.) on a short-term basis. A written plan must be submitted to the Owner for approval at least two (2) weeks prior to the scheduled date of obstruction.

1.07. HAZARD COMMUNICATION

A. GENERAL: The Owner and the Contractor are responsible under the Washington Administrative Code 296-800-170 through 296-800-18020 (the Hazard Communication Standard) to provide a safe and healthy environment for their employees.

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B. RESPONSIBILITIES:

1. The Owner maintains a centralized collection of all SDS's (Safety Data Sheets) for Owner materials. These are available to the Contractor if there is concern that an unknown chemical is in the work area and during construction a worker is concerned for exposure. This may be requested through the Owner.
2. The Contractor shall provide chemical hazard information (SDS) for all chemical products on the site including, but not limited to, all paints, glues, mastics, epoxies, and cleaning products for Owner's review. Maintain on the Project Site a 3-ring binder of all SDS for materials used on the Project and indicate where they are used.
3. Contractors are responsible for providing Hazard Communication training to their own employees. This training, in addition to the training that is regulated by the Hazard Communication Standard, should include SDS for any chemical product used on the site by the Owner.
4. The Contractor and Subcontractors shall prominently post an alphabetized SDS list and shall notify Owner of its location on the Project Site.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 41 26

PERMITS

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies permit acquisition, requirements, and conditions.

1.02. PERMITS AND AGREEMENTS

A. The Owner acquires the following:

1. Site Development Permits, City of Des Moines.
2. Building Permits, City of Des Moines.
3. NPDES Waste Discharge Permit for the Plant, State of Washington Department of Ecology.
4. General Construction Stormwater Permit, State of Washington Department of Ecology.
5. Air Quality Permits and Notice of Construction Permit, Puget Sound Clean Air Agency.

B. The Contractor acquires the following:

1. Electrical Permit, City of Des Moines.

C. Do not contact the permitting agencies for permits obtained by the Owner except in the event of an emergency or as specified in the Contract Documents. All non-emergency contact shall be through the Owner. In the event of an emergency, notify the Owner immediately after contacting the agency.

D. Work may be monitored by representatives of regulatory agencies. When aware of the presence of such representatives at the site, promptly inform the Owner. Although the representatives will not have direct contact with the Contractor, they will advise the Owner when the permit provisions and intent of the Contract Documents are not being implemented. Agencies that may be monitoring the Work include, but are not limited to, the U.S. Army Corps of Engineers, United States Fish and Wildlife Service, Washington State Department of Ecology, Washington State Department of Fish and Wildlife, National Oceanic and Atmospheric Administration, Washington State

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Department of Labor and Industries, City of Des Moines Health Department, City of Des Moines, Puget Sound Energy, and King County. Allow authorized agency representatives, upon presentation of proper credentials, to:

1. Access the Site.
2. View and copy submittals.
3. Inspect any facilities, equipment (including monitoring and control equipment), practices, methods, or operations regulated or required.
4. Sample or monitor any substances or parameters at any location for purposes for assuring compliance with the Contract Documents.

E. Where required on reports, provide the following signed certification: "*I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.*"

1.03. PERMITS OBTAINED BY CONTRACTOR

A. Permits obtained by the Owner are identified in this Section; obtain all other permits required to perform the Work.

B. Prepare and submit to the proper authority all information required for the issuance of such permits. Pay all costs thereof, including agency inspections and other costs.

C. Submit a copy of the completed permit, with the issuing agency acceptance, prior to performing any work covered by the permit.

D. When required, Work covered by the permit shall be inspected by the issuing agency.

1.04. SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. ACTION SUBMITTAL ITEMS: Contractor obtained permits.

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1.05. POSTING PERMITS

A. Permits, including those obtained by the Contractor, shall be posted at the site and protected from the elements.

B. Provide copies to subcontractor(s) performing any work authorized by such permit(s).

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 45 00

CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

1.01. SUMMARY

A. Comply with the quality control provisions as herein specified and described in the General Conditions and specified in the Contract Documents. Perform quality control tests and inspection and quality surveillance of all Work required by this Contract unless specifically designated to be performed by Owner.

B. Contractor Quality Control (CQC) shall consist of plans, procedures, and organization necessary to provide materials, equipment, work, fabrication, construction, and operations that comply with the requirements of the Contract Documents. CQC shall cover construction operations and be keyed to the Progress Schedule including, but not limited to, fabrication both on-site and off-site and field and factory tested construction mock-ups.

C. Owner's inspection and testing agency services are specified in Section 01 45 23 and may be required to ensure the Work complies with the Contract Documents, except where the Contract Documents specify tests to be performed by the Contractor.

1.02. WORK COVERED BY CONTRACT

A. CQC PLAN: Submit the CQC Plan within fourteen (14) calendar days after notice to proceed. CQC plan shall identify personnel, procedures, instructions, records, and forms to be used. At a minimum, each CQC Plan shall include:

1. Identification of the CQC Representative.
2. A description of the quality control organization, including chart showing lines of authority and acknowledgment that the Contractor’s QC staff shall report to the Project Manager or someone higher in the Contractor’s organization.
3. The name, qualifications, duties, responsibilities, and authorities of each person assigned a QC function.
4. Procedures for scheduling and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents.
5. Reporting procedures including proposed reporting forms.

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6. Testing, inspections, and approval records. Provide control testing procedures for each specific test.

B. PLAN ACCEPTANCE: Acceptance of the plan by the Owner is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.

C. CHANGE NOTIFICATION: After acceptance of the CQC Plan, notify the Owner in writing of any proposed change. Proposed changes are subject to Owner acceptance.

1.03. CONTRACTOR QUALITY CONTROL REQUIREMENTS

A. ORGANIZATION: Identify a dedicated full time CQC Representative who shall be on the Project Site at all times during the Work and as appropriate for all construction activities subsequent to the start of Owner's Final Inspection, with complete authority to take action necessary to ensure compliance with the Contract Documents. Staff the CQC organization, as required, to perform the activities outlined in this Section and elsewhere in the Contract Documents.

B. CQC REPRESENTATIVE QUALIFICATIONS: The Contractor shall propose for Owner approval, in writing, the Project CQC Representative. The CQC Representative must have construction management experience and prior experience with projects of similar construction, size, and complexity. The Owner will monitor and evaluate the performance of the CQC Representative based on: a) the conformance of the Work with the Contract Documents and; b) an assessment of the accuracy, timeliness, and completeness of the daily QC Report. If the CQC Representative fails to perform to the Owner's satisfaction, the Contractor shall replace him or her.

C. SUBMITTALS: Identify persons responsible for review and approval of shop drawings, layout drawings, samples and mock-ups, and other submittals required by the Contract Documents. Owner's review action will indicate only that the general method of construction and detailing is satisfactory (see Section 01 33 00) and does not relieve the Contractor of the responsibility for proper installation, coordination of the Work, and compliance with the Contract Documents.

D. WEEKLY QUALITY CONTROL REPORTS: CQC Representative shall maintain weekly Quality Control (QC) Reports (that are not the Superintendent's Daily Report). QC Reports shall be factual records containing, at a minimum: Work performed by Contractor, Work performed by subcontractors, specific inspections and inspection results, type and location of tests performed and test results, verbal instruction received from Owner on deficiencies or re-testing required, examination of areas upon

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which new Work is to be placed to verify the substrate for the new Work, and observations and remarks. Submit QC Reports, on approved forms, the next workday following the day of the report.

1. CQC Representative shall verify and sign all reports. Verification shall contain the statement that all supplies, materials, products, and equipment incorporated in the Work are in compliance with the Contract Documents.

E. CONTROL OF ON-SITE AND OFF-SITE CONSTRUCTION: Contractor's Quality Control system shall include the following phases of control and management for all activities including:

1. Pre-installation Meetings.
2. In-Progress Inspection Phase: In-progress inspections shall be performed continuously to verify that quality standards are maintained throughout the Project. Adjustment to control procedures and CQC Plans may be required based upon the results of these inspections and control testing. Report the results of the inspection in the daily QC Report. Discuss quality control procedures at construction progress meetings and revise CQC Plans for Owner’s records, if changes are required.
3. Above Ceiling Inspections: The Contractor shall identify and provide reasonable time: a) for the Owner to conduct above-ceiling final inspections, b) for the Contractor to perform corrective work, and c) for the Owner’s consultants to validate the work complete prior to covering from sight. Provide a two (2)-week notice for final inspections.
4. Off-Site Construction: Requirements for inspections of off-site construction activities are specified in individual equipment specifications. The CQC plan shall include specified inspections of off-site construction activities.
5. Final Punch List Report: The CQC Representative shall thoroughly inspect all aspects of the construction, including the Subcontractor’s work, and produce a Final Punch List Report of incomplete work and/or work requiring correction. Issue the list to all Subcontractors and complete all items prior to requesting Final Inspection. The Contractor’s request for Final Inspection shall certify that all features of the work are installed and reviewed by the Contractor to determine compliance with the Contract Documents and shall include the Final Punch List Report listing any incidental incomplete work. The Final Punch List Report shall be in a format acceptable to the Owner, with a comprehensive room number list and additional entry listings for site work, building enclosure, roofs, etc., to document the entire Project. Owner’s Final Inspections items will be added to the Final Punch List Report

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by the Contractor. Manage the consolidated list of comments daily until all comments are signed-off by the Owner.

6. Final Inspection: In accordance with Section 01 77 00.
7. Re-inspection: In accordance with Section 01 77 00.
8. Substantial Completion: In accordance with Section 01 77 00.
9. Final Completion: In accordance with Section 01 77 00.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 45 23

TESTING AND INSPECTING SERVICES

PART 1 - GENERAL

1.01. SUMMARY

A. GENERAL REQUIREMENTS: Comply with the testing and inspection and correction of nonconforming work provisions herein specified in this Section and elsewhere in the Contract Documents.

B. OWNER'S RESPONSIBILITIES:

1. The Owner will select and employ an independent Testing Agency to conduct the tests and Special Inspections required by the Building Code, in accordance with applicable standard methods of American Society for Testing and Materials (ASTM) or other standards specified by the local governing authorities having jurisdiction (AHJ) as a requirement of the building permit.
2. The Owner may require other inspection services to inspect and verify the Work installed is in accordance with the Contract Documents and construction industry standards.

C. CONTRACTOR’S RESPONSIBILITIES:

1. Scheduling and coordination of the Owner’s Independent Testing Agency.
2. The Contractor shall provide and pay for other inspection and testing services where specified in the Contract Documents or required to obtain regulatory approval by State or other AHJ.

1.02. DESCRIPTION

A. DEFINITION: For the purpose of this section, all references made herein to Testing Agency or special inspector shall be referred to as those tests or inspections that will be conducted by an inspector provided by the Owner.

1.03. QUALITY ASSURANCE

A. QUALIFICATIONS: The inspector for all Work as hereinafter specified; shall be a registered special inspector employed by an approved inspection and/or Testing Agency as listed by the WABO Special Inspection Registration Program. All inspection personnel

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used on this Project are subject to being disapproved from the Project at the discretion of the Owner. The inspector must comply with the minimum levels of qualifications as stated in the WABO Special Inspection Registration Program for various portions of the required inspections and testing.

1.04. DUTIES OF OWNER'S TESTING AGENCY

A. GENERAL: The Owner's Testing Agency will conduct testing and inspection services, interpret them, and evaluate the results for compliance with the building permit, the site development permit, and the Contract Documents; agency will report findings to the Owner, Contractor, and AHJ. Testing and inspection services shall be in accordance with applicable standard methods of ASTM or other standards specified by AHJ, the Contract Documents, and construction industry standards. The Testing Agency will reasonably support overtime, second shift, and out-of-area activity if requested by the Contractor and approved at the Owner's sole discretion.

B. TESTING AND INSPECTION: Materials to be tested are specified by the building permit and as required by the Contract Documents, as directed by Owner, or required by AHJ. Quantities and extent of tests and inspections shall be as specified and/or required by the Owner's Inspector or AHJ.

C. NON-CONFORMING WORK: The Owner's Inspector shall document and immediately notify the Contractor and Owner of any Work found defective or not in accordance with the requirements of the Contract Documents. Non-conforming Work shall be corrected or otherwise satisfactorily accepted by the Owner. See "Non- conformance Report" (NCR) in Section 01 31 00.

D. The Owner's inspectors are not authorized to do the following:

1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Approve or accept any portion of the Work, except as allowed by the special inspection duties delegated by governing AHJ for building permit inspections and testing.
3. Perform any duties of the Contractor.
4. Stop Work.

1.05. COSTS

A. The Owner's Testing Agency and special Inspector costs for initial testing and inspection as specified in the Contract Documents will be paid for by the Owner. Initial tests and

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inspections are defined as those required to complete the first tests and inspections specified.

B. Additional tests and inspections not herein specified, but requested by the Owner, shall be paid for by the Owner. However, if the results of such tests or inspections are found to be not in compliance with Contract Documents, the Contractor will be back charged for all costs for initial testing as well as re-testing, re-inspection, and Owner's Consultants services.

C. Costs for additional tests or inspections required because of Contractor changes to reviewed and accepted products or materials provided, or source, or supply shall be borne by the Contractor.

D. Costs for any Work that is required to correct any deficiencies shall be borne by the Contractor.

E. Costs of any testing that is required solely for the convenience of Contractor in its scheduling and performance of the Work shall be borne by the Contractor.

F. Costs for verification testing of Work done without prior notice, with improper supervision, or contrary to construction practice shall be borne by the Contractor.

G. Costs for testing of materials for which fabrication and mill reports are required, but not furnished, shall be borne by the Contractor.

1.06. TESTS AND INSPECTION REPORTS

A. Copies of Owner and Contractor test and inspection reports shall be distributed at weekly intervals. All reports will be signed by a Washington Association of Building Officials certified special inspector or Professional Engineer registered in the State or Washington, as appropriate. Such reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory. Samples taken but not tested shall also be reported. Records of special sampling operations that are required shall also be reported. Test and inspection reports shall be electronically posted and distributed through the EICMS as follows:

1. Owner.
2. Owner’s Testing Agency.
3. Contractor.
4. Authority Having Jurisdiction—two (2) copies.

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1.07. CONTRACTOR'S RESPONSIBILITIES

A. COORDINATION: It is the Contractor's responsibility to initiate, coordinate, and conform to the required tests and inspections of governing State and AHJ. Inspection of the Work by the Owner's special Inspectors and/or Testing Agency shall not relieve the Contractor from responsibility for compliance with the Contract Documents requirements. Owner's special Inspectors and/or Testing Agency and Owner shall have authority to reject Work whenever there is a failure to comply with the provisions of the Contract Documents and the Contractor shall instruct their employees accordingly.

B. ACCESS FOR THE PURPOSE OF INSPECTION: Ensure the Owner's special Inspectors and/or Testing Agency have free access to all parts of the Work and to the shops where the Work is in preparation; are provided proper facilities and safe access for such inspection; and are reasonably furnished access, equipment, tools, samples, certifications, test reports, design mixes, storage, and assistance as requested by the Owner's Inspector.

C. STORAGE FACILITIES: Furnish adequate storage facilities as approved by the Owner for the sole use of the Owner's Testing Agency for safe storage and curing of such specimens that must remain on the site prior to transport to the laboratory.

D. DATA: Furnish records, Contract Drawings and shop drawings, certificates, approved Change Orders, and similar data as required by Owner's Inspectors to perform their work to assure compliance with the Contract Documents.

E. NOTICE: Furnish notice to Owner and coordinate with Owner's Inspectors a minimum of five (5) working days in advance of all required tests and a minimum of 48 hours in advance of all required inspections, unless otherwise specified.

F. NON-CONFORMING WORK: Remove and replace Non-conforming Work at no additional cost to the Owner prior to Final Completion. Where Non-conforming Work requires design modifications, such re-design shall be performed by the Engineer of Record and costs shall be borne by the Contractor.

G. CANCELLATIONS: Contractor shall give sufficient advance notice to Owner and Inspectors to allow rescheduling of their work load in the event of cancellation or time extension of any scheduled test or inspection. Any charges from an Inspector due to insufficient advance notice of cancellations or time extensions shall be borne by the Contractor, at the Owner's discretion.

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1.08. TEST FAILURES

A. GENERAL: The Owner may require re-test of a sampled material when a sample or procedure has failed to pass the required tests. In such cases, two (2) samples shall be tested and the material shall be rejected if either sample fails. In the event any test or inspection indicates failure of a material or procedure to meet requirements of Contract Documents, all costs for re-testing or re-inspection shall be borne by the Contractor.

1.09. REPORTING TEST FAILURES

A. GENERAL: Immediately upon determination of a test failure, the Owner's Inspector shall telephone the test results to the Owner and Contractor. By the end of the following day, the Owner's Inspector shall send written test results to those named on the distribution list.

B. Contractor shall similarly report test failures to Owner resulting from work of testing agencies provided by the Contractor.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01. DESCRIPTION OF REQUIREMENTS

A. Minimum temporary facilities and controls requirements are specified in this section. Nothing in this section is intended to limit types and amounts of temporary Work and no omission from this Section will be recognized as an indication that such temporary Work is not required for successful completion of the Project and compliance with the Contract Documents.

B. This Section includes the following items:

1. Work area.
2. Protection of existing utilities.
3. Shutdowns of existing equipment and utilities.
4. Vegetation protection.
5. Temporary facilities including temporary power.
6. Temporary enclosures.
7. Project Signboard.

C. BEHAVIOR:

1. The Owner tolerates no unlawful, dangerous, or inappropriate behavior by any worker. Owner reserves the right, in its sole discretion, to dismiss and bar any personnel who act in violation of this Section. Contractor shall be responsible for replacing any dismissed personnel at no additional cost to the Owner.
2. The Contractor shall not allow obscene, offensive, or otherwise inappropriate material to be displayed on the project site.
3. Workers not allowed to live on site.

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1.02. WORK AREA

A. Confine Work to the designated work area. Maintain the work area in a clean and orderly manner.

B. SECURITY:

1. GENERAL:

a. Protect Work and stored products from theft and vandalism and protect premises from entry by unauthorized persons. At the end of work day, close temporary enclosures and lock exterior doors and/or gate. Secure all openings at any time site is left unoccupied.

b. Contractor shall use due care to maintain an equivalent level of security of Owner's property, where appropriate and as it normally exists (i.e., secure areas when not actively working, etc.). Normally locked doors shall not be propped open.

c. Contractor is advised to lock its gang boxes and secure them to the construction. Owner will not reimburse Contractor for any lost or stolen tools, material, or equipment.

C. WASTE MANAGEMENT:

1. The Contractor is responsible for general Project clean up and waste disposal during construction. Construction waste management and disposal per Section 01 74 19.

D. ODOR CONTROL:

1. GENERAL: The use of solvents and materials producing noxious fumes or any product or equipment that impacts air quality shall be subject to the approval of the Owner. Contractor shall submit a written procedure for the control of emissions prior to any use. Isolate odor causing work away from building air intakes, private properties, and pedestrian traffic areas. Vent to outside areas where solvents are used within enclosed structures.

2. EMISSIONS CONTROL PLAN: The plan shall consist of at a minimum the following items:

a. Products to be used (MSDS sheets).

b. Location of Work.

c. Application.

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d. Ventilation plan.

e. Hours of operation/use.

f. Material handling/storage.

3. Considerations shall include, but not be limited to:

a. Concrete curing.

b. Roofing and waterproofing.

c. Welding.

d. Exterior painting.

e. Asbestos abatement.

f. Soil remediation.

g. Demolition and installation of digester gas and natural gas pipe.

E. SMOKING: The Contractor shall not permit its employees or the employees of its subcontractors of any tier to smoke on the job site, except in designated areas.

1. If the site of the Work includes a construction fenced area, the Contractor shall establish an outside area within the fenced area where its employees and the employees of its subcontractors of any tier may smoke; provided that the area is in compliance with the requirements of Chapter 70.160 RCW. The Contractor shall communicate the location of the permitted smoking area to its employees and subcontractors and shall require subcontractors of any tier to communicate the location of the smoking area to its employees.

1.03. PROTECTION OF EXISTING UTILITIES

A. The existing concealed utilities shown on the drawings are not necessarily exact with respect to location or completeness; therefore, Contractor shall take the following steps:

1. Notify Owner in writing, with a minimum of two (2) weeks' notice for each occasion, of the intent to work near existing known underground utility services or structures or when a new excavation operation is about to begin. Submit procedure for approval to assure safe and continuous operation of the services.

2. Proceed with sufficient caution to preclude damaging any known utilities (i.e., hand digging or probing). In the event unidentified utilities are encountered, notify Owner immediately.

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3. In the event utilities are damaged during construction, temporary services and/or repairs must be made immediately to maintain continuity of services. Damaged utilities, shown on Drawings and/or installed by the Contractor, shall be repaired at the Contractor's sole expense.

1.04. SHUTDOWNS OF EXISTING EQUIPMENT AND UTILITY SERVICES

A. It is critical that all Plant systems remain operational throughout the duration of the Project, except for brief shutdowns. Equipment, process system, or utility shutdowns required to facilitate the Work at the existing Plant shall be accomplished in accordance with the following requirements:

1. Submit a schedule of equipment and utility shutdowns per Section 01 32 16.
2. Coordinate shutdown notification and procedure with Section 01 12 16.
3. The actual time and date of all shutdowns will be subject to approval of the Owner. Shutdowns will normally be scheduled for low flow periods.
4. The duration of all shutdowns shall be held to a reasonable minimum as determined by Owner.
5. Materials and equipment required for the Work to be accomplished during shutdown shall be complete and available on the job for review by Owner three (3) days prior to the shutdown, if requested. If Contractor is not adequately prepared, the shutdown will be canceled and rescheduled.
6. Only Owner's personnel will shut down and restart equipment and utilities. Owner will inspect the installation prior to restarting and will not restart if an unsafe condition exists. In the event Contractor's work is not completed during the time scheduled for the shutdown, Owner may elect to restart the equipment or utility service; any cost or resulting delays are to be borne by the Contractor. In that event, additional shutdown requirements shall be rescheduled in accordance with the preceding requirements. Restarting shall not be construed as acceptance of the Work as complete.
7. Include in the subcontractor bids all costs associated with equipment and utility shutdowns. Owner will make no extra payment for overtime work, schedule changes, or failure to complete utility connections within authorized shutdown periods.

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1.05. VEGETATION PROTECTION

A. DEFINITIONS:

1. Consulting Arborist: A Consulting Arborist registered with the American Society of Consulting Arborists (ASCA).
2. Certified Arborist: Certified by The International Society of Arboriculture (ISA).

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting at all times.

C. Where new finish grade is indicated below existing grade around trees, slope grade beyond tree protection zones. Maintain existing grades within tree protection zones; slope away as recommended by arborist.

D. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots with sharp pruning instruments; do not break or chop.

E. MINOR FILL: Where existing grade is six (6) inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

F. MODERATE FILL: Where existing grade is more than six (6) inches but less than twelve (12) inches below elevation of finish grade, place drainage fill, filter fabric, and topsoil on existing grade as follows:

1. Carefully place drainage fill against tree trunk approximately two (2) inches above elevation of finish grade and extend not less than eighteen (18) inches from tree trunk on all sides. For balance of area within drip-line perimeter, place drainage fill up to six (6) inches below elevation of grade.
2. Place filter fabric with edges overlapping six (6) inches minimum.
3. Place fill layer of topsoil to finish grade. Do not compact drainage fill or topsoil. Hand grade to required finish elevations.

G. TREE PRUNING:

1. Prune trees according to ANSI A300 (Part 1) as follows:
   a. Type of Pruning: Cleaning and Thinning.
   b. Specialty Pruning: Restoration or Vista.

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2. Prune trees affected by temporary and permanent construction.
3. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
4. Cut branches with sharp pruning instruments; do not break or chop.

1.06. TEMPORARY FACILITIES

A. The types of temporary support facilities required include, but not by way of limitation, field offices, storage sheds, general muster/lunch areas, sanitary facilities, drinking water, first aid facilities, bulletin board, telephones, clocks, thermometer, Project identification signs, clean up facilities, waste disposal service, and similar miscellaneous general services, all as may be reasonably required for proficient management and performance of the Work and accommodation of personnel at the site including Owner's and Engineer's personnel. Locate temporary support facilities for convenience of users and for minimum interference with construction activities. All placement shall be subject to review and approval by the Owner.

B. Remove all temporary facilities, such as water lines, gas lines, electric conduit and transformers, shoring, crane base and hoist foundation construction, etc., unless indicated otherwise in the Contract Documents. Restore site to original or new conditions, patching and filling as required to match adjacent surfaces.

C. ELECTRICAL POWER AND SERVICE: Coordinate the need and pay for all electric power and service with the local public utility. Contractor shall pay for, provide, and install all necessary equipment for the installation and removal of temporary power as required for Project, Owner, and public utility. Install and maintain temporary power in accordance with all applicable safety regulations and the direction of the Owner.

1. Contractor shall pay for, provide, and install all necessary equipment for the installation and removal of temporary power as required by the Project and Owner. Install and maintain temporary equipment in accordance with applicable safety regulations and the direction of the Owner and Puget Sound Energy.

D. LIGHTING: Provide and maintain security lighting as appropriate to provide general illumination of work area during nighttime hours. Provide general illumination of work area for all trades.

E. HEAT: Provide temporary heat as required to protect materials and equipment from dampness and cold. Method of heating is subject to approval of Owner.

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F. WATER:

1. Non-potable water for construction purposes may be sourced from onsite water hydrants. The Contractor shall install and operate a Reduced Pressure Backflow Assembly (RPBA) at the connection to the fire hydrant as well as an air gap system downstream of the RPBA when connecting to an onsite hydrant or other potable water source.
2. Provide drinking water from a proven safe source for all those connected with the Work. Transport water in such a manner as to keep it clean and fresh. As required, provide service in single service containers or sanitary drinking fountains.

G. TOILET FACILITIES: As required, provide self-contained single-occupant toilet units of the chemical, aerated circulation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material. Sanitary waste material shall be regularly pumped out and the chemicals recharged. Toilet paper and paper towels shall be furnished for each toilet facility.

H. COMMUNICATION SERVICES: The Contractor is to provide both local and long distance telephone phone services at the construction field office(s). The Contractors field staff must carry a cellular phone for external and team communications. In addition, the Contractor is to provide a radio communication system for internal communications. Contractor is to provide and pay for installation and all telephone, cellular phone, and radio services and charges.

I. COMPUTER SERVICES: Provide computers and commercial-grade broadband internet access, either DSL or cable, to perform Contract required services.

1. Provide for 24-hour technical support and a local or 1-800 phone number to troubleshoot and maintain the broadband connectivity.
2. If needed, provide inside wiring to support a Local Area Network inside the field offices and meeting room.

J. CONSERVATION: In compliance with Owner's policy on energy/materials conservation, install and operate temporary facilities and perform construction activities in manner that will be reasonably conservative and avoid waste of energy and materials including water.

K. CONTRACTOR'S FIELD OFFICE(S): Contractor is responsible for providing, equipping, maintaining, and removing upon Final Completion of the Work, field office(s), appropriate for and sufficient to meet the needs of Contractor's staff as specified in the

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General Conditions. Type and location of field offices shall be subject to review by the Owner to assess adequacy to accommodate services required by Contract.

L. CRANE(S) AND HOISTING: Provide crane(s) and hoisting including all tower cranes, mobile cranes, forklifts, and specialized lifting apparatus and temporary base construction, as required for the Work.

M. ELEVATOR OPERATIONS AND PERSONNEL HOISTS: Provide elevator operation and personnel hoists including all temporary and permanent elevator operations.

N. CONTRACTOR STAFF VEHICLES AND SITE PERSONNEL TRANSPORTATION: Provide staff vehicles and site transportation such as, but not limited to, trucks, cars, and ATVs. Pay all transportation and maintenance costs.

O. Staging and storing of equipment and materials by the Contractor shall be limited to the staging areas shown on the Drawings and as directed by the Owner. The Contractor shall be responsible for off site work and storage space deemed necessary for execution of the Work.

1.07. TEMPORARY ENCLOSURES

A. BARRIERS, SAFETY GUARDS AND WARNINGS: Provide for public protection as required by law and ordinance. Temporary barriers that obstruct exit paths from occupied areas shall not be installed unless approved by Owner. Keep streets and walks clean and free from obstructions.

1. Provide temporary construction to protect Work. Furnish, install, and maintain for the duration of construction all required site security fencing, tarpaulins, barricades, barriers, canopies, warning signs, steps, bridges, platforms, and other temporary construction necessary for proper completion of the Work. Comply with all pertinent safety and other regulations.

a. Egress Signage: Provide and install temporary exit signs, as needed, to insure a clear direction or emergency exit travel during construction. Review the temporary exiting routes and signage design and location with Owner.

b. Other Signage: Provide informational signs and any other sign required by authorities having jurisdiction (AHJ) to identify Project.

2. Provide one (1)-hour fire rated barriers of sheet rock and metal studs with taped joints where shown on the Drawings or when removing and/or compromising existing fire safety partitions indicated on the drawings, such as corridor wall and/or occupancy separations, to isolate the construction area for Work at the existing

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Plant. Remove and repair finishes to match existing at completion of Work. Fire Safety during construction, alteration, or demolition must be provided as indicated by the current edition of the International Fire Code. Combustible materials shall not be used as barriers.

3. Barriers within existing Plant must enclose entire work area and completely isolate it from surrounding areas unless otherwise approved by Owner. They are to be one (1) layer of sheet rock on metal studs with taped joints sealed with caulk at all connection points. Barriers must be constructed smoke tight and may be constructed of non-combustible or limited-combustible materials, when approved by the Owner. Barriers must be provided above the suspended ceiling to the structure above, unless ceilings are not disturbed, in which case, the seal may occur at the ceiling tile. Ceiling tiles damaged by Contractor shall be replaced with equivalent undamaged tiles prior to removal of the barrier. Repair finishes to match existing at completion of work. Under certain conditions, and when approved by the Owner, barriers within the occupied building areas may be constructed out of the following materials:

   a. For work sites to be completed within one (1) shift or with little anticipated noise and no "hot work" or above ceiling barriers or ceiling work outside of contained workspace: six (6)-mil fire-retardant (Rexam StarTex or Approved Equal) visqueen with zipper openings. Use appropriate mini-enclosure for all ceiling work outside of contained workspace. All ceiling panels moved by Contractor must be placed back into position before mini-enclosure is removed. All joints and other connection points are to be sealed with smooth surface vinyl tape.

   b. For all others, except fire rated barriers: Barriers below suspended ceilings shall be minimum 1/4-inch thick, plastic-coated, low VOC, fire treated melamine panels. All joints and other connection points are to be sealed with smooth surface vinyl tape.

   c. Barrier doors are to be self-closing and fitted with gaskets or other material to restrict closing noise and airflow.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 55 00

TRAFFIC CONTROL, SITE ACCESS, AND PARKING

PART 1 - GENERAL

1.01. DESCRIPTION

A. Work specified in this section includes providing for the safe and expeditious movement of vehicular traffic on the project site, streets, and internal roadways affected by the Project.

1.02. REFERENCES

A. This Section incorporates by reference the latest revision of the documents listed at the end of this subsection. They are a part of this section as specified and modified herein. In case of conflict between the requirements of this section and 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
MUTCD	US Department of Transportation Manual on Uniform Traffic Control Devices (MUTCD), 2023 Edition
WSDOT Standard Specifications	Washington State Department of Transportation (WSDOT), Standard Specifications for Road, Bridge and Municipal Construction, 2024 Edition

1.03. SUBMITTALS

A. PROCEDURES: Section 01 33 00.

1. Prepare and submit traffic control plans for all work within Owner Properties, including the Plant site(s).

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1.04. TRAFFIC CONTROL PLAN

A. The existing treatment plant and associated facilities and utilities (Plant) will remain in operation throughout the duration of this Contract. The traffic control plans prepared by the Contractor are to:

1. Maintain access for plant vehicles to all treatment process units at all times.
2. Identify the traffic control measures that the Contractor will use to maintain traffic flow within the plant site.
3. Maintain road access to all other activities on Lakehaven properties, including but not limited to public access areas, special events, and landscape and utility maintenance.
4. Maintain emergency vehicle access at all times.

1.05. SITE ACCESS

A. Site Access Requirements: Provide erosion and sediment control features at transitions from disturbed areas to paved areas at the construction access point in accordance with Section 01 57 13.

B. Regularly sweep all sidewalks and paved streets, and apply water to unpaved roads affected by the Work as needed to comply with sediment and dust control requirements. Provide, install, maintain and remove any temporary work surfaces, temporary roadways, platforms, timber mats, or similar equipment or materials needed to perform the Work.

1.06. PARKING

A. Park only in designated areas approved by the Owner.

B. Parking of commuting and work vehicles shall be limited to the parking and staging areas shown on the drawings and as directed by the Owner. All vehicles shall be parked in such a manner as to allow ready access to the site by emergency vehicles and maintain Owner access for operation of the WWTP. The Contractor shall be responsible for control of parking by all Contractor's and subcontractor's work force to assure compliance. The Contractor shall anticipate that there will not be sufficient parking space for all the work force and shall arrange for carpooling and/or off-site shuttling, as necessary.

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PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.01. GENERAL

A. Comply with the applicable provisions of WSDOT Standard Specifications Section 1-10 and the supplements stated herein.

B. The location of traffic control signing, barricades and other facilities, especially the location of the delineators, shall be checked daily to verify their proper location. All traffic signal and other traffic control devices shall be maintained at all times.

C. Notify the City of Des Moines of planned work and street closures at least ten (10) working days in advance. Any revisions to the schedule or scope of the planned work and street closures shall be subject to at least ten (10) working days prior notice.

D. Notify the Owner, and the Police, Fire and Traffic Departments with jurisdiction over the Work, daily of each work activity related to the Project and at least 48 hours prior to full roadway closures, re-openings, or partial obstruction of public rights of way. Additionally, the Contractor shall give the Police, Fire, and Public Works Departments telephone numbers where the Contractor may be reached at all hours in the event of an emergency involving the Work.

E. Should Contractor's warning and protective measures not meet the requirements above, the Owner may notify Contractor, who shall promptly supply appropriate warning and protective measures at its own expense.

F. Should the Contractor fail to provide and maintain adequate and suitable traffic control and related safety measures when ordered to do so by the Owner, the Owner shall provide traffic control at the cost of the Contractor as outlined the General Conditions.

G. Speed limits within the plant are ten (10) miles per hour. Inform subcontractors of the limits and the importance of strict adherence to all traffic regulations; repeat this information at regular safety and subcontractor coordination meetings.

END OF SECTION

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SECTION 01 61 45

AREA EXPOSURE DESIGNATIONS

PART 1 - GENERAL

1.01. DESCRIPTION

A. SCOPE: This section designates area exposure types.

B. EXPOSURE TYPE: Included as a supplement to this Section, the Area Exposure Table designates an Exposure Type for each room or area. Each Exposure Type, listed from least to most severe, is defined as follows:

1. Indoor Dry: Locations inside a building or other enclosed structure not subjected to wash down and/or not in contact with a liquid holding or earth retaining wall.
2. Indoor Wet: Locations inside a building or structure that is typically dry or damp and subject to wash down or walls or ceiling surfaces that are common with a liquid holding or earth retaining wall or slab.
3. Outdoor: Locations not protected from the weather in any way. Local weather conditions vary between 30% to 100% relative humidity and 0 to 100 degrees Fahrenheit with an annual rainfall of about thirty-six (36) inches.
4. Buried: Below grade wall or roofs; locations covered and in contact with earth/soil.
5. Submerged: Locations inside a covered liquid or solids holding structure that are not a head space; locations inside an open liquid or solids holding structure that are below the top of wall.
6. Process Corrosive: Locations exposed to high humidity, frequent wash down, and/or corrosive gases.
7. Head Space: Locations inside a covered liquid or solids holding structure that are above a plane located one (1)-foot below the minimum operating level.
8. Chemical Corrosive: Walls, ceilings, floors, trenches, and other surfaces exposed to delivery, storage, transfer, use, or containment of corrosive chemicals.

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C. ENVIRONMENTAL CONDITIONS: Environmental conditions for each Exposure Type are tabulated below:

Exposure Type	Environment	Chemical Exposure	Chemical Concentration
Indoor Dry	Atmospheric, Dry	None	Not Applicable
Indoor Wet	Atmospheric, Wet	None	Not Applicable
Outdoor	Atmospheric, Wet	None	Not Applicable
Process Corrosive	Atmospheric	Hydrogen Sulfide Chlorine Trace Chemicals	1 – 10 ppm Dilute Dilute
Head Space	Low Oxygen, Wet	Hydrogen Sulfide Other Trace Gases	10 – 1500 ppm Dilute

D. AREA EXPOSURE TYPE:

1. Construction materials and coating systems shall be as specified in the individual equipment / material specifications for the Exposure Type assigned in the Area Exposure Table. In the event of a conflict between the individual equipment / materials specification and the Area Exposure Table, the requirements specified in the individual equipment / materials specifications govern. In the event an Exposure Type is not designated, the most severe Exposure Type present in the room or area governs.
2. Components assigned multiple exposure conditions shall have their material and coating selected to comply with the most severe condition. When components cross, span, or straddle the boundary separating two (2) or more exposure types, materials shall comply with the most severe Exposure Type. Where materials change at a boundary between exposure types, the change in materials shall occur at the boundary or within the less severe Exposure Type. At material transitions, separate dissimilar metals by a dielectric coupling or barrier.

NOTE: Environmental exposures specific to this project are listed in the table that follows this Section.

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PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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ENVIRONMENTAL EXPOSURES

PROJECT TITLE: Redondo WWTP Primary and Secondary Clarifier Rehabilitation Project

PROJECT NO.: _____

ROOM NUMBER		ROOM NAME/DESCRIPTION	EXPOSURE TYPE	NOTES
AREA	SITE	GENERAL WWTP SITE		
None	Redondo	Primary Clarifiers Buildings	Indoor Wet and Headspace	Class 1 Div 1 Group D rated space.
None	Redondo	Secondary Clarifiers Building	Indoor Wet	Non-classified space.
None	Redondo	Primary Pump Room	Subgrade, Indoor	Class 1 Div 2 Group D rated space.
None	Redondo	Secondary Pump Room	Subgrade, Indoor	Non-classified space.

SECTION 01 66 00

SHIPMENT, PROTECTION, AND STORAGE

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies general requirements for the shipment, protection, and storage of equipment and materials. This Section supplements manufacturer recommendations and other requirements found elsewhere in the Contract Documents.

1.02. CARE

A. Ship, handle, and store equipment and materials to prevent damage.

B. Damaged items will not be permitted as part of the Work except in cases of minor damage that have been satisfactorily repaired and accepted in writing by the Owner.

C. Properly maintain stored equipment and materials.

1.03. TRANSPORTATION

A. Protect against damage from moisture, dust, handling, or other cause during transport from factory to site.

B. Furnish products in the manufacturer's original sealed container or other packaging system complete with labels, MSDS, and instructions for handling, storing, unpacking, protecting, and installing.

C. Mark each item or package with the number unique to the Specification Section covering the item.

D. Use stiffeners, where necessary, to maintain shape and to provide rigidity.

E. Deliver parts of equipment in assembled or sub-assembled units where possible.

F. Wrap or seal bearing housings, vents, and other openings to prevent contamination by grit and dirt. Tape ventilation openings closed.

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G. Correct damage to conform to the requirements of the Contract Documents before the assembly is incorporated into the Work.

H. Pay costs arising from dismantling, inspection, repair, and reassembly.

1.04. SPECIAL MONITORING

A. Where special monitoring is specified in individual equipment specifications, affix a recording accelerometer to each separately packed assembly or packing crate and record the magnitude of sudden impacts in three directions (X, Y, Z) on continuous strip charts with both time and "g" force scale.

B. Upon arrival, immediately notify the Owner; remove the accelerometer in the presence of the Owner.

C. If the magnitude of the maximum acceleration exceeds 3.0 g, dismantle, inspect, and test the assembly or subassembly for damage.

D. Correct all damage to the complete satisfaction of the Owner before the assembly is incorporated into the Work.

E. Pay all costs arising out of dismantling, inspection, testing, repair, and reassembly, even if no damage is found.

1.05. INSPECTION

A. When items are delivered to the site, remove all coverings, containers, or crates and permit the Owner to inspect and determine if the items are of the specified quality and in good order and condition. Should the Owner find evidence of damage or deficient quality, provide the necessary documentation or conduct such tests to demonstrate compliance with the Contract Documents.

1.06. STORAGE, HANDLING, AND PROTECTION

A. Handle and store equipment and materials in a manner to prevent damage, deterioration, and soiling and in accordance with manufacturer's instructions.

B. During the interval between the delivery of equipment to the site and installation, store all equipment in an enclosed space affording protection from weather, dust, and mechanical damage and providing favorable temperature, humidity, and ventilation conditions to ensure against equipment deterioration.

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C. Place materials at least six (6) inches above ground if stored outdoors.

D. Provide temporary power to energize space heaters or other heat sources for control of moisture condensation. Energize space heaters or other heat sources without disturbing the sealed enclosure.

E. Store packaged or bundled products in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in the Work.

F. Store cementitious materials in a dry place clear of earth or concrete floors and away from walls.

G. Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

H. Store sheet materials on flat, solid supports and keep clear of ground. Slope to shed moisture.

I. Store pipes with paint, tape coatings, linings, or the like to protect the coating or lining from physical damage or other deterioration. Remove bracing from pipes shipped with interior bracing only when recommended by the manufacturer.

J. Store and mix paints in a heated and ventilated room; prevent from freezing. Remove oily rags and other combustible debris daily. Prevent spontaneous combustion.

K. Maintain stored rotating equipment per the manufacturer's instructions. Provide manufacturer's maintenance instructions a minimum of two (2) weeks before receiving the equipment on site. Maintain detailed records confirming rotating equipment maintenance complies with all requirements.

L. Replace damaged products at own expense and to the Owner’s satisfaction.

1.07. COATINGS

A. Ship each item of equipment to the site with the manufacturer's shop applied prime coating as specified in Section 44 42 24.01.

1.08. PROTECTION OF EQUIPMENT AFTER INSTALLATION

A. Protect equipment against damage from, but not limited to, dust, abrasive particles, debris, and dirt generated by sandblasting, cutting, finishing, and grinding of concrete,

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terrazzo, and metal and from the fumes, particulate matter, and splatter from welding, brazing, and painting.

B. As a minimum, provide vacuum cleaning, blowers with filters, protective shielding, and other dust suppression methods at all times to adequately protect all equipment.

C. During concrete installation, including finishing, equipment that may be affected by dust must be completely covered.

D. During painting operations, cover grease fittings and similar openings to prevent the entry of paint.

E. Do not install electrical switchgear, unit substations, and motor control centers until after completing concrete work and sandblasting in those areas.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 71 23

FIELD ENGINEERING

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies field engineering administrative and procedural requirements for the Contractor to employ a registered Structural Engineer and Land Surveyor.

1.02. QUALITY ASSURANCE

A. The Contractor shall employ a registered Structural Engineer (Contractor's Structural Engineer) experienced in construction techniques and sequences and temporary structural support systems, who is licensed in the State of Washington.

B. The Contractor shall employ a registered Land Surveyor (Contractor's Surveyor) who is registered in the State of Washington, and acceptable to Owner, to perform survey work of this Section.

C. Submit the name, address, and telephone numbers of the Contractor's Structural Engineer and Land Surveyor for Owner's records. as Also submit the Surveyor's certificate of insurance for Surveyor's Errors and Omissions policy and general liability policy as required in the General Conditions, prior to their performance of Work.

1.03. CONTRACTOR'S STRUCTURAL ENGINEER

A. The Contractor's Structural Engineer shall advise the Contractor as to the safety and adequacy of all temporary structural provisions necessary for cranes and hoisting, erection, and/or alteration of the building structure and shall assume the responsibilities and duties as it relates to means and methods (i.e., erection sequence, temporary bracing, cutting, etc.).

1. Temporary bracing shall be coordinated with other trades to permit continuous operation of construction.
2. Should it be necessary to modify the structural design to accommodate construction means and methods, the Structural Engineer shall advise the Contractor who shall immediately notify the Owner and await their direction.

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3. Proposed changes or modifications to the structural design shall be submitted to the Owner for approval prior to the Contractor incorporating changes or modifications into the Work.

1.04. PROJECT SURVEY REQUIREMENTS

A. Conform to all survey requirements outlined in the General Conditions.

B. Before proceeding with layout of actual Work, the Contractor, working through the Contractor's Surveyor, shall verify the layout information shown on Contract Documents.

C. As Work proceeds, the Contractor shall check every major element for line, level, and plumb and shall require the Contractor's Surveyor to maintain a complete and accurate record book log of control of such checks. Upon request, Contractor shall make this log of control available for the Owner's reference.

1. Record deviations from required lines and levels and promptly advise the Owner upon detection of any discrepancies including, but not limited to, conflicts, errors, inconsistencies, or deviations that exceed the Contract specified or indicated or industry recognized tolerances.
2. If discrepancies are found, no work shall be done until the Owner has been so notified and has provided the Contractor with written direction and/or drawings that correct and clarify the discrepancy.
3. All Work that is determined to be incorrectly located will be rejected by the Owner. Any additional corrective work caused by discrepancies that should reasonably have been known to the Contractor, and were not called to the attention of the Owner, shall be borne at the Contractor's expense.

D. Protect Owner's benchmarks and survey control points prior to starting site work and preserve during construction. Do not change or relocate benchmarks or control points without Owner's written approval. Promptly report lost or destroyed benchmarks or control points.

E. Monuments located within the public rights-of-way that are removed, disturbed, or destroyed by the Contractor's operations shall be replaced by the Contractor with a standard monument adopted by the governing jurisdiction. All other disrupted monuments or property corners shall be replaced as required by the Owner or the governing jurisdiction.

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F. Pursuant to RCW 58.24.040 (8) and WAC 332-120, no survey monument shall be removed or destroyed before a permit is obtained from the Department of Natural Resources. The Contractor's surveyor shall establish reference points as necessary to replace all removed or destroyed monuments resulting from the Contractor's operations within public rights-of-way and it is the Contractor's responsibility to preserve these reference points during construction. Monument restoration shall be in accordance with the latest adopted standards or as required by the governing jurisdiction.

1.05. PROJECT RECORD SURVEY

A. Contractor working through the Contractor's Surveyor shall perform the following:

1. Upon completion of new foundation walls, prepare and submit a certified survey showing that dimensions, elevations, angles, and location of the building are in accordance with the Contract Documents.
2. Upon completion of the below grade Site Work, certify that the record Site Survey represents the actual dimensions, elevations, lines, grades, and levels, including invert elevations, constructed in the field for all below grade installations and existing services located during the Work referenced to Owner's benchmarks. This shall include the locations of all below grade Site improvements including, but not limited to, civil, electrical, and mechanical services; utility tunnels; duct banks and vaults; and irrigation system.
3. Submit the above documentation under the provisions of Section 01 78 39.

1.06. PROJECT LAYOUT REQUIREMENTS

A. The Contractor shall be responsible for laying out the Work utilizing recognized engineering survey practices. Establish elevations, grades, lines, and levels for:

1. Site improvements including pavements, walks, retaining walls; stakes for grading, fill, and topsoil placement; utility locations including slopes and invert elevations; and irrigation system.
2. Grid and axis of building structures.
3. Building foundations, column locations, ground floor elevations, and elevations and levelness for floors and roofs.
4. Other elevations, grades, lines, and levels as needed to properly locate each element of the Project.

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B. Calculate and measure required dimensions as shown within recognized tolerances. Do not scale drawings to determine dimensions.

C. Advise entities performing Work of marked elevations, grades, lines, and levels provided for their use.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 71 33

PROTECTION AND MAINTENANCE OF PROPERTY AND WORK

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies protection and maintenance of underground and above ground utilities, structures, fences, parking strips, sidewalks, driveways, streets, and other improvements that may be affected by the work.

1.02. QUALITY ASSURANCE

A. REFERENCE STANDARDS:

1. 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.

2. 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
Chapter 19.122 RCW	Underground Utilities
WAC 296-155-657	Requirements for Protective Systems
WAC 296-24-960	Working on or Near Exposed Energy Parts

1.03. SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. ACTION SUBMITTAL ITEMS:

1. Listing and schedule of all potholing.

2. Listing of all utilities/facilities to be physically protected and relocated.

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1.04. LOCATION OF EXISTING UNDERGROUND FACILITIES

A. The Drawings indicate the existence of underground facilities known to the Owner within the treatment plant site. Determine the location of all utilities outside the treatment plant site that may be impacted during construction.

B. Abide by all the applicable requirements of Chapter 19.122 RCW.

C. Call Utility Underground Notification Center, 811, for location of underground facilities outside of the treatment plant site. Call a minimum of forty-eight (48) hours in advance of excavation operations. Those utility owners who do not locate their facilities in accordance with Chapter 19.122 RCW are liable for costs incurred by the Contractor. If the Contractor discovers underground facilities that are not identified, the Contractor shall immediately notify the owner of such facilities and the Underground Notification Center. Promptly notify the Owner prior to any work in the area of a utility where a utility owner fails to meet its obligations under Chapter 19.122 RCW.

D. Locate existing underground utilities. Review with the Owner the locations of existing utilities in relation to the new construction and evaluate areas of conflict.

E. Excavate and expose all major and minor existing utilities prior to new construction to determine utility elevations in relation to the new facilities.

F. Examine and repair all pipelines prior to pipelines being buried.

G. The following is a list of utilities that may serve the work area. The listing is provided for convenience. The list shall not be considered to be comprehensive or complete. There may be other utilities in the area that are not listed. The Owner assumes no responsibility for the accuracy or completeness of the list.

Utility/Facility	Owner or Agency
Water	Lakehaven Water and Sewer District
Sewer	Lakehaven Water and Sewer District
Traffic	City of Des Moines
Communications	AT&T
Cable	Comcast
Natural Gas	Puget Sound Energy
Power	Puget Sound Energy

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1.05. EXISTING UTILITIES AND FACILITIES

A. Protect, modify, and/or relocate all existing utilities required to complete the work.

B. The locations of existing major utilities, whether above ground or underground, are indicated on the Drawings with the exception of overhead power or other above ground utilities supported on power/telephone poles. This information has been obtained from utility maps and field surveys. The Owner does not guarantee the accuracy or completeness of this information and it is to be understood that other above ground or underground facilities not shown on the Drawings may be encountered during the course of the work.

C. Contractor shall be responsible for damages resulting from any failure to contact Utility Underground Notification Center and utility owners for location, routing, and marking of a specific utility and its subsequent effects.

D. The Drawings may show underground utilities that are to be relocated. Contractor shall be responsible for all these relocations prior to commencing work in the area.

E. Protect, modify, or relocate existing utilities and facilities required to accommodate Contractor's means and methods. Specific means and methods to be utilized by the Contractor are not known to the Owner. Therefore, the Owner will not be liable for utility protection, modification, and relocation not shown on the Drawings, which are required by the Contractor due to its means and methods. It is the Contractor's responsibility to determine the Work required by the Contract Documents and make provision for protection, modification, and relocation required. Coordinate all protection, modification, and relocation work through the affected utility. Complete Work to the utility owner's requirements and standards.

F. UNDERGROUND UTILITIES:

1. For the purpose of this Section, an underground utility will be defined as a transmission, collection, or distribution line where it would be customary to expect that drawings would exist for the line and the utility owner would be aware of the line.

2. An existing underground utility is considered to be in conflict if it crosses or projects into the specified excavation at an elevation between the top and bottom of the new facility or when parallel to the new facility and projects into the specified excavation.

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3. The Contractor shall be responsible for protecting all utilities not in conflict with the new construction and shall not affect or damage utilities not in conflict with the new construction.
4. When not shown on the Drawings and in conflict with the new construction, meet and agree with the Owner on how to proceed. Reimbursement for additional work in accordance with the General Conditions.
5. When not shown on the Drawings and no conflict with the new facility exists, no additional payment will be considered.
6. When in a substantially different location and not in conflict with the new construction, no additional payment will be considered.
7. When in a substantially different location and in conflict with the new construction, reimbursement for additional work in accordance with the General Conditions.

G. Protect, modify, and/or relocate all existing utilities required to complete the work.

H. Locate existing underground utilities with field staking. Review with the Owner the locations of existing utilities in relation to the new construction and evaluate areas of conflict.

I. STORM AND SANITARY SEWERS:

1. For the purpose of this Section, an underground utility will be defined as a transmission, collection, or distribution line where it would be customary to expect that drawings would exist for the line and the utility owner would be aware of the line.
2. Remove water accumulating during construction from the new sewers and prevent it from entering existing lines. Flush existing pipes affected by the construction to the point of the next upstream connection and repair any pipelines or manholes damaged by gravel, rocks, or other debris that has entered the existing system during construction. The physical connection to an existing manhole or sewer line shall not be made until so authorized by the Owner.

J. ABOVE GROUND ELECTRICAL, CABLE, AND COMMUNICATION FACILITIES:

1. Attention is called to all overhead items including, but not limited to, power and telephone lines, temporary traffic signals, traffic signal mast arms, overhead sign bridges, sign support span wires, signs, and street lights.
2. Observe the location of these overhead facilities and plan and conduct work operations accordingly.

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3. Take precautions to protect and avoid damage to all overhead facilities.
4. Relocate facilities as required to meet the means and methods to be utilized.
5. Observe and investigate the presence of facilities that may be affected by the work. Consult with and rely on the information given by utility owners and operators to determine the extent of any hazards and measures required. Determine the extent of any hazard created by facilities in all areas and follow approved safety procedures during the work.
6. Support poles at risk of being undermined by the work.
7. Follow the requirements of WAC 296-24-960 for all energized primary conductors. For fifty (50) kV lines and less, at no time shall personnel or equipment approach closer than ten (10) feet to any energized primary conductors. For greater than fifty (50) kV, meet the requirements of WAC 296-24-960.

K. UNDERGROUND ELECTRICAL, CABLE, AND COMMUNICATION FACILITIES:

1. Determine the protection necessary to proceed safely to protect these underground facilities.

L. GAS:

1. As required by the appropriate utility owner, protect, maintain, support in place, or relocate all gas mains crossing the pipeline trenches.
2. Provide a minimum of twelve (12) inches of clearance, measured from edge to edge, between gas mains or gas service lines and new facilities. If relocating either utility is not practical, a protective wrap shall be provided for the entire distance where less than twelve (12) inches of vertical clearance and less than six (6) inches of horizontal clearance is provided. Wrapping material shall consist of either a split polyvinyl chloride (PVC) pipe or PVC wrapping of at least 0.04-inch in thickness and shall be applied to either one of the pipes.
3. All abandoned gas mains encountered in the trench area shall be removed.
4. All temporary gas service slack lines shall be protected and maintained during pipeline installation.
5. Notify Puget Sound Energy at least two (2) days (minimum of 48 hours) in advance of any excavation in the vicinity of any gas piping. Puget Sound Energy requires one of its inspectors to be onsite anytime work is conducted near gas lines.

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M. WATER:

1. As required by the appropriate utility, protect, maintain, support in place, or relocate all water pipelines affected by the work.
2. Maintain water service along the alignment of work at all times.
3. Thrust blocks are not shown on the Drawings and shall be assumed to be present at all water line deflections of 12.5 degrees or greater.
4. Notify the Owner in writing immediately of any damage. Begin repairs immediately and work continuously until water service is restored.

N. ROADWAYS:

1. Take adequate precautions to protect existing sidewalks, curbs, pavements, utilities, adjoining property, and structures and avoid damage.
2. Traffic signage, paint striping, and channelization shall be protected and replaced if damaged.
3. Maintain the existing illumination pattern for signs and roads at all times.
4. Install temporary roadway lighting as necessary.
5. Access for emergency equipment shall be maintained at all times.

1.06. SHORING AND BRACING

A. Shore up, brace, under-pin, and protect as necessary, the foundations and other parts of existing structures adjoining the site of the work that may be affected by the work. Contractor is responsible for any damages because of settlements or the loss of lateral or subjacent support of adjoining property and from all loss and damages to adjoining and adjacent structures and their premises.

B. Fully comply with the requirements of WAC 296-155-657 as applicable.

1.07. EMERGENCIES

A. Whenever work endangers the safety of life or property, including adjoining property or property in the immediate proximity of the work, take all reasonable and prudent actions to prevent threatened loss or injury.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

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PART 3 - EXECUTION

3.01. GENERAL

A. Contact Utility Underground Notification Service prior to an excavation.

B. Pothole to locate and expose all utility locations to be affected by the work prior to new construction in the area of the utility. Adjust work when location of utility is different than shown on the Drawings and materially impacts construction. If the utility requires relocation not shown on the Drawings and the Contractor incurs additional cost, then the Owner will consider additional costs.

C. If damage to a utility occurs, repair damage to the requirements of the utility owner prior to backfilling said utility.

END OF SECTION

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SECTION 01 73 23

STRUCTURAL DESIGN AND ANCHORAGE REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS AND NON-BUILDING STRUCTURES

PART 1 - GENERAL

1.01. SUMMARY

A. SCOPE:

1. This section specifies the minimum structural requirements for the design, anchorage, and bracing of architectural/mechanical/HVAC/electrical components, equipment, and systems, and non-building structures. Design of supports, attachments, and bracing for all parts or elements of the architectural, mechanical, HVAC, and electrical systems shall be provided in accordance with this section. The requirements of this section shall apply to the design of the structural elements and features of equipment and to platforms/walkways that are provided with equipment or non-building structures.
2. This section applies to non-structural components that are permanently attached to structures and non-building structures as defined below in paragraph 1.01-B and ASCE 7-05. Note that equipment is defined as a non-structural component and tanks are defined as a non-building structure.
3. Design shall be in accordance with the criteria listed within this section and shall conform to the provisions of the design codes listed within this section. Engineering design is not required for attachments, anchorage, or bracing detailed on the drawings or where the size of attachments, anchorage, or bracing is defined in the technical specification sections.
4. The following nonstructural components are exempt from the seismic design loading requirements of this section:
    a. Mechanical and electrical components in Seismic Design Categories D, E, or F where the component importance factor, I_p, is equal to 1.0 and both of the following conditions apply:
        1) Flexible connections between the components and associated ductwork, piping, and conduit are provided, and

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2) Components mounted at four (4) feet or less above a floor level and weigh 400 lbs. or less (four (4)-foot criteria applies to the mounting support elevation relative to the floor).

b. Mechanical and electrical components in Seismic Design Categories D, E, or F where the component importance factor, I_p, is equal to 1.0 and both of the following conditions apply:

1) Flexible connections between the components and associated ductwork, piping, and conduit are provided, and

2) The components weigh twenty (20) lbs. or less or, for distribution systems, weighing five (5) lbs./ft. or less.

B. DEFINITIONS:

1. STRUCTURES: The structural elements of a building that resist gravity, seismic, wind, and other types of loads. Structural components include columns, posts, beams, girders, joists, bracing, floor or roof sheathing, slabs or decking, load-bearing walls, and foundations.

2. NON-STRUCTURAL COMPONENTS: The non-structural portions of a building include every part of the building and all its contents, except the structural portions, that carry gravity loads and that may also be required to resist the effects of wind, snow, impact, temperature, and seismic loads. Non-structural components include, but are not limited to, ceilings, partitions, windows, equipment, piping, ductwork, furnishings, lights, etc.

3. NON-BUILDING STRUCTURES: All self-supporting structures that carry gravity loads and that may also be required to resist the effects of wind, snow, impact, temperature, and seismic loads. Non-building structures include, but are not limited to, pipe racks, storage racks, stacks, tanks, vessels, and structural towers that support tanks and vessels.

1.02. QUALITY ASSURANCE

A. QUALITY CONTROL BY OWNER: Special Inspection of non-structural components and non-building structures, and their anchorages, shall be performed by the Special Inspector under contract with the Owner and in conformance with IBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Owner in their sole discretion. Special Inspection is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein

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conforms to Special Inspection standards, such sampling and testing need not be duplicated.

B. REFERENCES:

1. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). 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. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced. When conflicting requirements occur, the most stringent requirements will govern the design.

Reference	Title
AAMA	American Architectural Manufacturer's Association
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
AISC 341	Seismic Provisions for Structural Steel Buildings
ACI 360	Specification for Structural Steel Buildings
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASTM C635	Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
ASTM C636	Standard Practice for Installation for Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code – Aluminum
AWS D1.2	Structural Welding Code – Stainless Steel

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Reference	Title
IBC	International Building Code with local amendments
NFPA-13	Standard for the Installation of Sprinkler Systems
OSHA	U.S. Dept. of Labor, Occupational Safety and Health Administration
DOSH	WA Industrial Safety and Health Act administered by the Labor and Industries Division of Occupational Safety and Health
SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems

1.03. SUBMITTALS

A. For structural elements of non-structural components and non-building structures required to be designed per this specification section, drawings and design calculations shall be stamped by a Washington licensed professional engineer qualified to perform structural engineering.

B. Submit drawings and calculations no less than four (4) weeks in advance of the installation of any component to be anchored to the structure or installation of any structural member to which the component will be attached. However, it is the responsibility of the Contractor to submit the drawings and calculations to the Owner for approval with a proper amount of time for review by the Owner and the governing jurisdiction along with potential corrections due to review comments so that a permit may be issued prior to installation of the component.

C. The following submittals shall be provided in accordance with Section 01 33 00:

1. List of all non-structural components and non-building structures requiring wind and seismic design and anchorage.
2. Shop drawings showing details of complete wind and seismic bracing and anchorage attachment assemblies including connection hardware and embedment into concrete.
3. Shop drawings showing plans, elevations, sections, and details of equipment support structures and non-building structures including anchor bolts, structural members, platforms, stairs, ladders, and related attachments.
4. Identify all interface points with supporting structures or foundations, as well as the size, location, and grip of all required attachments and anchor bolts. Clearly indicate who will be providing each type of attachment/anchor bolt. Equipment vendor shall

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design anchor bolts, including embedment into concrete, and submit stamped calculations.

5. Calculations for all supports, bracing, and attachments shall clearly indicate the design criteria applied in the design calculations. Concrete embedment calculations shall be coordinated with thickness and strength of concrete members. Submit a tabulation of the magnitude of unfactored (service level) equipment loads at each support point, broken down by type of loading (dead, live, wind, seismic, etc.). Indicate impact factors applied to these loads in the design calculations.
6. Product Data: Manufacturer's certificates of compliance with the seismic force requirements of this section.

1.04. DESIGN CODES

A. The following standard codes have application at this site for:

1. Buildings/Structures: International Building Code 2021 and ASCE 7-05.
2. Reinforced Concrete: ACI 350-06 for Concrete Liquid Containing Tanks, ACI 318-08 for all other reinforced concrete structures.
3. Structural Steel: AISC 360-05 and AISC 341-05.
4. Welding: AWS Welding Codes, Latest Edition.
5. Occupational Health and Safety Requirements: U.S. Dept. of Labor, Occupational Safety and Health Administration (OSHA) and WA industrial Safety and Health Act administered by the Labor and Industries Division of Occupational Safety and Health (DOSH).

B. When conflicting requirements occur, the most stringent requirements will govern the design.

1.05. DESIGN LOADS

A. All non-structural components and non-building structures shall be designed for the following loads. Wind and snow loads shall not be applied to non-structural components and non-building structures that are located inside buildings.

B. DEAD LOADS: An additional allowance will also be added for piping and conduit when supported and hung from the underside of equipment and platforms.

C. Typical allowance for piping and conduit unless noted otherwise: Twenty (20) psf.

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D. UNIFORM LIVE LOADS:

1. Elevated Grating Floors: 100 psf.
2. Columns: No column live load reduction allowed.
3. Stairs and Landings: 100 psf.
4. Equipment Platforms, Walkways/Catwalks (other than exitways): 100 psf.

E. SNOW LOADS:

1. Code: IBC 2009 and ASCE 7-05.
2. Ground Snow Load (pg): Twenty (20) psf.
3. Exposure: C.
4. Importance Factor (I): 1.1.
5. Minimum Roof Snow Load: 25 psf.

F. Protect, modify, and/or relocate all existing utilities required to complete the work.

1. Code: IBC 2009 and ASCE 7-05.
2. Basic Wind Speed (three (3)-second gust): 85 mph.
3. Exposure: C.
4. Topographic Factor (K_{zt}): 1.0.
5. Importance Factor (I): 1.15 (Wastewater Treatment Facilities are Occupancy Category III).
6. All exterior non-structural components and non-building structures, unless located in a pit or basin, shall be designed to withstand the design wind loads without consideration of shielding effects by other structures.

G. SEISMIC LOADS:

1. Code: IBC 2009 and ASCE 7-05.
2. 0.2 Sec. Mapped Spectral Response, SS: 1.2 g.
3. 1.0 Sec. Mapped Spectral Response, S1: 0.42 g.
4. Site Class: C.
5. 0.2 Sec. Design Spectral Response, S_{DS}: 0.80 g.

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6. 1.0 Sec. Design Spectral Response, S_{D1}: 0.39 g.
7. Importance Factor (I): 1.25 (Wastewater Treatment Facilities are Occupancy Category III), except 1.5 for buildings with quantities of highly toxic material that exceed the limits shown in IBC Table 307.1.
8. Component Importance Factor (I_p): 1.0, except I_p=1.5 for fire protection sprinkler systems, components required to function for life-safety purposes after an earthquake, components containing hazardous materials, or components inside or attached to an Occupancy Category IV Structure.
9. Seismic Design Category: D.
10. Seismic loads shall be calculated on the basis of the governing building code. The structure dead load shall include equipment operating loads.
11. Individual members shall be checked for seismic and full member live load acting simultaneously, except that flooded equipment loads (infrequent occurrence) need not be combined with seismic loads. Equipment operating loads shall be combined with seismic loads.

H. IMPACT LOADS:

1. Impact loads shall be considered in the design of support systems.
2. The following impact load factors shall be used unless recommendations of the equipment manufacturer will cause a more severe load case.
   a. Rotating Machinery: 20% of moving load.
   b. Reciprocating Machinery: 50% of moving load.
   c. Monorail Hoist – Vertical: 25% of lifted load.
   d. Monorail Hoist – Longitudinal: 10% of lifted load.
   e. Hangers Supporting Floors and Platforms: 33% of live and dead load.

I. TEMPERATURE: The effects of temperature shall be included in design where non-structural components and non-building structures are exposed to differential climatic conditions. See Article Design Considerations, for temperature extremes.

1.06. LOAD COMBINATIONS

A. All non-structural components and non-building structures shall be designed to withstand the load combinations as specified in the governing building code. Where

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the exclusion of live load or impact load would cause a more severe load condition for the member under investigation, then the load shall be ignored when evaluating that member.

1.07. DESIGN CONSIDERATIONS

A. All non-structural components and non-building structures shall be designed for the following conditions:

B. CLIMATIC CONDITIONS:

1. Maximum Design Temperature: 110 degrees Fahrenheit.
2. Minimum Design Temperature: 10 degrees Fahrenheit.

C. FOUNDATIONS:

1. Foundations supporting non-structural components and non-building structures shall extend below the frost line or be supported on non-frost susceptible structural fill down to the frost line.
   a. Frost Line for Foundations: Eighteen (18) inches.
2. Consult project geotechnical report for allowable soil bearing recommendations at location of structure.

1.08. COLUMN BASE FIXITY

A. Column bases shall be designed as pinned connections. No moments shall be assumed to be transferred to the foundations.

B. Where significant shear loads (greater than 5,000 lbs. per anchor bolt) are transferred at column base plates, the equipment vendor shall provide a shear key.

1.09. DEFLECTIONS

A. Maximum beam deflections as a fraction of span for walkways and platforms shall be L/240 for total load and L/360 for live load. Maximum total load deflection for equipment supports shall be L/450.

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PART 2 - PRODUCTS

2.01. GENERAL

A. Materials shall be in conformance with information shown on the drawings and in other technical specification sections. See individual component and equipment specifications for additional requirements.

PART 3 - EXECUTION

3.01. GENERAL

A. Attachments and braces shall be made in such a manner that the component force is transferred to the lateral force-resisting system of the structure. Attachment requirements and size and number of braces shall be based on the calculations submitted by the Contractor.

B. All anchorage of equipment is specified to be made by cast-in anchor bolts in concrete elements unless specifically noted otherwise on the drawings or other specification Sections. Contractor shall be responsible for any remedial work or strengthening of concrete elements because of superimposed seismic loading if anchor bolts are improperly installed or omitted due to lack of submittal review or improper placement for any reason, at no additional cost to the Owner.

C. Anchor bolts shall be provided and installed by the Contractor in accordance with Section 05 05 19. Size of anchor bolts and embedment of anchor bolts shall be based on the calculations submitted by the Contractor.

D. Details of and calculations for all anchorages shall be submitted and accepted in accordance with Article Submittals, prior to placement of concrete or erection of other structural supporting members. Submittals received after structural supports are in place will be rejected if proposed anchorage method would create an overstressed condition of the supporting member. The Contractor shall be responsible for revisions to the anchorages and/or strengthening of the structural support so that there is no overstressed condition, at no additional cost to the Owner.

END OF SECTION

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SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.01. SUMMARY

A. This Section includes administrative and procedural requirements for salvaging, recycling, and disposal of nonhazardous construction waste.

1.02. DEFINITIONS

A. CONSTRUCTION WASTE: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. DEMOLITION WASTE: Building and site improvement materials resulting from demolition or selective demolition operations.

C. DISPOSAL: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. RECYCLE: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. SALVAGE: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. SALVAGE AND REUSE: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.03. PERFORMANCE REQUIREMENTS

A. GENERAL: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:
    a. Asphalt paving.

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b. Concrete.
c. Concrete reinforcing steel.
d. Structural and miscellaneous steel.
e. Electrical conduit.
f. Copper wiring.
g. Lighting fixtures.
h. Electrical devices.
i. Switchgear and panel boards.

2. Construction Waste:
   a. Wood sheet materials.
   b. Wood trim.
   c. Metals.
   d. Piping.
   e. Electrical conduit.
   f. Packaging: Salvage or recycle 100% of the following uncontaminated packaging materials:
      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.
      5) Polystyrene packaging.
      6) Wood crates.
      7) Plastic pails.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

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PART 3 - EXECUTION

3.01. WASTE MANAGEMENT PRACTICES

A. Comply with Section 01 50 00.

B. Provide containers, storage, signage, transportation, and other items as required.

C. Train workers, subcontractors, and suppliers on proper waste management practices.

3.02. SALVAGING DEMOLITION WASTE

A. SALVAGED ITEMS FOR REUSE IN THE WORK: Handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. SALVAGED ITEMS FOR SALE AND DONATION: Not permitted on Project site.

C. LIGHTING FIXTURES: Separate lamps by type; protect from breakage.

3.03. RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. GENERAL: Recycle paper and beverage containers used by on-site workers. Do not use Owner's containers for trash or recycling generated by cleaning or construction, unless approved by Owner.

B. RECYCLING INCENTIVES: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. PREPARATION OF WASTE: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

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D. PROCEDURES: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Stockpile materials away from construction area. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Do not store within the drip line of trees.
3. Store components off the ground and protect from the weather.
4. Remove recyclable waste and transport to recycling receiver or processor.

3.04. RECYCLING DEMOLITION WASTE

A. METALS: Separate metals by type.

1. Stack structural steel according to size, type of member, and length.
2. Stack metal siding and roofing panels with profile nested.
3. Remove and dispose of bolts, nuts, washers, and other rough hardware.

B. PIPING: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

C. CONDUIT: Reduce conduit to straight lengths and store by type and size.

3.05. RECYCLING CONSTRUCTION WASTE

A. PACKAGING:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

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4. Break down crates into component wood pieces and comply with requirements for recycling wood.

3.06. DISPOSAL OF WASTE

A. Remove waste materials and legally dispose of them in a location acceptable to authorities having jurisdiction.

B. Do not allow waste materials to accumulate on-site.

C. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

D. Do not burn waste materials.

E. Remove waste materials and legally dispose of them.

END OF SECTION

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SECTION 01 74 23

FINAL CLEANING

PART 1 - GENERAL

1.01. SUMMARY

A. This section specifies administrative and procedural requirements for final cleaning.

1.02. CLEANING

A. General cleaning during construction is required by the General Conditions; cleaning required for specific trades of work is specified in sections pertaining to that trade of work.

1. If Contractor fails to clean up as provided herein and after reasonable notice from Owner, Owner may do so and the cost thereof shall be charged to Contractor.
2. Employ continuous housekeeping cleaning to minimize interior construction dust and particulates during the Work, which shall include cleaning and removal of all debris and refuse from physically inaccessible areas including, but not limited to, wall and chase cavities prior to cover with finished materials.

B. PRELIMINARY CLEANING: Perform the following preliminary cleaning operations as a prerequisite for Owner's Final Inspection. The following are examples, but not by way of limitation, of cleaning levels required:

1. Remove labels that are not permanent labels.
2. Remove protective coatings from all accessories.
3. Remove and clean glazing compound, and other substances that are noticeable vision-obscuring materials, from transparent and reflective materials including mirrors and glass in doors and windows inside and out.
4. Clean exposed exterior and interior hard-surfaced finishes, including cabinet interiors, to a dust-free condition, free of stains, films, and similar foreign substances.
5. Leave floors broom-clean. Vacuum carpeted surfaces and clean consistent with manufacturer's recommendations for installation.
6. Clean plumbing fixtures to a sanitary condition.
7. Clean light fixtures and lamps.

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8. Remove and clean all construction debris and refuse from: a) roofs, mechanical and electrical rooms, tunnels and equipment vaults; b) limited access spaces including above ceiling areas and shafts, and c) physically inaccessible components of the Work including gutters, downspouts, floor drains, and other drainage systems.
9. Wipe surfaces of mechanical and electrical equipment including elevator equipment and similar equipment. Remove excess lubrication and other substances.
10. Clean the Project Site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills, and other foreign deposits.
11. Final Cleaning: Prior to Substantial Completion, employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to the condition expected in a normal commercial building cleaning and maintenance program. Comply with manufacturer's instructions.
12. Leave entire Project clean and ready for occupancy. All interior and exterior building and fixture surfaces shall be turned over to the Owner in a new condition, free of all damage, dust, dirt, spots, stains, encrustations, and other blemishes.
13. Clean transparent materials including mirrors and glass in doors and windows, inside and out.
14. Contractor shall wax and apply sealers to finished vinyl composition tile and sheet vinyl floors.
15. Pest Control: Rid the project of rodents, insects, and other pests that may have entered as a result of the work.
16. Vacuum debris from completed control panels and cabinets.

C. COMPLIANCE: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a lawful manner. Do not use Owner's containers for trash generated by cleaning or construction, unless approved by Owner.

1. Where extra materials of value remain after completion, or associated work has become Owner's property, arrange for disposition of these materials as directed.
2. Use low toxic cleaning supplies for surfaces, equipment, and personnel use. Submit products for Owner's information.

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PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

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SECTION 01 75 00

TESTING, TRAINING, AND COMMISSIONING

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies the requirements for testing, commissioning, and the training of the Owner's personnel. Testing, training, and commissioning includes documentation and procedures, preoperational testing, component testing, training, system testing, operational tests, commissioning, and possession by the Owner.

1.02. DEFINITIONS

A. FACILITY: An area of the Plant with a common process goal including all associated structures, equipment, and materials (e.g., Aeration Basins, Grit removal, etc.).

B. EQUIPMENT: All mechanical, electrical, and instrumentation equipment and devices specified in the Contract Documents to provide a completed operational facility.

C. SYSTEM: An arrangement of items, such as equipment, structures, components, piping, wiring, materials, or incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent part of the Plant.

D. PIPING, PROCESS, AND INSTRUMENTATION DIAGRAMS (P&IDs) define the systems and provide an organizational framework for assembly of training, pre-operational testing, component testing, and system testing plan materials.

1. In addition to systems defined by the control sequences described in the integrated automation control sequences for process systems, other specific systems include, but are not limited to, the following:

a. HVAC systems:

1) Exhaust fans.

2) Supply fans.

3) Make-up air units.

4) Motor operated dampers.

5) HVAC controls.

6) Control circuits and alarms.

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7) Circulation, heat transfer, and hydronic equipment.

b. Network Telephone System.

c. Distributed Antenna System.

d. Fire and Alarm System.

e. Data System.

E. PRE-OPERATIONAL TEST PHASE:

1. Factory testing as specified in the individual equipment specifications.
2. Manufacturer's standard factory and recognized industry practice tests.

F. COMPONENT TEST PHASE:

1. Conducted by Contractor with assistance from manufacturer's representatives using process water on installed equipment and components to verify operation and performance of equipment and components adheres to the Contract Documents.
2. Includes two (2) subphases as follows:
   a. Equipment and Component Checkout: Testing to verity that equipment and components have been installed correctly (e.g., is the electrical wiring properly connected, pump rotation correct, piping properly aligned?).
   b. Equipment Performance Testing: Following completion of equipment and component checkout, conduct performance testing of equipment if specified in the individual equipment specification (e.g., demonstrate the RDT feed pumps meet the specified service requirements).

G. SYSTEM TEST PHASE:

1. Follows completion of Component Test Phase for all equipment included within the system.
2. Conducted by Contractor using process water. Simulate foul air conveyance using ambient atmospheric air.
3. Overall test of system control (local process controllers and supervisory level controllers) and operation demonstrating interlocks, alarms, data acquisition, and control over entire range of operation including, but not limited to, the following:
   a. Changes in operating parameters (e.g., does the system respond correctly to a change in influent flow rate?).

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b. Alarm conditions (e.g., does the system respond correctly to a high level alarm?).

c. Sequences (e.g., does the system correctly start/stop/control equipment for an automatic startup or shutdown sequence?).

d. Operator interface (e.g., does the system respond correctly to set point and/or discrete changes made at the operator interface?).

H. OPERATIONAL TEST PHASE: Testing of the entire facility operated and controlled by the Plant control systems. The full operation of the facility for a specified period that assures that all Systems and processes operate to defined design criteria. Operational Test Phase shall be conducted using process fluids present during normal operation (e.g., process, wastewater, sludge, digester gas). Process water and/or ambient air may be substituted for process fluids during operational testing in instances where process fluids are not reasonably available or suitable for operation testing. Substitutions for process fluids during operational testing are subject to the Owner's approval. Process fluids, chemicals, and air shall be transferred between facilities to simulate operation of facility. Coordinate transfer of process water, chemicals, and air with other contractors working at site.

I. COMMISSIONING: The initiation of full facility operation by Owner personnel using actual wastewater. During this period, complete Operational Testing of systems that could not be completed during the Operational Test Phase.

1.03. QUALITY ASSURANCE

A. REFERENCE STANDARDS:

1. 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.

2. 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
ASTM	ASTM International

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Reference	Title
HI	Hydraulic Institute
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
NEMA	National Electrical Manufacturer's Association

B. Install testing equipment and apparatus with personnel trained in the trades and professions required to assure competent performance.

C. Supervise the installation of specific equipment testing items specified to be accomplished by factory-trained installation specialists furnished or certified by the equipment manufacturers.

D. Document the skills and training of workers engaged in the installation of testing equipment furnished by the Contractor.

1.04. SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. ACTION SUBMITTAL ITEMS DESCRIBED BELOW.

C. TESTING AND TRAINING PLANS:

1. Submit comprehensive Testing and Training Plans a minimum of 180 days prior to the scheduled start of the first Component Test Phase. The first Component Test Phase cannot commence until thirty (30) days after the Testing and Training Plan is returned with a "No Exceptions Taken" or "Make Corrections Noted" review action.
2. Coordinate training scheduling with applicable Owner staff work schedule.
3. Organize Testing and Training Plans as follows:
    a. Pre-operational Testing, Component Testing, System Testing, and Training requirements for the equipment and components presented on each P&ID shall be compiled in a common testing plan. Equipment and components of a system that are represented on multiple P&IDs may be aggregated into a common testing plan where the equipment and components operate in parallel and/or share common piping or electrical connections.
4. Include the following information:
    a. System name corresponding to P&ID names.

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b. Equipment name and number.

c. Component name.

d. Pertinent control strategy numbers and titles.

e. Detailed summary of all testing and training activities.

f. Written procedures for all test phases.

g. Plans for filling process tankage and flow/circulation paths used during testing.

h. Disinfection plans and plans for controlling odors from stagnant water.

i. Detailed drawings for testing layouts and for accomplishing flow schemes necessary for testing.

j. All forms prepared for recording test results and training activities.

k. Narrative of training plan.

l. Detailed schedule for all testing and training activities.

m. Schedule of start-up meetings.

n. Proposed Startup Team including roles and responsibilities during each test phase.

o. List of chemicals and quantities required during testing.

p. Details on all other aspects of startup required to make a complete and workable plan, including integration with testing requirements specified for mechanical, HVAC, electrical, instrumentation, and control components.

q. How water, chemicals, and air will be transferred or circulated to simulate process systems.

r. Procedures for introducing sludge into process facilities at the beginning of Commissioning and measures that will be taken to minimize release of foul air.

s. Procedures to ensure an orderly transition from Operational Test Phase to Commissioning.

t. Testing safety plan.

5. Format: Word documents and Excel spreadsheets, to organize information, plus a monthly calendar that shows the following:

   a. Start and end dates for component and system test phases identified by equipment, component, or system name.

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b. Date and time period for training identified by equipment, component, or system name.

6. Update spreadsheet and calendar biweekly and as necessary to communicate schedule changes to the Owner.

D. PREOPERATIONAL TEST PHASE:

1. Factory tests results specified in equipment specification sections.
2. Submit prior to equipment shipment.

E. COMPONENT TEST PHASE:

1. Submit written test procedures for Component Test Phase for each component or item of equipment. Include performance testing requirements specified in the individual equipment specifications.
2. Submit completed test forms, which include:
   a. Pre-operation check-out, alignment, adjustment, and calibration.
   b. All test information and results alongside specified values.
   c. Use separate form for each item of equipment installed.
   d. Use form that includes all test information including specified operational parameters.
   e. Separate sections to record values for a pre-operation inspections.
   f. Initials of manufacturer's representatives, the Contractor's representative, and the Owner verifying tests satisfactorily completed.
   g. Record of relevant performance data for the testing.
   h. Format acceptable to Owner.
   i. Manufacturer's written certification that equipment item or component is installed correctly and ready for next phase of testing, including completed Form 46 05 13-A.

F. SYSTEM TEST PHASE:

1. Submit written procedures for System Test Phase. Include the following:
   a. Identification of the system with a description of operating parameters.
   b. Process and instrumentation diagrams detailing System.

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c. System equipment list with cross-references to the appropriate Specification Sections. Reference Systems as defined above.

d. Written procedures detailing the Contractor's Component Tests and System Tests proposed to verify equipment compliance with the Contract Documents and operating parameters.

e. Submittals from Pre-operational and Component Test Phases and delivery acceptance tests and inspections for each equipment item and component included in the system.

2. Update System Test Package with results of System Test phase and submit final system test package within fourteen (14) days after completion of System Test.

3. Following completion of system testing, submit Form 01 75 00-A for each equipment item within the system.

G. OPERATIONAL TEST PHASE:

1. Submit written procedures for Operational Test Phase. Organize procedures into a common plan for each by process area or unit process.

2. Submit one (1) electronic copy of Operational Test Phase results within fourteen (14) days after successful completion of Operation Test Phase. Include the following:

a. A chronological record of operational adjustments made and description of the resulting effect on Plant operation, including time period required for operation to return to steady-state condition.

b. A list of alarms that occurred with time of occurrence and resolution.

c. Manual operations performed.

d. Equipment or system startup and shutdown information, including starting and shutdown time.

e. A troubleshooting log that describes significant upsets and other unusual events and the action taken to resolve. These upsets and events generally result in multiple alarm conditions.

f. Format acceptable to Owner.

H. COMMISSIONING:

1. Provide transition plan and checklist for transfer of operation to Owner.

2. Record dates of beginning of Commissioning for each facility.

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I. Qualifications of the Contractor's Startup Manager demonstrating compliance with the experience requirements specified in this Section.

1.05. CONTRACTOR'S STARTUP MANAGER

A. MINIMUM QUALIFICATIONS:

1. Operations engineer or equally qualified operations specialist.
2. Contractor's Startup Manager shall have at least five (5) years of total experience or experience on at least five (5) separate projects, managing the startup and commissioning of mechanical, electrical, instrumentation, HVAC, and piping systems for wastewater treatment facilities.

B. The Contractor's Startup Manager shall be responsible for the following:

1. Review and approve all functional and performance tests, results, and documentation for all equipment and systems.
2. Develop schedules for all testing, integrate testing into the master construction activity schedule, and coordinate all required testing.
3. Develop test procedures and forms for documentation of all equipment tests, system functional tests, and cross system functional tests. Test procedures shall be in accordance with equipment manufacturer's recommendations, where applicable. Test procedures shall fully describe system configuration and steps required for each test. The test procedures shall reflect actual procedures used. The test procedures shall be appropriately documented so that another party can repeat the test to verify results.
4. Complete test procedure schedule, procedures, forms, and other documentation.
5. Coordinate directly with all subcontractors, manufacturer's representatives, and the Owner specific to their responsibilities.
6. Observe the startup and initial testing of equipment and then all final testing of equipment and systems.
7. Coordinate all cross system testing. Some examples of cross system testing include process controls, HVAC, fire alarm, closed circuit television, etc.
8. Note and document any inconsistencies or deficiencies in system operations and ensure system compliance or recommend modifications to system design that will enhance system performance.

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9. Coordinate testing participation and approve procedures after verifying that previous test phases have been satisfactorily conducted and the systems are ready for the next test phase.
10. Review as-built drawings provided by the various subcontractors and manufacturer's representatives for verification with as-built conditions.
11. Document all test results and assemble a final report.
12. Oversee training.
13. Participate in commissioning activities.
14. Manage, coordinate, and supervise the Contractor's quality control program.

1.06. SEQUENCE AND COORDINATION

A. TEST PHASES AND SEQUENCE:

1. Preoperational Test Phase: Factory Tests.
2. Component Test Phase: Field testing of installed equipment, including component checkout and performance testing using process water.
3. Conduct training after completing the Component Test Phase.
4. System Test Phase: Operation and control tests for complete systems using process water supplied by Owner.
5. Operational Test Phase: Operation of related systems comprising a complete facility using process fluids present during normal operation of the facility.
6. Commissioning: Operation of related systems comprising a complete facility using wastewater, ambient air, and chemical systems. During commissioning, the facility is operated by Owner's personnel, with assistance from the Contractor. During this phase, complete any Operational testing activities that cannot be completed during the Operational Test Phase due to absence of sludge, digester gas, foul air, or other process streams that are not present until facilities are operated with wastewater.

B. COORDINATION:

1. During testing activities, water may be pumped and transferred from tank to tank. Water and chemicals may also be transferred between facilities. Take precautions to ensure that construction debris and other harmful materials are not introduced into the system.

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2. Coordinate water use, water transfer, chemical transfer, air transfer, and similar activities with the Owner.

C. MATERIALS AND SERVICES:

1. Provide lubricants, compressed air supplies, temporary utilities, and all other necessary items and work required to complete the tests and inspections specified in this Section.
2. Contractor is responsible for purchasing all fuel and chemicals required for use in testing, training, and commissioning activities.

D. Prior to commissioning, provide temporary heating, ventilation, and air conditioning as required for areas within permanent facilities.

E. If, during testing, a portion of the Work fails to comply with the Contract Documents and is adjusted, altered, renewed, or replaced, tests on that portion, and other affected portions, shall be repeated within a reasonable time.

F. Test results shall be within the tolerances set forth in the Contract Documents. If no tolerances are specified, conform to tolerances established by recognized industry practice.

G. Where, in the case of an otherwise satisfactory installed test, doubt or dispute arises between the Owner and the Contractor regarding the results, methods, or test equipment, the Owner may request the test be repeated. The repeat test using modified methods or equipment will be paid per the following:

1. If the test results confirm the satisfactory installed test results, costs for the repeat test will be paid by the Owner through the change order process.
2. If the results of test fail to comply with the Contract Documents, all costs associated with the repeat tests and equipment necessary to comply with the Contract Documents are at the Contractor's expense.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

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PART 3 - EXECUTION

3.01. TEST MATERIALS AND EQUIPMENT

A. Provide test gauges, meters, recorders, and monitors, as required, to supplement or augment the instrumentation system specified in the Contract Documents. Select devices designed to measure the performance of the specific equipment and systems. Instruments to be recently calibrated.

B. Through recalibration, demonstrate testing equipment accuracy.

C. Calibration procedures shall be in accordance with applicable standards of ASTM, ISA, and IEEE. Calibration records for testing equipment used shall be submitted to the Owner prior to testing.

3.02. INSTALLATION

A. Install all equipment in accordance with manufacturer's requirements and the Contract Documents. Notify the Owner of any conflict between a manufacturer's installation recommendations and the Contract Documents.

3.03. TESTING

A. GENERAL REQUIREMENTS:

1. Testing shall be designed to not interfere with the plant's ability to continuously comply with NPDES Permit requirements.
2. Test and inspect equipment and partially completed or fully completed portions of the work to demonstrate compliance with the Contract Documents.
3. Pay all testing costs, including for temporary facilities and connections.
4. Test the following:
    a. Equipment with one (1) or more moving parts or devices requiring an electrical, pneumatic, or hydraulic connection.
    b. Leakage tests and other piping tests as specified in the Contract Documents.
    c. Electrical devices in accordance with Division 26.
    d. Instrumentation devices in accordance with Division 25.
5. Obtain Owner's approval for testing only after Owner's inspection of equipment for conformance with the Contract Documents.

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6. Tests and inspections shall be in accordance with recognized standards of the industry.

B. PROCEDURES:

1. To prevent equipment damage, design testing procedures to duplicate, as nearly as possible, conditions of operation. Once the testing procedures have been reviewed and approved by the Owner, organize into system test packages and include the proper checkout, alignment, adjustment, and calibration signoff forms for each item of equipment.
2. Jointly use forms with the Owner to ensure that documentation for each electrical, mechanical, and instrumentation equipment item has been properly recorded for installation and testing. Failure to follow the Owner-approved procedure will result in non-acceptance of the equipment.
3. Fulfillment of the test and inspection requirements are by either of the following:
   a. Tests and inspections performed in Owner's presence.
   b. Certificates or reports of tests and inspections performed by persons or organizations approved by Owner.
4. Maintain the test package, which contain tests and sign-off forms including, but not limited to, piping, equipment, electrical, and instrumentation. Submit test packages to the Owner for inspection upon request.

C. PREOPERATIONAL TEST PHASE: Test items at the place of manufacture during or upon completion of manufacture. Tests shall be comprised of, but not limited to, hydraulic pressure tests, electric and instrumentation tests, performance and operating tests, recognized industry practice tests, and tests specified in the individual equipment specifications.

D. COMPONENT TEST PHASE:

1. General:
   a. Incorporate Construction Document requirements into the installed tests and inspection procedures and proceed in a logical, step-wise sequence to ensure that the installed equipment has been properly assembled, serviced, aligned, adjusted, connected, and calibrated prior to operation.
   b. Perform all changes, adjustments, or replacements required to make the equipment operate.

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2. Equipment and component checkout procedures include, but are not limited to:
    a. Piping System pressure testing and cleaning as specified in the Contract Documents.
    b. Testing specified in the individual equipment specifications.
    c. Electrical system testing as specified in Division 26.
    d. Process instrumentation and control system testing as specified in Division 25.
    e. Testing, checking, and correcting deficiencies of:
        1) Power, control, and monitoring circuits for continuity prior to connection to power source.
        2) Voltage of all circuits.
        3) Phase sequence.
        4) Cleanliness of connecting piping systems.
        5) Alignment of connected machinery.
        6) Vacuum and pressure of all closed systems.
        7) Lubrication.
        8) Valve orientation and position status for manual operating mode.
        9) Instrumentation and control signal generation, transmission, reception, and response.
        10) Tagging and identification systems.
        11) Proper connections, alignment, calibration, and adjustment.
    f. Calibrate all instrumentation, alarms, and safety equipment.
    g. Manually rotate or move moving parts to assure freedom of movement.
    h. Bump electric motors to verify power and direction of rotation.
    i. Perform other tests, checks, and activities required to make component ready for System Test Phase.
3. Performance Test Requirements:
    a. Completely field test each equipment item specified in the Technical Specifications Divisions 02 through 46 over the entire range of specified operating conditions.

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b. The Contractor shall record pertinent operating data such as flow, suction pressure, and discharge pressure for pumps in field testing report.

c. Provide necessary measuring equipment. Calibrate prior to use.

d. Provide a complete field testing report on each equipment item and include in System Test Package.

4. Prior to Component Test Phase, deliver final Operation and Maintenance Manuals specified in Section 01 78 23.

5. Upon completion of Component Testing, the manufacturer's representative shall certify on Form 46 05 13-A that the component is installed correctly and ready for the next phase of testing.

E. SYSTEM TEST PHASE:

1. General:

a. Once the Owner approves the Component Test Phase results and finds no deficiencies in that portion of the work, test and operate all individual Systems under specified operating conditions to determine as comprehensively as possible whether the equipment and System meet the functional requirements of the Contract Documents.

b. Except as described below, process water will be used in the testing of all wastewater systems, including sludge systems. For all other Systems, use the intended fluid or a compatible substitute. Owner to approve test media disposal methods.

c. Following System Testing:

1) Recheck machines for alignment and realign if necessary.

2) Check equipment for loose connections, unusual movement, or other indications of improper operating characteristics.

3) Correct deficiencies to the Owner's satisfaction.

4) Disassemble and inspect equipment that exhibits unusual or unacceptable operating characteristics. Repair or remove from the site and replace with new. Test until equipment complies with the Contract Documents.

2. System test procedures include, but are not limited to, the following:

a. Provide and complete a checklist to demonstrate discrete and analog points are displayed on graphic screens at operator interface unit.

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b. Provide and complete a checklist to demonstrate operator entries via operator interface are communicated to Plant control system.

c. Provide and complete a checklist to demonstrate entries via Plant control system for the equipment and systems as described in Division 40.

d. Provide and complete a checklist to verify discrete and analog inputs from field devices update operator interface panel.

e. Provide and complete a checklist to demonstrate operator entries via interface panel control as described in Division 25.

f. Whenever possible, actuate all alarms from field devices by physically changing actual operating condition so that field device causes alarm. Perform similar exercising of instruments across their range of operation. Electronically simulate conditions only when physical initiation is not possible. Provide and complete a checklist to demonstrate that all alarms are received on operator interface.

g. Test to the Owner's satisfaction prior to proceeding to Operational Test Phase.

3. The following procedures are in addition to and supplement those procedures described above. Additional specific System test procedures include, but are not limited to, the following:

a. Foul Air and Supply Air:

1) Balance foul air and supply air systems as per sheets.

F. OPERATIONAL TEST PHASE:

1. General:

a. To ensure proper Owner staff coordination, provide Owner thirty (30) days' notice prior to starting Operational Test Phase.

b. Coordinate to ensure the Owner's operation is not compromised.

c. Prior to start of Operational Test Phase, configure all systems for complete automatic operation as specified in Division 25.

d. During Operational Test Phase, demonstrate operation of equipment under both normal and abnormal/shut down conditions. Undertake the following activities and coordinate with the Owner:

1) Vary flows and process levels to exercise equipment across a range of operating conditions.

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2) Demonstrate manual and automated equipment operation, alarms, and shutdowns and communication of data, status, and other I/O in accordance with control strategies and associated process and instrumentation diagrams. Fail individual equipment items, instruments, and control panels; demonstrate that alarms are communicated to SCADA and that back-up units are brought into service as appropriate.

3) Interrupt the utility power system to individual process areas and overall Plant. Test operation on standby power system. Test automated equipment restarts upon restoration of utility power.

4) Assist the Owner with demonstration of controls and alarms that reside at SCADA level such as communication failures between process areas, alarm and data communication to SCADA, and Plant-wide controls.

e. Do not allow water overflows or discharges.

f. Bring process units to full operating conditions including temperature, pressure, and flow as applicable.

g. Test in a step-by-step method in accordance with the approved testing procedures. Systematically test equipment, systems, structures, and the complete facility as a unit. Owner to witness each individual step.

h. Operate equipment and systems during the operational testing phase, to the greatest extent practical, at conditions that represent the full range of operating parameters as defined in the Contract Documents.

i. For each process area or unit process operational test phase, allot a minimum time period of thirty (30) days in the project schedule. The facility shall perform through its complete design range for a period of ten (10) consecutive uninterrupted 24-hour days. Operational Test Phase must be restarted if testing is interrupted due to significant interruptions or impact to performance as determined by the Owner.

j. Supply operational manpower for tests requiring 24-hour operations.

3.04. COMMISSIONING

A. After successful completion of the Operational Test Phase, completion of specified training, and submission of all specified documentation, the Owner will begin operating the Facility during the Commissioning Period.

B. Prior to start of Commissioning, remove temporary piping, plugs, and other apparatus that may have been in use during the Operational Test Phase.

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C. Provide labor to support Owner and ensure facility attains its fully operational mode.

D. The Owner's personnel will be responsible for operation of the facility or portion thereof. The facility shall be fully operational and capable of accepting design flows.

E. The Owner will conduct comprehensive performance testing of all processes, process equipment, instrumentation and control systems, utilities, and support systems to validate that the Plant functions as a complete and operable treatment system when receiving raw wastewater. The Owner may operate at additional setpoints during Commissioning. The Contractor shall assist the Owner in planning and conducting the testing.

F. The Owner will be responsible for costs of continuous normal operational and routine maintenance during Commissioning.

G. The Contractor shall be responsible for all costs of necessary repairs or replacements required to keep the facility operational. Failures of equipment will require restart of the Commissioning Period.

H. Provide required skilled labor to support the Owner around the clock to ensure the facility maintains its fully operational mode and to address any warranty or performance issues in a timely manner that prevent adverse impact to the performance of the facility.

I. The Commissioning Period is thirty (30) continuous days without equipment failures for all systems being commissioned. Failure of equipment or facilities where, in the opinion of the Owner, a significant interruption or impact to performance occurs, will be grounds for restarting the Commissioning Period.

J. During Commissioning, complete and document any operational tests that could not be completed during the Operational Test Phase due to lack of sludge, digester gas, or foul air.

3.05. TRAINING

A. Conduct training after completion of Component Test Phase.

1. Training shall be performed by factory representatives experienced in operation and maintenance of the equipment. Sales representatives will not be considered qualified for providing training.

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2. Personnel training on individual equipment or systems will not be considered completed unless:
   a. All training deliverables are received and approved before commencement of training.
   b. System operates free of malfunctions during training.
   c. All provisions of field and classroom training are met.
3. Training not in compliance with the above shall be performed again in its entirety by the Contractor.

B. FIELD AND CLASSROOM TRAINING REQUIREMENTS:

1. Conduct classroom training on-site.
2. Provide factory trained instructors familiar with both classroom and hands-on instruction.
3. Training instructors shall be at class on time. Session beginning and ending times to be coordinated with the Owner and indicated on the master schedule. Normal time lengths for class periods can vary, but brief rest breaks shall be scheduled and taken.
4. Schedule training into two (2) separate sessions. Each training session shall be at least eight (8) hours in duration and be broken into two (2) sections. The first section shall be conducted in a classroom setting (in the Owner's training facilities) and the second section shall be conducted at the site where each piece of equipment is installed.
5. Plan for minimum class attendance of twelve (12) people at each session; provide sufficient classroom materials, samples, and handouts for those in attendance.
6. Instructors to have a typed agenda and well-prepared instruction material. The use of visual aids (e.g., films, pictures, and slides) is recommended. Specific instructional materials shall be provided for each section of the training session(s) and Instructors shall supply said materials to the Owner a minimum of two (2) weeks prior to the actual training session(s).
7. Provide equipment required for presentation of films, slides, and other visual aids.
8. Maintain a log of classroom training including instructors, topics, dates, time, and attendees.
9. Digitally record the training and provide the recording to the Owner.
10. Include hands-on training held at the actual installed equipment location.

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11. Submit electronic copies of handouts and presentation materials including copies of PowerPoint presentations.

C. Notify the Owner of class times at least ten (10) days prior to the day of training.

D. Owner may, at its discretion, choose to record training sessions using internal resources or by contracting with a third party. Contractor and manufacturers shall cooperate with recording efforts.

E. In addition to training described in this Section, provide the training as listed in the individual equipment specifications.

3.06. TRAINING PRESENTATION CONTENTS

A. Train the Owner's personnel only with manufacturers' representatives. Provide correct expertise during any questioning periods. Use the following general outline for manufacturer training presentations:

1. Familiarization:
    a. Show catalog, parts lists, drawings, and O&M manuals.
    b. Provide overview of design intent.
    c. Review the installation of the specific equipment items.
    d. Demonstrate the unit's operation.
    e. Answer questions.
2. Safety:
    a. Point out safety references.
    b. Discuss safety precautions around equipment.
3. Operation:
    a. Point out reference literature.
    b. Explain all modes of operation, including emergency.
    c. Test personnel on proper use of the equipment by letting them operate it.
4. Preventative Maintenance:
    a. Distribute the preventative maintenance list including reference material and daily, monthly, quarterly, semi-annual, and annual tasks.
    b. Demonstrate how to perform preventative maintenance tasks.

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c. Identify indicators of equipment problems.

5. Corrective Maintenance:
   a. List possible problems.
   b. Discuss repairs; point out special problems.
   c. Open up the equipment and demonstrate procedures where practical.
6. Parts:
   a. Review spare parts list and indicate how to use.
   b. Indicate how to order additional spare parts.
   c. Provide recommendations for spare parts inventory.
   d. Provide price list.

B. Schedule and attend a planning and coordination meeting ten (10) days prior to first anticipated training class.

C. Provide a training status report and schedule-to-complete presentation materials.

D. Provide agenda and training materials for each presentation a minimum of seven (7) days prior to the presentation.

3.07. SCHEDULING

A. Identify time frames for testing, training, and commissioning activities in the Construction Progress Schedule specified in Section 01 32 16.

B. Update schedule as the testing process occurs.

C. Use hourly scheduling when required by the tasks to be completed and coordinated.

END OF SECTION

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SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01. SUMMARY

A. This section specifies the following sequence and procedures for Project closeout:

1. Final Inspection (portions of the Work).
2. Substantial Completion (portions of the Work per the General Conditions).
3. Final Completion (all Work per the General Conditions).
4. Final Acceptance (all Work per the General Conditions).

1.02. FINAL INSPECTION

A. REQUEST FOR FINAL INSPECTION: Complete the following actions prior to the Owner's Final Inspection.

1. Submit a written notice that the Project is ready for Final Inspection. Include a written plan and schedule outlining all actions necessary to achieve Substantial Completion.
2. Preliminary Cleaning per Section 01 74 23.

B. FINAL INSPECTION: Upon receipt of the Request for Final Inspection, the Owner will commence Final Inspection and, as necessary, provide a Corrective Work Items List. If a Corrective Work Items List is issued, make the required corrections and/or identify items that Contractor feels are not required by the Contract Documents; resolve these items with the Owner.

C. RE-INSPECTION: After completing the Owner's Corrective Work Items List and providing a Final Inspection Report noting completion of each item, request a re-inspection. Items for which completion is delayed due to circumstances acceptable to the Owner will be exceptions. Owner will confirm completion of the Corrective Work Items List. If Owner is required to perform more than one (1) re-inspection, costs for additional inspections may be borne by the Contractor, at Owner's sole discretion.

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1.03. SUBSTANTIAL COMPLETION

A. PRIOR TO SUBSTANTIAL COMPLETION: Substantial Completion is achieved when the portion of Work, other than incidental Corrective Work Items or Punch List items, is complete. Tasks to complete include, but are not limited to, the following:

1. Work is complete and correct to the satisfaction of the Owner.
2. Removal of temporary facilities and controls (not required in other areas).
3. Provision of asbestos abatement information.
4. Waste properly disposed per Section 01 74 19.
5. Final cleaning complete per Section 01 74 23.
6. Completion of all testing, training, and commissioning per Section 01 75 00.
7. Certificate(s) of Occupancy submitted, as required.

B. SUBSTANTIAL COMPLETION: Upon satisfactory completion of all specified requirements, the Owner will issue a letter of Substantial Completion. The letter will identify the date of Substantial Completion and list any incomplete Work.

1.04. FINAL COMPLETION

A. PRIOR TO FINAL COMPLETION: Final Completion is achieved when all Work is fully complete in accordance with the Contract Documents. Task to complete include, but are not limited to, the following:

1. All Work is complete and correct to the satisfaction of the Owner.
2. All temporary facilities and controls removed.
3. All waste properly disposed per Section 01 74 19.
4. All final cleaning complete per Section 01 74 23.
5. Final Operation and Maintenance Manuals provision per Section 01 78 23.
6. Warranties and Bond Manual submission per Section 01 78 36.
7. Submittal of the Project Record Documents per Section 01 78 39.
8. Spare parts delivery and acceptance per Section 01 78 43.
9. Landscaping complete.
10. All final permits submitted, including Certificates of Occupancy.

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11. All Change Orders are approved and signed by both parties.
12. Draft Final Application for Payment submitted per Section 01 29 00.
13. Final Schedule of Values submitted per Section 01 29 00.
14. Project Identification Badges collected from all personnel.

B. FINAL COMPLETION: Upon satisfactorily completion of all Construction Document requirements, the Owner will approve and process the Final Application for Payment and establish the date of Final Completion.

1.05. FINAL ACCEPTANCE

A. Final Application for Payment approved and payment made to Contractor.

B. The Owner will establish the date of Final Acceptance and issue the Letter of Final Acceptance after the Contractor completes all Construction Document requirements.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01. SUMMARY

A. This section specifies Operation and Maintenance (O&M) manuals and related equipment data for incorporation into the Owner's asset management system.

1.02. SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. Provide completed Operational and Maintenance Transmittal Form (Form 01 78 23-A), Equipment Record Forms (Form 01 78 23-B), Asset Management Field Data Forms (Form 01 78 23-C), and Spare Parts Record Forms (Form 01 78 23-D) with each submittal. Forms 01 78 23-B and 01 78 23-C shall be the initial pages of the manual and shall be provided in a separate Excel file. Forms are located in Section 01 31 30 and are available in Microsoft Word or Microsoft Excel format upon request.

C. Sixty (60) days prior to the Operational Test Phase specified in Section 01 75 00, submit four (4) hard copies and one (1) electronic copy of the Preliminary Operation and Maintenance manuals. Identify copies as "Preliminary."

D. Owner will complete review of preliminary O&M manuals and deliver review comments within thirty (30) days of receipt.

E. Provide one (1) hard copy and one (1) electronic copy of the final O&M Manual.

1.03. OPERATION AND MAINTENANCE MANUAL

A. Operation and Maintenance Manuals shall contain all the information needed to operate, maintain, and repair all systems and equipment and material provided in the Project. The information provided shall include, but not be limited to, the following:

1. General: The names, addresses, and telephone numbers of the manufacturer, the nearest manufacturer's representative, and the manufacturer's nearest supplier of equipment and parts. Include the manufacturer's web site information.

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2. Operating Instructions:
    a. Safety Precautions: List personnel hazards for equipment and list safety precautions for all operating conditions.
    b. Operator Prestart: Provide requirements to set up and prepare each system for use.
    c. Start-up, Shutdown, and Post-Shutdown Procedures: Provide a control sequence for each of these operations.
    d. Normal Operations: Provide control diagrams; explain operation and control of systems and specific equipment. As applicable, provide baseline vibration, temperature, pressure, etc., readings.
    e. Emergency Operations: Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage. Include shutdown instructions for fire, explosion, spills, or other foreseeable contingencies.
    f. Service Requirements: Provide instructions for services to be performed by the operator such as lubrication, adjustments, and inspection.
    g. Environmental Conditions: Provide a list of environmental conditions (temperature, humidity, and other relevant data) that are best suited for each product and describe conditions under which product should not be allowed to run.
3. Preventive Maintenance:
    a. Lubrication Data: Provide a table showing recommended lubricants for specific temperature ranges and applications; provide charts with a schematic diagram showing lubrication points, recommended lubricants, and capacities; and provide a lubrication schedule showing service interval frequency.
    b. Provide manufacturer's preventative maintenance schedule for routine inspections, tests, and adjustments required to ensure proper and economical operation and minimize repairs. Provide manufacturer's projection of preventive maintenance manhours, by type of craft, on a daily, weekly, monthly, and annual basis.
    c. In addition, provide a customized maintenance schedule to be input into the Owner’s asset management system using Form 01 78 23-E. The customized maintenance schedule shall include all preventive maintenance tasks identified in the preventive maintenance schedule specified above, listing tasks to be performed at specific calendar and usage intervals.

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4. Corrective Maintenance:

   a. Troubleshooting Guides and Diagnostic Techniques: Provide step-by- step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

   b. Wiring and Control Diagrams: Provide point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job-specific wiring and control work. On diagrams, number electrical and electronic wiring terminals identically to actual installation.

   c. Maintenance and Repair Procedures: Provide instructions and list tools required to restore equipment to proper operational condition.

   d. Removal and Replacement Instructions: Provide step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, subcomponents, and accessories. Provide tolerances, dimensions, settings, and adjustments required. Include a combination of text and illustrations.

   e. Spare Parts and Supply Lists: Provide lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays using Form 01 78 23-D. Identify spare parts and supplies that require a long lead time. Provide list prices.

   f. Corrective Maintenance: Provide manufacturer's projection of corrective maintenance manhours by type of craft. Separately identify and tabulate corrective maintenance requiring equipment manufacturer’s participation.

5. Appendices:

   a. Parts Identification: Identify each component, subcomponent, and accessory subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification. When illustrations omit the part numbers and description, cross reference the illustrated part to the listed part. Group parts by components, subcomponents, and accessories.

   b. Training Requirements: Provide manufacturer’s information for use in Owner training.

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c. Testing Equipment and Special Tool Information: Provide information on required test equipment and on special tools needed for the operation, maintenance, and repair.

B. Hard copies shall be bound in slant-D, 3-ring, four (4)-inch capacity view binders with insertable clear vinyl overlay on the front cover and spine. The binders shall have heavy duty nylon reinforced hinges.

1. Provide typed cover slip sheet identifying Project name, equipment name, equipment number(s), Contractor, and date. Provide typed spine slip sheet identifying equipment name, equipment number(s), and date. For the final Operation and Maintenance Manual leave the date blank.
2. Each copy shall have a typed index and tabbed dividers between equipment categories or specification sections.
3. Each volume shall not exceed 3-1/2 inches thickness of paper contents. Label volumes consecutively, beginning with the Design Package designation. For example, label the first volume for Design Package 1 as Volume DP1-1, the first volume for Design Package 3 as DP3-1, and the first volume for Design Package 4 as DP4-1.

C. Deliver electronic copies on a cloud-based file sharing site.

1. Electronic O&M manuals shall be in searchable PDF format.
2. Where scanned pages are used, each scanned page shall be provided with a bookmark and identified in the index. In addition, annotate each scanned page identifying the content. For example, for a scan of a Special Warranty, insert an annotation in the file stating “Special Warranty Documentation, Page 1.”
3. Index each manual with hyperlinks and bookmarks to each section.
4. Consistently orient all diagrams, drawings, pictures, and illustrations.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 78 36

WARRANTIES

PART 1 - GENERAL

1.01. SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties required by the Contract Documents, including manufacturer's Standard Product Warranties and Special Warranties.

B. Refer to the General Conditions for terms of the Contractor's Warranty obligations under the Contract and Public Works Contract Bond.

C. If there is any discrepancy in the Contract Documents regarding the warranty period or its date of commencement, the passage granting the Owner the longest warranty period ending on the latest date shall govern.

D. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and Subcontractors that are required to countersign Special Warranties with the Contractor.

1.02. DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by Standard Product Warranties or to provide greater rights to the Owner. Refer to individual sections of the Specifications for Special Warranty requirements.

1.03. WARRANTY REQUIREMENTS

A. All warranties begin at the date of Substantial Completion.

B. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to access the failed, warranted Work.

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C. When Work covered by a warranty has failed and been corrected, replaced, retested, and recommissioned, reinstate the warranty by written endorsement. The reinstated warranty shall equal the original warranty with an equitable depreciation adjustment.

D. Upon determination that Work covered by a warranty has failed, correct or replace the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of correcting, replacing, retesting, and recommissioning defective Work regardless of whether the Owner has benefited from use of the Work.

E. Written warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

F. The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

G. The Owner reserves the right to refuse to accept Work for the Project where a Special Warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

H. Owner acceptance of warranties does not relieve the Contractor of the warranty requirements specified in the General Conditions.

I. Ensure all Standard Product Warranties and Special Warranties are transferrable to Owner.

1.04. SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. WARRANTIES AND BONDS MANUAL: Assemble executed licenses, certificates, warranties, bonds, and any required service and maintenance contracts from the respective manufacturers, suppliers, and Subcontractors. Provide one (1) final signed copy of the Warranties and Bonds Manual following review and acceptance of the preliminary manual by the Owner.

1. Provide one (1) PDF document, including an index with hyperlinks to the individual sections.

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C. Include complete information for each of the following:

1. Neatly typed Table of Contents in a complete and orderly sequence.
2. Product or work item, including applicable specification section number(s) per the Contract Documents.
3. Firm, with name of principal, address, telephone number, email address, and web site address.
4. Scope of warranty.
5. Start date of warranty or service and maintenance contract.
6. Duration of warranty or service and maintenance contract.
7. Proper procedure in case of failure.
8. Instances that might affect validity of warranty or bond.
9. Contractor, name of responsible principal, address, and telephone number.
10. For Special Warranties, prepare a written document containing all pertinent information and ready for execution by the required parties.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01. SUMMARY

A. This section outlines the requirements for maintaining electronic documentation.

B. The Project Record to be maintained by the Contractor and delivered to the Owner prior to Final Completion includes the following:

1. Project Record Drawings (redline drawings).
2. CAD Drawings, where specified in the Contract Documents.

C. Prior to the start of construction, the Contractor will be provided with electronic copies of the Contract Documents and supporting information. These electronic copies will include 2D drawing files and text files. The drawings and text files will be in a file format acceptable to all parties. The file formats may include AutoCAD .dwg files, Microsoft Word .docx files, Microsoft Excel .xlsx files, and PDF files.

D. Electronic versions of the Contract Documents and other information are made available to the Contractor for informational purposes only. Neither the Owner nor any other party makes any warranties whatsoever with respect to the electronic copies (and hereby disclaim any implied warranties, including any implied warranty of accuracy). Contractor's use of this information shall be at the Contractor's sole risk. The Contractor shall check the electronic information provided for consistency with the Contract Documents.

1.02. PROJECT RECORD

A. GENERAL: Protect and backup record documents from deterioration and loss in a secure fire-resistant location. Record documents will be reviewed by the Owner on a monthly basis during construction. Project Record Documents shall be provided as Contractor redline documents. The Owner will be responsible for the creation of as-built drawings.

B. ELECTRONIC PROJECT RECORD DRAWINGS: Maintain an electronic version of the Contract Drawings and Shop Drawings in .pdf format. Use the electronic record drawings to show the actual installation where the installation varies substantively from

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the Work, as originally shown. Record changes on whichever drawing can show conditions fully and accurately. Where shop drawings are used, insert a hyperlink to the shop drawing at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Maintain electronic record drawings to distinguish separate categories of the Work. Good basic drafting practice must be applied.
2. Record new information that was not shown on Contract Documents or Shop Drawings. Record information concurrently with construction progress. No work shall be concealed until the required information is recorded. Should soil be placed without recording the concealed items, payment may delayed or withheld.
3. Show addenda items, Change Orders, and Request for Information (RFI) responses by their number and date the revisions with a “cloud” around the revision, with hyperlinks to the documents inserted into the corresponding location on the Contract Drawings.
4. Keep accurate measurements of underground services and utilities, referenced to the building, or if approved by Owner, the building or other permanent construction. Note changes of directions and locations, by dimensions and elevations, as utilities are actually installed.
5. Show location of construction-concealed internal utilities and appurtenances referenced to visible and accessible features of the structure.
6. Record accurate locations of piping, valves, equipment, and the like.
7. The following actual new construction and exposed existing items shall be recorded on the Project Record Drawings:
    a. Depth of foundation elements in relation to ground elevation.

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b. Horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements. Minimum accuracy requirements are specified in the following table.

Description	Horizontal Location	Vertical Location (elevation)	Notes
Pressurized piping	CL +/- 1 ft	CL +/- 0.01 ft	Includes water and process lines except irrigation systems
Gravity drains: floor, process, sewer, and storm.	CL +/- 1 ft	I.E. +/- 0.01 ft	Recalculate slope if shown
Irrigation sprinkler systems including lines, valves, risers and drains	Plotted to scale or dimensioned +/-1 ft (see note)	Nominal depth of cover	Dimensions required when location cannot be established on surface by valves and risers
Sewer interceptors and trunks (alignment and profile drawings)	Coordinates, stations, and offsets +/- 0.01 ft	I.E. +/- 0.01 ft	Recalculate actual slopes
Conduits, cable and duct banks at beginning and end of straight runs	CL +/- 3 inches	Nominal depth of cover to final grade or T.O.C. elevations +/-0.5 ft	Show conduit cross- sections, encasement width, and height for encased duct banks

CL = centerline

I.E. = invert elevation

T.O.C. = top of concrete

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c. The actual arrangement and routing of embedded conduit and piping relative to visible structural items. Conduit and piping shall be dimensioned off of walls, columns, or other similar features.

d. Precise Survey Measurements:

1) Taken on all final locations of buried or concealed items.

2) Coordinates and elevations of starting and ending points and at directional changes.

3) List survey coordinates on the Project Record Drawings.

4) Complete survey and recording before any burial by soil, concrete, or other materials.

8. Locate all covered structures including thrust blocks and piping junctions.

9. Indicate field changes of dimension and detail.

10. Cross out conditions not constructed and appropriately annotate "not constructed" to convey the actual "as constructed" condition.

11. Organize electronic record drawings in manageable sets, with cover sheets showing suitable titles, dates, and other appropriate identification.

12. Include links to signed off permits including plumbing, electrical, and building.

13. Submittal: Provide all Project Record Drawings in PDF format compatible with Bluebeam software.

C. FINAL DELIVERABLE: Provide the Project Record Drawings in PDF format on CDs, DVDs, or USB memory devices. Provide electronic copies of 2D drawing files.

1. The Engineer and Owner will be responsible for creating project as-built documents. Provide availability to answer any questions or clarifications the Engineer may have about the Contractor’s Project Record Drawings (redlines).

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION (NOT APPLICABLE TO THIS SECTION)

END OF SECTION

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SECTION 01 78 43

SPARE PARTS

PART 1 - GENERAL

1.01. SUMMARY

A. This Section summarizes spare parts inspection, storage, and acceptance requirements. Spare part types and quantities are specified in the individual equipment specifications.

PART 2 - PRODUCTS (NOT APPLICABLE TO THIS SECTION)

PART 3 - EXECUTION

3.01. INITIAL INSPECTION AND STORAGE

A. Provide seven (7) days written notification prior to shipment of spare parts to the site.

B. Include a completed Spare Parts Release Form (Form 01 78 43-A, Section 01 31 30) with the notification. Price information is required for individual spare parts. Listing one price for several spare parts is not acceptable. A single price may be provided for assemblies consisting of multiple parts/components, rebuild kits, or other groupings if they are listed as individual spare parts in the equipment specification.

C. Jointly inspect with Owner to verify spare part condition and quantity. If Owner agrees condition and quantity comply with the individual equipment specification, jointly sign initial inspection portion of Form 01 78 43-A.

D. Place spare parts into the on-site, Contractor-controlled, spare parts storage facility or in an alternate location approved by the Owner.

E. Store and protect spare parts in accordance with Section 01 66 00.

F. Protect spare parts subject to deterioration, such as ferrous metal items or electrical components, with lubricants and desiccants; hermetically seal in plastic wrap.

G. Place smaller parts in hinged wooden boxes or similar containers. Paint and identify boxes with stenciled lettering indicating "Spare Parts." Place an inventory sheet in a heavy-duty plastic protective sleeve and tape to the underside of the cover.

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H. Store on pallets or skids and identify as follows:

1. Alphanumerically order and tag Items/containers on each pallet/skid with the information listed below.
    a. Pallet or Skid Number.
    b. Container or Item I.D.
    c. Equipment Tag Number.
    d. Area Designation.
    e. System.
    f. Description of Equipment.
    g. Installation Location.
    h. Manufacturer.
    i. Serial Number.
    j. Contents of Container.
2. Equipment, pallets, or parts with inaccurate, incomplete, or missing tags will not be accepted.
3. Alphanumerically sequence pallets or skids with a unique designation. Begin sequence of items/containers on each pallet/skid with an "A." For example: If Pallet 007 contains five (5) items, items would be individually tagged and identified as 007-A, 007-B, 007-C, 007-D, and 007-E.

3.02. DELIVERY AND ACCEPTANCE

A. Provide fourteen (14) days written notification prior to spare parts delivery to Owner; notification shall include a copy of the same Spare Parts Release Form signed during the initial inspection.

B. Deliver spare parts to a location determined by the Owner.

C. Deliver spare parts during Commissioning of the associated equipment.

D. Jointly inspect spare parts with the Owner and verify condition and quantities. Mutual signoff on Form 01 78 43-A constitutes spare parts acceptance by Owner.

END OF SECTION

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SECTION 02 41 00
DEMOLITION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. Washington Administrative Code (WAC) 296-155 Safety Standards for Construction Work.
2. Environmental Protection Agency (EPA), U.S. Code of Federal Regulations (CFR), Title 40:
   a. Part 61—National Emission Standards for Hazardous Air Pollutants.
   b. Part 82—Protection of Stratospheric Ozone.
   c. Part 273—Standards for Universal Waste Management.

1.02 DEFINITIONS

A. ACM: Asbestos-containing material.

B. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof. Demolition also includes removal of pipes, manholes tanks, conduit, and other underground facilities, whether as a separate activity or in conjunction with construction of new facilities.

C. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.

D. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on Drawings.

E. Renovation: Altering a facility or one or more facility components in any way.

F. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless

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otherwise specified, title to items identified for demolition shall revert to Contractor.

G. Universal Waste Lamp: In accordance with 40 CFR 273, the bulb or tube portion of an electric lighting device, examples of which include, but are not limited to, fluorescent, high-intensity discharge, neon, mercury vapor, high-pressure sodium, and metal halide lamps.

H. Universal Waste Thermostat: A temperature control device that contains metallic mercury in an ampule attached to a bimetal sensing element, and mercury-containing ampules that have been removed from these temperature control devices in compliance with the requirements of 40 CFR 273.

1.03 SUBMITTALS

A. Informational Submittals:

1. Submit proposed Demolition/Renovation Plan, in accordance with requirements specified herein, for approval before such Work is started.
2. Submit copies of any notifications, authorizations and permits required to perform the Work.
3. Submit a shipping receipt or bill of lading for all universal waste shipped.

1.04 REGULATORY AND SAFETY REQUIREMENTS

A. When applicable, demolition Work shall be accomplished in strict accordance with WAC 296-155 and all related subsections.

B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.

C. Furnish timely notification of this renovation project to applicable federal, state, regional, and local authorities in accordance with 40 CFR 61-Subpart M.

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1.05 DEMOLITION/RENOVATION PLAN

A. Demolition/Renovation Plan shall provide for safe conduct of the Work and shall include:

1. Detailed description of methods and equipment to be used for each operation.
2. The Contractor's planned sequence of operations, including coordination with other work in progress.
3. Procedures for removal and disposition of materials specified to be salvaged.
4. Disconnection schedule of utility services.

B. Include statements affirming Contractor inspection of the construction and equipment, and their suitability to perform as a safe working platform or, if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the Work.

1.06 SEQUENCING AND SCHEDULING

A. The Work of this Specification shall not commence until Contractor's Demolition/Renovation Plan has been approved by Engineer.

B. Include the Work of this Specification in the progress schedule, as specified in Section 01 32 16, Construction Progress Schedule.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXISTING FACILITIES TO BE DEMOLISHED OR RENOVATED

A. Equipment:

1. Notify Engineer or appropriate utilities to turn off affected services at least forty-eight (48) hours before starting demolition or renovation activities.
2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Engineer.

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3. When utility lines are encountered that are not indicated on Drawings, notify Engineer prior to further work in that area.
4. Remove meters and related equipment and deliver to a location as determined by the Engineer.
5. Provide a permanent leak-proof closure for water and gas lines.

B. Concrete:

1. Core drill corners of new opening to avoid overcutting adjacent reinforcing in existing concrete to remain. Saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished Work, and the remaining concrete is sound.
2. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Repair exposed rebar ends and embeds by cutting rebar back 1/2 inch from the surface and patching pocket with epoxy grout.
3. Where new concrete adjoins existing concrete, thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 3/16 inch. Rebar and small embeds at existing concrete may be required to be left to engage new concrete. Saturate surface with water for twenty-four (24) hours prior to placing new concrete. The new Work shall tie into the existing construction as shown on Drawings.

C. Repair of Concrete Surfaces:

1. Where removals leave holes and damaged surfaces exposed in the finished Work, patch and repair to match adjacent finished surfaces as required in Section 03 01 32, Repair of Vertical and Overhead Concrete Surfaces, or Section 03 01 33, Repair of Horizontal Concrete Surfaces, as appropriate.
2. Where new Work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new Work. Patches shall be similar to the Structural Details Concrete Repair on Drawing.

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3. Repairs shall be as specified and indicated, and shall include:

   a. Prepare, clean, prime, fill, finish and core holes and depressions caused by previous physical damage or left as a result of removals in existing masonry or concrete walls with an approved Polymer-Modified Repair Mortar material, applied in accordance with the manufacturer's printed instructions.

D. Electrical:

1. Cut off concealed or embedded conduit, boxes, or other materials a minimum of 3/4-inch below final finished surface.
2. When removing designated equipment, conduit and wiring may require rework to maintain service to other equipment.
3. Rework existing circuits or provide temporary circuits as necessary during renovation to maintain service to existing lighting and equipment not scheduled to be renovated. Existing equipment and circuiting shown are based upon limited field surveys. Verify existing conditions, make all necessary adjustments, and record the Work on the Record Drawings. This shall include, but is not limited to, swapping and other adjustments to branch circuits and relocation of branch circuit breakers within panelboards as required to accomplish the finished work.
4. Reuse of existing luminaires, devices, conduits, boxes, or equipment will be permitted only where specifically indicated.
5. Raceways and cabling not scheduled for reuse.
6. Inaccessibly Concealed: Cut off and abandon in place.
7. Exposed or Concealed Above Accessible Ceilings: Remove.
8. Raceways and Cabling Scheduled for Future Use: Cap/seal and tag.
9. Relocating Equipment: Extend existing wiring or run new wiring from the source.
10. Where the existing raceway is concealed, the outlet box shall be cleaned, and a blank cover plate installed.
11. Where the concealed raceway is uncovered remove raceway (or extended to new location if appropriate).
12. Provide new typewritten panelboard circuit directory cards.

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E. Universal Waste Lamps and Thermostats: Manage, contain, package, and label in strict accordance with 40 CFR 273.

3.02 PROTECTION

A. Dust and Debris Control:

1. Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

2. Vacuum and dust the Work area daily.

B. Existing Work:

1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.

2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.

3. Provide temporary weather protection during interval between removal of existing exterior surfaces and installation of new to ensure that no water leakage or damage occurs to structure or interior areas of existing building.

4. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Engineer approval.

5. Do not overload pavements to remain.

C. Weather Protection: For portions of the building scheduled to remain, protect building interior and materials and equipment from weather at all times. Where removal of existing roof or roofing is necessary to accomplish the Work, have materials and workmen ready to provide adequate and temporary covering of exposed areas so as to ensure effectiveness and to prevent loss.

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D. Facilities:

1. Mark location and termination of utilities. Contractor shall perform ground penetrating radar (GPR) scanning of existing concrete walls and slabs prior to cutting or core drilling to check for embedded conduit and utilities.
2. Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.
3. Floors, roofs, walls, columns, pilasters, and other structural elements that are designed and constructed to stand without lateral support or shoring and are determined by Contractor to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Engineer.
4. Protect all facility elements not scheduled for demolition.
5. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities.

E. Protection of Personnel:

1. During demolition, continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.
2. Provide temporary barricades and other forms of protection to protect Owner's personnel and the general public from injury due to demolition Work.
3. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the structure.

3.03 BURNING

A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

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3.04 RELOCATIONS

A. Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Clean all items to be relocated prior to reinstallation, to the satisfaction of Engineer. Repair items to be relocated which are damaged or replace damaged items with new undamaged items as approved by Engineer.

3.05 BACKFILL

A. Do not use demolition debris as backfill material.

3.06 TITLE TO MATERIALS

A. All items designated to be removed shall become the property of Contractor.

B. Title to equipment and materials resulting from demolition or renovation is vested in the Contractor upon approval by Engineer of Contractor's Demolition/Renovation Plan, and the resulting authorization by Engineer to begin demolition or renovation.

3.07 DISPOSITION OF MATERIAL

A. Do not remove equipment and materials without approval of Contractor's Demolition/Renovation Plan by Engineer.

B. Salvage equipment and material to the maximum extent possible.

3.08 REUSE OF MATERIALS AND EQUIPMENT

A. Remove and store materials and equipment listed in Article Title To Materials, to be reused or relocated to prevent damage, and reinstall as the Work progresses.

B. Properly store and maintain equipment and materials in same condition as when removed.

C. Store equipment and material designated to be reused in a location designated by Engineer.

D. Equipment and material designated to be reused shall be cleaned, serviced, and checked for proper operability before being put back into service.

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E. Engineer will determine condition of equipment and materials prior to removal.

3.09 CLEANUP

A. Debris and rubbish shall be removed from basement and similar excavations. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION

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SECTION 03 01 32
REPAIR OF VERTICAL AND OVERHEAD CONCRETE SURFACES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
    a. 301, Specifications for Structural Concrete.
    b. 506.2, Specification for Shotcrete.
2. ASTM International (ASTM):
    a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
    b. A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
    c. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
    d. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
    e. C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
    f. C78/C78M, Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
    g. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
    h. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
    i. C293/C293M, Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading.
    j. C348, Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.

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k. C496/C496M, Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.

l. C531, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

m. C596, Standard Test Method for Drying Shrinkage of Mortar Containing Hydraulic Cement.

n. C666/C666M, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.

o. C882/C882M, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

p. C1202, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.

q. C1583/C1583M, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method).

r. D4258, Standard Practice for Surface Cleaning Concrete for Coating.

s. D4259, Standard Practice for Abrading Concrete.

t. E699, Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.

1.02 DEFINITIONS

A. Abrasive Blasting: Surface preparation method that uses compressed air intermixed with an abrasive medium to clean surface of substrate concrete, exposed steel, and steel reinforcement. Compressed air and abrasive medium is projected at high speed through a nozzle directly at the surface. Method is used to remove corrosion by-products, laitance, micro-cracked concrete or other materials that may inhibit bond of repair concrete.

B. Defective Area: Surface defect such as honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch diameter, cracks in liquid containment structures and below grade habitable spaces 0.005-inch wide and wider, cracks in other structures 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar

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leakage from form joints, deviations in formed surface that exceed specified tolerances which include but are not limited to fins, form pop-outs, and other projections, and at exposed concrete which includes texture irregularities, stains, and other color variations that cannot be removed by cleaning..

C. High-Pressure Water Blasting: Sometimes referred to as hydro-demolition. Uses water that may contain an abrasive medium, projected under high pressure and high velocity. Used for demolition, cutting, partial or full depth removal, cleaning, scarifying, or roughening of concrete surfaces, or removing micro-cracked concrete, existing coatings, for preparation of substrate concrete surfaces.

D. New Concrete: Concrete less than sixty (60) days old forming structures constructed as part of the Work.

1.03 SUBMITTALS

A. Action Submittals:

1. Product data sheets for each material supplied.
2. Drawings supplemented by photographs indicating location, size, estimated quantity, and proposed repair mortar for each repair location in existing concrete.

B. Informational Submittals:

1. Repair Mortar System: Manufacturer’s preparation and installation instructions.
2. Written description of equipment proposed for concrete removal and surface preparation.
3. Certificates:
   a. Manufacture’s certification of compliance that propose repair mortar systems are prepackaged, shrinkage compensated, and specially designed for use on vertical and overhead concrete surfaces that are exposed to weather.
   b. Polymer-modified Repair Mortar Manufacturer’s Certificate of Proper Installation.

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4. Statements of Qualification: Polymer-modified Repair Mortar system applicator.

5. Field and laboratory test reports.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Polymer-modified Repair Mortar System Applicator: For Low-Pressure Spray Mortar, in lieu of recognition or certification, demonstrate application of repair mortar manufacturer's system and obtain Certification of Proper Installation, from the manufacturer.

B. Independent Testing Laboratory: Meet criteria stated in ASTM E699.

C. Demonstration Mockup for Repair System B - Low-Pressure Spray Polymer-modified Mortar Repair System:

1. For each noted type of Polymer-modified Repair Mortar system to be used, prepare one demonstration mockup in each orientation of at least 1 foot by 1 foot with average thickness, and containing reinforcement, representative of area being repaired on Project. Alternatively, a repair area in each orientation that is representative of areas to be repaired in terms of size, thickness, and reinforcement, may be used for demonstration in lieu of mockups; subject to acceptance by Engineer.

2. Polymer-modified Repair Mortar System Manufacturer's Demonstration:

a. Schedule time for manufacturer's demonstration of repair system proposed for Project.

b. Prepare mortar to specified consistency for testing and placement.

c. Cure portions of each type of surface to be repaired using proposed curing procedure and materials, including overhead and vertical applications.

d. Prepare surface area in advance of demonstration and obtain manufacturer's acceptance of preparation for each type of application.

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e. Demonstrate the following:

1) Mixing and application equipment capabilities and procedures, including flow of material from nozzle or sprayer.

2) Nozzle operator, capabilities and ability to follow prescribed application procedures and properly operate equipment and apply surface repair materials.

f. Compression Strength Test: Make compression test samples from wet mortar during demonstration placement and deliver to independent testing laboratory for testing at seven (7) days and twenty-eight (28) days.

g. Tensile Bond Test: Test in situ or take a core of demonstration placement and test as specified herein below for tensile bond at seven (7) days as specified in Paragraph Direct Tension Bond Test.

D. Where Required by Engineer: Demonstration Mockup for Repair System C – trowel applied Polymer Modified Repair Mortar System:

1. Prepare one demonstration mockup in each orientation of average size and thickness, and containing reinforcement, representative of area being repaired on Project. Alternatively, a repair area in each orientation that is representative of areas to be repaired in terms of size, thickness, and reinforcement, may be used for demonstration in lieu of mockups; subject to acceptance by Engineer.

2. Trowel applied Polymer-modified Repair Mortar System Manufacturer's Demonstration:

a. Schedule time for manufacturer's demonstration of repair system proposed for Project.

b. Prepare polymer-modified repair mortar to specified consistency, for testing and placement.

c. Cure portions of each type of surface to be repaired using proposed curing procedure and materials, including overhead and vertical applications.

d. Prepare surface area in advance of demonstration and obtain manufacturer's acceptance of preparation for each type of application.

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e. Demonstrate mixing and application procedures.

f. Compression Strength Test: Make compression test samples from wet mortar during demonstration placement and deliver to independent testing laboratory for testing at seven (7) days and twenty-eight (28) days.

g. Tensile Bond Test: Test in situ or take a core of demonstration placement and test for tensile bond at seven (7) days as specified in Paragraph Direct Tension Bond Test.

E. Pre-repair Conference:

1. Required Meeting Attendees:

a. Contractor.

b. Repair Subcontractor.

c. Engineer.

2. Schedule and conduct prior to conducting mockups and incorporation of respective products into Project. Notify Engineer of location and time.

3. Agenda shall include, but not limited to:

a. Review of field conditions. Conduct field observations of Work to be performed.

b. Based on above observations, confirm material selection and make Project-specific repair method recommendations.

c. Review proposed surface preparation, material application, consolidation, finishing, curing, and protection of repair material from weather conditions.

d. Other specified requirements requiring coordination.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package repair mortar system products in moisture-resistant bags, pails, or moisture-resistant bulk bags.

B. Deliver, store, and handle repair materials in accordance with manufacturer's printed instructions.

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PART 2 PRODUCTS

2.01 REPAIR SYSTEM B – LOW-PRESSURE SPRAY MORTAR

A. One or two component, cement based, fiber reinforced, shrinkage compensated, gray in color, with a minimum 30-minute working time.

B. Cured materials mixed in accordance with manufacturer's instructions shall conform to the following criteria:

1. Compressive Strength, ASTM C109/C109M at 28 Days: 6,000 psi minimum.
2. Flexural Strength, ASTM C348 at 28 Days: 1,100 psi minimum.
3. Slant Shear Bond Strength, ASTM C882/C882M Test Method Modified with No Bonding Agent, at 28 Days: 2,000 psi minimum.
4. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 500 psi minimum.
5. Drying Shrinkage, ASTM C157/C157M Modified at 28 Days or ASTM C531: 0.1 percent maximum.
6. Chloride Ion Permeability Based on Charge Passed, ASTM C1202: 1,100 coulombs maximum.
7. System shall not produce a vapor barrier.
8. Sprayable, extremely low permeability, sulfate resistant, easy to use and requiring only addition of water.
9. Free of chlorides and other chemicals causing corrosion.

C. Manufacturers and Products:

1. Sika Corp., Lyndhurst, NJ; SikaCem 133.
2. W. R. Meadows, Hampshire, IL; MEADOW-CRETE GPS.
3. Euclid Chemical Co., Cleveland, OH; Tamms Structural Mortar.

2.02 REPAIR SYSTEM C – POLYMER-MODIFIED REPAIR MORTAR

A. Polymer-modified, one- or two-component cementitious based, chloride resistant, flowable, gray in color, working time of 20 minutes minimum, surface renovation mortar.

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B. Cured Polymer-Modified Repair Mortar Properties:

1. Compressive Strength, ASTM C109/C109M at 28 Days: 7,000 psi minimum.
2. Flexural Strength, ASTM C348 at 28 Days: 1,200 psi minimum.
3. Slant Shear Bond Strength, ASTM C882/C882M Test Method Modified with No Bonding Agent at 28 Days: 2,000 psi minimum.
4. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 500 psi minimum.
5. Drying Shrinkage, ASTM C596 at 28 Days: 0.12 percent maximum. Not required for small repair areas approximately 1 square foot in area or less.
6. Freeze Thaw Resistance, ASTM C666/C666M, at 300 Cycles: 90 percent RDM.
7. Chloride Ion Permeability Based on Charge Passed, ASTM C1202: 800 coulombs maximum for liquid holding and below grade repairs.

C. Manufacturers and Products:

1. SpecChem, Kansas City, MO; RepCon V/O.
2. Sika Corp., Lyndhurst, NJ; SikaTop 123 PLUS.
3. Euclid Chemical Co., Cleveland, OH; Verticoat.

2.03 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards, as specified in Section 03 30 00, Cast-in-Place Concrete.

2.04 REINFORCEMENT

A. Deformed Steel Reinforcement: Per Section 03 21 00, Steel Reinforcement.

B. Mesh Reinforcement: Welded wire fabric flat sheets with spacing of wires and wire size in accordance with ASTM A185/A185M, wire 75 ksi minimum tensile strength per ASTM A82/A82M, and repair mortar system manufacturer's recommendations.

C. Tie Wire: 16-gauge, galvanized.

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D. Mesh Anchors:

1. Manufacturers and Products:

a. Powers Fastening, Inc., Brewster, NY; Tie Wire Version of Power-Stud.

b. Hilti Fastener Systems, Tulsa, OK; Kwik Bolt II HHDCA, 1/4-inch ceiling hanger.

2.05 CEMENTITIOUS BONDING AGENT AND REINFORCEMENT COATING

A. Cementitious adhesive, specifically formulated for bonding polymer-modified mortar to hardened portland cement concrete.

1. Mixed Bonding Agent Properties:

a. Pot Life: 75 minutes to 105 minutes.

b. Contact Time: Twenty-four (24) hours.

2. Cured Cementitious Adhesive Properties:

a. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 500 psi minimum.

b. Flexural Strength, ASTM C348: 1,000 psi minimum.

c. Slant Shear Bond Strength, ASTM C882/C882M at 14 Days:

1) Two (2)-Hour Open Time: 2,500 psi minimum.

2) Twenty-four (24)-Hour Open Time: 2,000 psi minimum.

3. Bonding agent shall not produce a vapor barrier.

4. Compatible with and from same manufacturer as the repair system used.

B. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco P 124.

2. Sika Corp., Lyndhurst, NJ; Sika Armatec 110 EpoCem.

3. Euclid Chemical Co., Cleveland, OH: Dural Prep AC.

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PART 3 EXECUTION

3.01 GENERAL

A. Existing Concrete Work: Repair concrete as identified in Contract Documents.

3.02 APPLICATION

A. General:

1. Repair System B: Medium to large areas and number of repair areas.
2. Repair System C: Small and limited areas and number of repair areas.

3.03 PREPARATION

A. Identify unsound and deteriorated concrete by sounding techniques, or as directed by Engineer, and review proposed extent of repair with Engineer.

B. Remove unsound, honeycombed, deteriorated, or otherwise defective areas of concrete from work areas.

1. Use 15,000 psi minimum high-pressure water blasting machine as required for Site conditions.
2. Remove concrete to abrade substrate concrete surfaces to a minimum amplitude roughness of 3/16 inch measured between high and low points with a 3-foot-long straightedge, in accordance with ASTM D4259.
3. Where final surface is required to be flush with existing adjacent surface remove existing concrete depth as required for application of minimum thickness of repair mortar.

C. Do not use power-driven jackhammers, chipping hammers, or scabblers unless water blasting is not permitted or practical because of Site conditions, or may cause other damage to equipment or facilities. In such cases where chipping hammers are required, limit size of chipping hammer to 16 pounds or lighter, or use small electric chipping hammer, to reduce formation of micro-fractures in substrate concrete surface.

D. Following removal of unsound or deteriorated concrete, check substrate concrete surface by sounding techniques to identify unsound concrete remaining or resulting from use of chipping hammer.

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E. Remove unsound concrete to satisfaction of Engineer.

F. Square edges of patch areas by sawing or chipping to avoid tapered shoulders or featheredges. Avoid cutting embedded steel reinforcement. Roughen polished saw-cut edge by high-pressure water blasting.

G. Remove concrete adjacent to steel reinforcement to a minimum of 1-inch clearance around steel reinforcement for application and bonding of new repair mortar to circumference of exposed steel reinforcement if one or more of the following surface conditions exist:

1. 50 percent or more of circumference around steel reinforcement is exposed during concrete removal.
2. 25 percent or more of circumference around steel reinforcement is exposed during concrete removal and corrosion is present to extent that more than 25 percent loss of section has occurred.
3. Otherwise evident that bond between existing concrete and steel reinforcement has been destroyed or has deteriorated as determined by Engineer.

H. Clean exposed steel reinforcement of loose rust and concrete splatter per recommendations of repair material manufacturer and in accordance with ASTM D4258.

I. Keep areas from which concrete has been removed free of dirt, dust, and water blasting waste slurry. Remove laitance and other bond inhibiting contaminates from prepared areas.

J. Dampen repair areas at least 6 inches beyond area to receive repair mortar for at least twenty-four (24) hours to provide saturated surface dry (SSD) condition without standing water at time of application of mortar as required by and in accordance with repair mortar manufacturer's printed instructions.

K. Collect and dispose of spent water and concrete debris from removal operations offsite in manner and location acceptable to Owner.

3.04 REINFORCEMENT INSTALLATION

A. Replace deteriorated steel reinforcement with new steel reinforcement as shown on Drawing.

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B. Install mesh anchors in accordance with mesh manufacturer's instructions.

C. Fasten steel reinforcement to mesh anchors with tie wire to prevent from moving during placement of repair mortar.

D. Lap reinforcement mesh a minimum of one mesh spacing and securely fasten mesh to mesh anchors, or to reinforcement fastened to mesh anchors, with tie wire at intervals no more than 12 inches to prevent movement during application of repair mortar.

3.05 PROTECTION

A. If cementitious coating or bonding agent is used, protect adjacent surfaces from over application. Promptly remove bonding agent applied beyond repair area.

B. Protect adjacent surfaces, and equipment, from being damaged by overshooting, rebound, and dust, as applicable for repair mortar system used, from low-pressure spray mortar.

3.06 REPAIR SYSTEM B – LOW-PRESSURE SPRAY MORTAR PLACEMENT

A. Mix polymer-modified repair mortar in accordance with manufacturer's printed instructions.

B. After priming prepared substrate concrete surface per manufacturer's recommendations, apply mortar by low-pressure spraying equipment, unless noted otherwise.

C. Bonding Agent:

1. Use bonding agent when manufacture required for hand applied areas, in accordance with repair mortar manufacturer's instructions.
2. Application of repair mortar over bonding agent shall be completed within time frame recommended by bonding agent manufacturer.
3. Consult with manufacturer for optimum and minimum acceptable degrees of surface tackiness of coat.

D. Work mortar firmly and quickly into repair area.

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E. Finish repair mortar to match adjacent concrete surface.

F. Cure as specified in Article Curing.

3.07 REPAIR SYSTEM C – POLYMER-MODIFIED REPAIR MORTAR PLACEMENT

A. Mix polymer-modified repair mortar in accordance with manufacturer's printed instructions.

B. Bond Coat: Apply to prepared substrate concrete surface before application of mortar in accordance with repair mortar manufacturer's printed instructions. Do not apply more bond coat than can be covered with mortar before bond coat dries. Do not retemper bond coat.

C. Place mortar by hand or low-pressure spray and trowel to specified surface finish, in accordance with requirements of repair material's printed instructions.

D. Finish repair mortar to smooth even surface to match adjacent concrete surface.

3.08 CURING

A. Prior to curing, apply water fog to repair mortar system in accordance with repair mortar system manufacturer's printed instructions.

B. Cure in accordance with polymer-modified repair mortar manufacturer's printed instructions.

C. Where permitted by polymer-modified repair mortar manufacturer's printed instructions, commence water curing after repair mortar system application and when curing will not cause erosion of mortar.

D. Continuously water cure polymer-modified repair mortar system for a period of seven (7) days.

E. Do not cure using curing compound or membrane, unless method is part of repair mortar system manufacturer's printed instructions and approval is obtained from Engineer.

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F. Cure intermediate layers of polymer-modified repair mortar in accordance with polymer-modified repair mortar manufacturer's printed instructions.

G. Where curing compound is permitted by repair mortar system manufacturer, apply curing compound in accordance with Section 03 39 00, Concrete Curing.

3.09 FIELD QUALITY CONTROL

A. Sounding for Hollow Areas:

1. Light hammer tap repaired areas listening for hollow sound to determine areas that have not properly bonded to substrate concrete.
2. Mark hollow areas for removal and replacement.

B. Compression Strength Test:

1. Test in accordance with ASTM C109/C109M, except modified by making samples using polymer-modified repair mortar.
2. Obtain production samples of mixed wet polymer-modified repair mortar materials from nozzle, or mixer, during construction for compliance with Specifications for testing at seven (7) days and twenty-eight (28) days. Alternatively, take core samples in accordance with ASTM C42/C42M from applied mortar material for testing at seven (7) days and twenty-eight (28) days.
3. Provide a minimum of three (3) samples for each 200 square feet of polymer-modified mortar repair, and a minimum of three (3) samples in total, whichever is greater, for testing.
4. Record location where polymer-modified repair mortar is being applied at time production samples are obtained.

C. Direct Tension Bond Test:

1. In Situ Bond Testing: Perform tension bond test in accordance with ASTM C1583/C1583M.
2. Record locations on in situ bond tests on each type of applied repair mortar.

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D. Testing laboratory retained by Owner will provide the following:

1. Compression Strength Test:

a. Testing will follow a “modified” ASTM C109/C109M.

b. A minimum of three (3) production samples of mixed material will be obtained from each 200 square feet of polymer-modified mortar repair, and a minimum of three (3) samples in total, whichever is greater, for testing at seven (7) days and twenty-eight (28) days.

c. Record location where polymer-modified repair mortar is being applied at time production samples are obtained.

2. Direct Tension Bond Test:

a. Two (2) core samples will be obtained and tested for each 2,000 square feet of repair work.

b. Cores will be 2-1/2-inch or 3-inch diameter to a total depth equal to at least 2.5 times polymer-modified repair mortar thickness.

c. Bond Strength of Polymer-modified Repair Mortar to Substrate Concrete: 300 psi minimum in direct tension without failure or movement.

d. Record locations of Bond Tests on each type of applied polymer-modified repair mortar tested.

E. Retest polymer-modified mortar repairs that do not meet test requirements.

F. Repair and fill holes using polymer-modified same repair mortar where core samples have been removed.

3.10 MORTAR REPAIR FAILED TEST

A. Remove and replace unacceptable Work.

B. Hollow Sounding Areas: Saw cut hollow sounding areas to a new square edge. Remove unsound mortar repair. Prepare substrate surface and reapply polymer-modified repair mortar as specified herein above.

C. Failed Compression Strength Test: Remove affected areas of polymer-modified repair mortar represented by failed compression strength test results. Prepare

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substrate surface and reapply polymer-modified repair mortar as specified herein above.

D. Failed Bond Tests: Remove affected areas of polymer-modified repair mortar represented by failed bond test results. Prepare substrate surface and reapply polymer-modified repair mortar as specified herein above.

E. Retest areas where polymer-modified repair mortar was removed and replaced, in accordance with test requirements specified herein above.

3.11 CLEANING

A. Remove overshot low-pressure spray, repair system polymer-modified repair mortar and rebound materials as the Work proceeds. Remove waste materials, unsound material from concrete surfaces, material chipped from structure, and water used in preparation of or repair areas, finishing, and curing, and dispose offsite at an approved disposal site.

END OF SECTION

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SECTION 03 01 33
REPAIR OF HORIZONTAL CONCRETE SURFACES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): T277, Standard Method of Test for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.
2. ASTM International (ASTM):
   a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   b. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   c. C42/C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   d. C78/C78M, Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
   e. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
   f. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
   g. C348, Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
   h. C469, Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.
   i. C496/C496M, Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
   j. C779/C779M, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.

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k. C882/C882M, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

l. C928/C928M, Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs.

m. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.

n. C1202, Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration.

o. C1583/C1583M, Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method).

p. D638, Standard Test Method for Tensile Properties of Plastics.

q. D695, Standard Test Method for Compressive Properties of Rigid Plastics.

r. D4258, Standard Practice for Surface Cleaning Concrete for Coating.

s. D4259, Standard Practice for Abrading Concrete.

t. E699, Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components.

1.02 DEFINITIONS

A. Abrasive Blasting: Surface preparation method that uses compressed air intermixed with an abrasive medium to clean surface of substrate concrete, exposed steel, and steel reinforcement. Compressed air and abrasive medium is projected at high speed through a nozzle directly at the surface. Method is used to remove corrosion by-products, laitance, micro-cracked concrete or other materials that may inhibit bond of repair concrete.

B. Defective Area: Surface defect such as honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch diameter, cracks in liquid containment structures and below grade habitable spaces 0.005-inch wide and wider, cracks in other structures 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances which include but are not limited to fins, form pop-outs, and other

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projections, and at exposed concrete which includes texture irregularities, stains, and other color variations that cannot be removed by cleaning.

C. High-Pressure Water Blasting (sometimes referred to as hydro-demolition): Uses water that may contain an abrasive medium, projected under high pressure and high velocity. Used for demolition, cutting, partial or full depth removal, cleaning, scarifying, or roughening of concrete surfaces, or removing micro-cracked concrete, existing coatings, for preparation of substrate concrete surfaces.

D. New Concrete: Concrete less than sixty (60) days old forming structures constructed as part of the Work.

1.03 SUBMITTALS

A. Action Submittals:

1. Product data sheets for each material supplied.
2. Drawings supplemented by photographs indicating location, size, estimated quantity, and proposed repair mortar for each repair location in existing concrete.

B. Informational Submittals:

1. Repair Mortar System: Manufacturer's preparation and installation instructions.
2. Written description of equipment proposed for concrete removal and surface preparation.
3. Certificates:
    a. Manufacturer's certificate of compliance that proposed repair mortar systems are prepackaged, shrinkage compensated, and specially designed for use on vertical and overhead surfaces that are exposed to weather.
    b. Polymer-modified Repair Mortar Manufacturer's Certificate of Proper Installation.
4. Statements of Qualification: Polymer-modified Repair Mortar system applicator.
5. Field and laboratory test results.

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1.04 QUALITY ASSURANCE

A. Qualifications:

1. Polymer- Modified Repair Mortar System Applicator: Trained and experienced applicator endorsed by repair mortar system manufacturer. In lieu of recognition or certification, demonstrate application of repair mortar manufacturer's system and obtain Certification of Proper Installation, from the manufacturer.

B. Pre-repair Conference:

1. Required Meeting Attendees:
   a. Contractor.
   b. Repair Subcontractor.
   c. Engineer.
2. Schedule and conduct prior to incorporation of respective products into Project. Notify Engineer of location and time.
3. Agenda shall include, but not limited to:
   a. Review of field conditions. Conduct field observations of the Work to be performed.
   b. Other requirements requiring coordination.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package repair mortar system products in moisture-resistant bags, pails, or moisture-resistant bulk bags.

B. Deliver, store, and handle repair materials in accordance with manufacturer's printed instructions.

PART 2 PRODUCTS

2.01 POLYMER MODIFIED REPAIR MORTAR

A. Polymer-modified, one- or two-component cementitious based, chloride resistant, flowable, gray in color, working time of 20 minutes minimum, surface renovation mortar.

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B. Cured Polymer-Modified Repair Mortar Properties:

1. Compressive Strength, ASTM C109/C109M at 28 Days: 7,000 psi minimum.
2. Flexural Strength, ASTM C348 at 28 Days: 1,200 psi minimum.
3. Slant Shear Bond Strength, ASTM C882/C882M Test Method Modified with No Bonding Agent at 28 Days: 2,000 psi minimum.
4. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 500 psi minimum.
5. Drying Shrinkage, ASTM C596 at 28 Days: 0.12 percent maximum. Not required for small repair areas approximately 1 square foot in area or less.
6. Freeze Thaw Resistance, ASTM C666/C666M, at 300 Cycles: 90 percent RDM.
7. Chloride Ion Permeability Based on Charge Passed, ASTM C1202: 800 coulombs maximum for liquid holding and below grade repairs.

C. Manufacturers and Products:

1. Sika Corp., Lyndhurst, NJ; SikaTop 122 PLUS.
2. SpecChem, Kansas City, MO; RepCon V/O.
3. Approved equal.

2.02 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards, as specified in Section 03 30 00, Cast-in-Place Concrete.

2.03 BONDING AGENT AND REINFORCEMENT COATING

A. Cementitious adhesive, specifically formulated for bonding plastic portland cement concrete or mortar to hardened portland cement concrete.

1. Mixed Bonding Agent Properties:
   a. Pot Life: 75 minutes to 105 minutes.
   b. Contact Time: Twenty-four (24) hours.

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2. Cured Cementitious Adhesive Properties:

a. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 600 psi minimum.

b. Flexural Strength, ASTM C348: 1,000 psi minimum.

c. Slant Shear Bond Strength, ASTM C882/C882M:

1) Two (2)-Hour Open Time: 2,500 psi minimum.

2) Twenty-four (24)-Hour Open Time: 2,000 psi minimum.

3. Bonding agent shall not produce a vapor barrier.

4. Compatible with, and from same manufacturer as the, repair mortar system used.

B. Manufacturers and Products:

1. Sika Corp., Lyndhurst, NJ; Sika Armatec 110 EpoCem.

2. Approved equal.

2.04 REINFORCEMENT

A. Deformed Steel Reinforcement: Per Section 03 21 00, Steel Reinforcement.

B. Mesh Reinforcement: Welded wire fabric flat sheets with spacing of wires and wire size in accordance with ASTM A185/A185M, wire 75 ksi minimum tensile strength per ASTM A82/A82M, and repair mortar system manufacturer's recommendations.

C. Tie Wire: 16-gauge, galvanized.

D. Mesh Anchors:

1. Manufacturers and Products:

a. Powers Fastening, Inc., Brewster, NY; Tie Wire Version of Power-Stud.

b. Hilti Fastener Systems, Tulsa, OK; Kwik Bolt II HHDCA, 1/4-inch ceiling hanger.

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2.05 CEMENTITIOUS BONDING AGENT AND REINFORCEMENT COATING

A. Cementitious adhesive, specifically formulated for bonding polymer-modified mortar to hardened portland cement concrete.

1. Mixed Bonding Agent Properties:

a. Pot Life: 75 minutes to 105 minutes.

b. Contact Time: Twenty-four (24) hours.

2. Cured Cementitious Adhesive Properties:

a. Splitting Tensile Strength, ASTM C496/C496M at 28 Days: 500 psi minimum.

b. Flexural Strength, ASTM C348: 1,000 psi minimum.

c. Slant Shear Bond Strength, ASTM C882/C882M at 14 Days:

1) Two (2)-Hour Open Time: 2,500 psi minimum.

2) Twenty-four (24)-Hour Open Time: 2,000 psi minimum.

3. Bonding agent shall not produce a vapor barrier.

4. Compatible with and from same manufacturer as the repair system used.

B. Manufacturers and Products:

1. BASF Construction Chemicals, LLC - Building Systems, Shakopee, MN; MasterEmaco P 124.

2. Sika Corp., Lyndhurst, NJ; Sika Armatec 110 EpoCem.

3. Euclid Chemical Co., Cleveland, OH: Dural Prep AC.

PART 3 EXECUTION

3.01 GENERAL

A. New Concrete Work: Repair deficiencies in new concrete structures constructed under this Contract with applicable repair system.

B. Existing Concrete Work: Repair concrete as identified in Contract Documents.

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3.02 PREPARATION

A. Identify unsound and deteriorated concrete by sounding techniques, or as directed by Engineer. Review proposed extent of repair with Engineer.

B. Remove unsound, honeycombed, deteriorated, or otherwise defective areas of concrete from work areas.

1. Use 15,000 psi minimum high-pressure water blasting machine as required for Site conditions.
2. Remove concrete to abrade substrate concrete surfaces to a minimum amplitude roughness of 3/16 inch measured between high and low points with a 3-foot-long straightedge, in accordance with ASTM D4259.
3. Where final surface is required to be flush with existing adjacent surface remove existing concrete depth as required for application of minimum thickness of repair mortar.

C. Do not use power-driven jackhammers, chipping hammers, scabblers, or scarifiers unless water blasting is not permitted or practical because of Site conditions, or may cause other damage to equipment or facilities. In such cases where chipping hammers are required, limit size of chipping hammer to 16 pounds or lighter, or use small electric chipping hammer, to reduce formation of micro-fractures in substrate concrete surface.

D. Following removal of unsound or deteriorated concrete, check substrate concrete surface by sounding techniques to identify unsound concrete remaining or resulting from use of chipping hammer.

E. Remove unsound concrete to satisfaction of Engineer.

F. Square edges of patch areas by sawing or chipping to avoid tapered shoulders or featheredges. Avoid cutting embedded steel reinforcement. Roughen polished saw-cut edge by high-pressure water blasting or abrasive blasting.

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G. Remove concrete adjacent to steel reinforcement to a minimum of 1-inch clearance around steel reinforcement for application and bonding of new repair mortar to entire circumference of exposed steel reinforcement if one or more of the following surface conditions exist:

1. 50 percent or more of circumference around steel reinforcement is exposed during concrete removal.
2. 25 percent or more of circumference around steel reinforcement is exposed during concrete removal and corrosion is present to extent that more than 25 percent loss of section has occurred.
3. Otherwise evident that bond between existing concrete and steel reinforcement has been destroyed or has deteriorated as determined by Engineer.

H. Clean exposed steel reinforcement of loose rust and concrete splatter per recommendations of repair material manufacturer and in accordance with ASTM D4258.

I. Keep areas from which concrete has been removed free of dirt, dust, and water blasting waste slurry. Remove laitance and other bond inhibiting contaminates from prepared areas.

J. Preparation of Substrate Concrete Surface in Areas to Receive Polymer Modified Repair Mortar: Dampen repair areas at least 6 inches beyond area to receive repair mortar for at least forty-eight (48) hours to provide saturated surface dry (SSD) condition without standing water at time of application of mortar, as required by and in accordance with repair mortar manufacturer's printed instructions.

K. Collect and dispose of spent water and concrete debris from removal operations offsite in manner and location acceptable to Owner.

3.03 REINFORCEMENT INSTALLATION

A. Replace deteriorated steel reinforcement with new steel reinforcement as shown on Drawing.

B. Install mesh anchors in accordance with mesh manufacturer's instructions.

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C. Fasten steel reinforcement to mesh anchors with tie wire to prevent from moving during placement of repair mortar.

D. Lap reinforcement mesh a minimum of one mesh spacing and securely fasten mesh to mesh anchors, or to reinforcement fastened to mesh anchors, with tie wire at intervals no more than 12 inches to prevent movement during application of repair mortar.

3.04 PROTECTION

A. If cementitious coating or bonding agent is used, protect adjacent surfaces from over application. Promptly remove bonding agent applied beyond repair area.

B. Protect adjacent surfaces, and equipment from spillage of repair mortar and dust, as applicable for repair mortar system used.

3.05 PLACEMENT

A. Polymer Modified Mortar System:

1. Mix polymer-modified repair mortar in accordance with manufacturer's printed instructions.
2. Bond Coat: Apply to prepared substrate concrete surface before application of mortar in accordance with repair mortar manufacturer's printed instructions. Do not apply more bond coat than can be covered with mortar before bond coat dries. Do not retemper bond coat.
3. Place mortar by hand or low-pressure spray and trowel to specified surface finish, in accordance with requirements of repair material's printed instructions.
4. Finish repair mortar to smooth even surface to match adjacent concrete surface.

3.06 CURING

A. Prior to curing, apply water fog to repair mortar system in accordance with repair mortar system manufacturer's printed instructions.

B. Cure in accordance with polymer-modified repair mortar manufacturer's printed instructions.

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C. Where permitted by polymer-modified repair mortar manufacturer's printed instructions, commence water curing after repair mortar system application and when curing will not cause erosion of mortar.

D. Continuously water cure polymer-modified repair mortar system for a period of seven (7) days.

E. Do not cure using curing compound or membrane, unless method is part of repair mortar system manufacturer's printed instructions and approval is obtained from Engineer.

F. Cure intermediate layers of polymer-modified repair mortar in accordance with polymer-modified repair mortar manufacturer's printed instructions.

G. Where curing compound is permitted by repair mortar system manufacturer, apply curing compound in accordance with Section 03 39 00, Concrete Curing.

3.07 FIELD QUALITY CONTROL

A. Sounding for Hollow Areas:

1. Chain drag or light hammer tap repaired areas listening for hollow sound to determine areas that have not properly bonded to substrate concrete.
2. Mark hollow areas for removal and replacement.

B. Compression Strength Test:

1. Test in accordance with ASTM C109/C109M, except modified by making samples using polymer-modified repair mortar.
2. Obtain production samples of mixed wet polymer-modified repair mortar materials from nozzle, or mixer, during construction for compliance with Specifications for testing at seven (7) days, and twenty-eight (28) days. Alternatively, take core samples in accordance with ASTM C42/C42M from applied mortar material for testing at seven (7) days and twenty-eight (28) days.
3. Provide a minimum of three (3) samples for each 200 square feet of polymer-modified mortar repair, and a minimum of three (3) samples in total, whichever is greater, for testing.

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4. Record location where polymer-modified repair mortar is being applied at time production samples are obtained.

C. Direct Tension Bond Test:

1. In Situ Bond Testing: Perform tension bond test in accordance with ASTM C1583/C1583M.
2. Record locations on in situ bond tests on each type of applied repair mortar.

D. Testing laboratory retained by Owner will provide the following:

1. Compression Strength Test:
   a. Testing will follow a "modified" ASTM C109/C109M.
   b. A minimum of three (3) production samples of mixed material will be obtained from each 200 square feet of polymer-modified mortar repair, and a minimum of three (3) samples in total, whichever is greater, for testing at seven (7) days, and twenty-eight (28) days.
   c. Record location where polymer-modified repair mortar is being applied at time production samples are obtained.
2. Direct Tension Bond Test:
   a. Two (2) core samples will be obtained and tested for each 2,000 square feet of repair work.
   b. Cores will be 2-1/2-inch or 3-inch diameter to a total depth equal to at least 2.5 times polymer-modified repair mortar thickness.
   c. Bond Strength of Polymer-modified Repair Mortar to Substrate Concrete: 300 psi minimum in direct tension without failure or movement.
   d. Record locations of Bond Tests on each type of applied polymer-modified repair mortar tested.

E. Retest polymer-modified mortar repairs that do not meet test requirements.

F. Repair and fill holes using polymer-modified same repair mortar where core samples have been removed.

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3.08 MORTAR REPAIR FAILED TEST

A. Remove and replace unacceptable Work.

B. Hollow Sounding Areas: Saw cut hollow sounding areas to a new square edge. Remove unsound mortar repair. Prepare substrate surface and reapply polymer-modified repair mortar as specified herein above.

C. Failed Compression Strength Test: Remove affected areas of polymer-modified repair mortar represented by failed compression strength test results. Prepare substrate surface and reapply polymer-modified repair mortar as specified herein above.

D. Failed Bond Tests: Remove affected areas of polymer-modified repair mortar represented by failed bond test results. Prepare substrate surface and reapply polymer-modified repair mortar as specified herein above.

E. Retest areas where polymer-modified repair mortar was removed and replaced, in accordance with test requirements specified herein above.

3.09 CLEANING

A. Remove excess repair mortar materials as the Work proceeds. Remove waste materials, unsound material from concrete surfaces, material chipped from structure, and water used in preparation of repair areas, finishing, and curing, and dispose offsite at approved disposal site.

END OF SECTION

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SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):

a. 117, Specification for Tolerances for Concrete Construction and Materials.

b. 301, Specifications for Structural Concrete.

c. 318, Building Code Requirements for Structural Concrete.

1.02 DEFINITIONS

A. Defective Areas: See definition in Section 03 30 00, Cast-in-Place Concrete.

B. Exposed Concrete: See definition in Section 03 30 00, Cast-in-Place Concrete.

1.03 DESIGN REQUIREMENTS

A. Design formwork to provide concrete finishes specified in Section 03 30 00, Cast-in-Place Concrete.

B. Unless otherwise specified, limit deflection of facing materials for concrete surfaces to comply with ACI 301. Limit deflection of facing materials to comply with tolerance limits established by Contract Documents and with tolerances required by equipment manufacturers. Coordinate tolerance requirements with equipment manufacturers.

1.04 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Form release agent.

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b. Form ties.

c. Products to be used for sealing tie holes.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Formwork Designer: Formwork, falsework, and shoring design shall be designed by person experienced with formwork design.

PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Wall Forms and Underside of Slabs and Beams:

1. Materials: Plywood, hard plastic finished plywood, overlaid waterproof particle board, or steel in “new and undamaged” condition, of sufficient strength and surface smoothness to produce specified finish.

2. Where steel forms are used, treat steel surfaces to prevent rusting using products approved for use on steel forms.

B. All Other Forms: Materials as specified for wall forms.

2.02 ACCESSORIES

A. Form Release Agent:

1. Material:

a. Shall not bond with, stain, or adversely affect concrete surfaces.

b. Shall not impair subsequent treatments of concrete surfaces when applied to forms.

c. Ready-to-use water-based material formulated to reduce or eliminate surface imperfections.

d. Contain no mineral oil or organic solvents.

2. Manufacturers and Products: Not for surfaces exposed to potable water.

a. Master Builders, MasterFinish RL 211.

b. Cresset Chemical Company; Crete-Lease 20-VOC-Xtra.

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B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.

C. Form Snap-Ties:

1. Material: Stainless steel.
2. Spreader Inserts:
   a. Conical or spherical type.
   b. Design to maintain positive contact with forming material.
   c. Furnish units that will leave no metal closer than 1.5 inches to concrete surface when forms, inserts, and tie ends are removed.
3. Wire ties not permitted.
4. Flat bar ties for panel forms; furnish plastic or rubber inserts with minimum 1.5-inch depth and sufficient dimensions to permit patching of tie hole.

PART 3 EXECUTION

3.01 FORM SURFACE PREPARATION

A. Prior to coating surface, thoroughly clean form surfaces that will be in contact with concrete or that have been in contact with previously cast concrete, dirt, and other surface contaminants.

B. Exposed Wood Forms in Contact with Concrete: Apply form release agent as recommended by manufacturer.

C. Steel Forms: Apply form release agent as soon as they are cleaned to prevent discoloration of concrete from rust.

3.02 ERECTION

A. General: In accordance with ACI 301, unless otherwise specified.

B. Beveled Edges (Chamfer):

1. Form 3/4-inch bevels at concrete edges, unless otherwise shown.

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2. Where beveled edges on existing adjacent structures are other than 3/4 inch, obtain Engineer's approval of size prior to placement of beveled edge.

C. Forms:

1. Do not reuse forms with damaged surfaces.
2. Locate form ties and joints in uninterrupted uniform pattern.
3. Inspect form surfaces prior to installation to ensure conformance with specified tolerances.

D. Form Tolerances:

1. Provide forms in accordance with ACI 117 and ACI 318, and the following tolerances for finishes specified:
   a. See the Schedule of Concrete Finishes in Section 03 30 00, Cast-in-Place Concrete.
   b. Tolerances:
      1) Straight Vertical or Horizontal Surface: Flat planes within tolerance specified.
         a) Flat or Plumb within 1/8 inch in 10 feet.
         b) Depressions in Surface: Maximum 1/8 inch when 10-foot straightedge is placed on high points in all directions.
      2) Thickness: Maximum 1/4-inch minus or 1/2-inch plus from dimension shown.
      3) Form Offset: Between adjacent pieces of formwork, facing material shall not exceed 1/8-inch.

3.03 FORM REMOVAL

A. Nonsupporting forms, may be removed after cumulatively curing at not less than 50 degrees F for twenty-four (24) hours from time of concrete placement if:

1. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
2. Curing and protection operations are maintained.

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B. Form Ties: Remove conical inserts and plug holes as specified in Section 03 30 00, Cast-in-Place Concrete.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 00, Contractor Quality Control.

END OF SECTION

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SECTION 03 21 00
STEEL REINFORCEMENT

PART 1 GENERAL

1.01 GENERAL

A. Steel reinforcement shall comply with ACI 301 and as modified in the following.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
    a. 117, Specification for Tolerances for Concrete Construction and Materials.
    b. 301, Specifications for Structural Concrete.
    c. 318, Building Code Requirements for Reinforced Concrete
    d. SP-66, Detailing Manual.
2. American Welding Society (AWS): D1.4/D1.4M, Structural Welding Code - Reinforcing Steel.
3. ASTM International (ASTM):
    a. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
    b. A706/A706M, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
    c. A767/767M, Standard Specification for Zinc-Coated (Galvanized) Steel bars for Concrete Reinforcement
    d. A775/A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
    e. A1064/A1064M, Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

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4. Concrete Reinforcing Steel Institute (CRSI):
    a. Placing Reinforcing Bars.
    b. Manual of Standard Practice.
5. International Code Council (ICC): Evaluation Services Report.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings prepared in accordance with ACI 301 and ACI SP-66:
    a. Bending lists.
    b. Placing drawings.
2. Welded, metallic sleeve splice, and mechanical threaded connection.

B. Informational Submittals:

1. Lab test reports for steel reinforcement showing stress-strain curves and ultimate strengths.
2. Mechanical Threaded Connections:
    a. Current ICC Evaluation Services Report or equivalent code agency report listing findings to include acceptance requirements, and restrictions.
    b. Verification device threads have been tested and meet requirements for thread quality, in accordance with manufacturer's published methods.
    c. Manufacturer's instructions.
3. Test results of field testing.

1.04 DELIVERY, STORAGE, AND HANDLING

A. In accordance with ACI 301 and recommendations of CRSI Placing Reinforcing Bars.

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PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing Bars:

1. Includes stirrups, ties, and spirals.
2. ASTM A615/A615M, Grade 60.

B. Mechanical Splices and Connections:

1. Mechanical Threaded Connections:
   a. Furnish metal coupling sleeve with internal threads engaging threaded ends of bars developing in tension or compression 125 percent of yield strength of bar.
   b. Manufacturers and Products:
      1) NVent/Lenton, Inc.; Lenton Reinforcing Steel Couplers.
      2) Dayton Superior, Inc.; Bar Lock Couplers.
      3) Approved equal.

2.02 ACCESSORIES

A. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-, epoxy-, or plastic-coated wire.

B. Bar Supports and Spacers:

1. Use precast concrete bar supports or all-plastic bar supports and side form spacers, unless noted otherwise. Do not use other types of supports or spacers.
2. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports.
3. Use only precast concrete bar supports where concrete surfaces are exposed to weather, earth, water, chloride intrusion, or corrosive

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chemicals. Bar supports shall be nonconductive and have geometry and bond characteristics that deter movement of moisture from the surface to the reinforcement.

4. Precast concrete supports shall have same minimum strength and shall be made from same materials as that of the concrete in which they are to be embedded. Precast concrete supports shall be cast and properly cured for at least seven (7) days before use and shall have a wire or other device cast into each block for the purpose of attaching them securely to steel reinforcement.

5. Design and fabricate special bar supports for top reinforcing bars in slabs where standard bar supports do not possess necessary geometry, strength, or stiffness.

6. Plastic Bar Supports: Manufactured by Aztec Concrete Accessories, Bloomington, CA.

7. Precast Concrete Supports: Total bond precast, high-performance concrete bar supports as supplied by Dayton Superior, Miamisburg, OH, Dobies.

PART 3 EXECUTION

3.01 PREPARATION

A. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for inspection prior to placing concrete.

B. Clean reinforcing bars of loose mill scale, oil, earth, and other contaminants.

3.02 INSTALLATION

A. Bundle or space bars, instead of field bending where construction access through reinforcing is necessary.

B. Splicing:

1. Minimum length of lap splices shall comply with the requirements of ACI 318.

2. Use Class B lap splices, unless otherwise shown or permitted in writing by Engineer.

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3. Stagger splices in adjacent bars where indicated.

C. Mechanical Splices and Connections:

1. Use only in areas specifically approved in writing by Engineer.
2. Install threaded rods as recommended by manufacturer with threads totally engaged into coupling sleeve and in accordance with ICC Evaluation Services Report or equivalent code agency report.
3. For metal sleeve splice, follow manufacturer's installation recommendations.
4. Maintain minimum edge distance and concrete cover.

D. Tying Reinforcing Bars:

1. Tie every other intersection on mats made up of Nos. o3, 4, 5, and 6 bars to hold them firmly at required spacing.
2. Bend tie wire away from concrete surface to provide clearance of 1 inch from surface of concrete to tie wire.

E. Reinforcement Around Openings: On each side and above and below pipe or opening, place an equivalent area of steel bars to replace steel bars cut for opening. Extend steel reinforcing a standard lap length beyond opening at each end.

F. Straightening and Rebending: Field bending of steel reinforcement bars is not permitted.

G. Unless permitted by Engineer, do not cut reinforcing bars in field.

3.03 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 00, Contractor Quality Control.

END OF SECTION

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Concrete Institute (ACI):
    a. 117, Specification for Tolerances for Concrete Construction and Materials.
    b. 301, Specifications for Structural Concrete.
    c. 305.1, Specification for Hot Weather Concreting.
    d. 306.1, Standard Specification for Cold Weather Concreting.
    e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.
    f. CP-1, Technical Workbook for ACI Certification of Concrete Field Testing Technician – Grade 1.
2. ASTM International (ASTM):
    a. C31/C31M, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
    b. C33/C33M, Standard Specification for Concrete Aggregates.
    c. C39/C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
    d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
    e. C109/C109M, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
    f. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
    g. C150/C150M, Standard Specification for Portland Cement.
    h. C157/C157M, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.

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i. C231/C231M, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

j. C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.

k. C494/C494M, Standard Specification for Chemical Admixtures for Concrete.

l. C595/C595M, Standard Specification for Blended Hydraulic Cements.

m. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

n. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

o. C979/C979M, Standard Specification for Pigments for Integrally Colored Concrete.

p. C989, Standard Specification for Slag Cement for Use in Concrete and Mortars.

q. C1012/C1012M, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.

r. C1074, Standard Practice for Estimating Concrete Strength by the Maturity Method.

s. C1077, Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation.

t. C1218/C1218M, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.

u. C1240, Standard Specification for Silica Fume Used in Cementitious Mixtures.

v. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).

w. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.

x. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).

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y. C1582/C1582M, Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete.

z. C1602/C1602M, Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.

aa. D4580, Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding.

bb. E329, Standard Specification for Agencies Engaged in Construction Inspection, Special Inspection, or Testing Materials Used in Construction.

cc. E1155, Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.

3. National Ready Mixed Concrete Association (NRMCA).

1.02 DEFINITIONS

A. Contractor's Licensed Design Engineer: Individual representing Contractor who is licensed to practice engineering as defined by statutory requirements of professional licensing laws in state or jurisdiction in which Project is to be constructed.

B. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.

C. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.

D. Hot Weather: As defined in ACI 305.1.

E. New Concrete: Less than sixty (60) days old.

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1.03 SUBMITTALS

A. Action Submittals:

1. Mix Designs:

a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.

b. Documentation of average strength for each proposed mix design in accordance with ACI 301.

c. Manufacturer's certification of compliance, for the following:

1) Portland Limestone cement, ASTM C595, Type 1L.

2) Fly ash.

3) Ground Granulated Blast Furnace Slag.

4) Silica Fume.

5) Aggregates, including specified class designation for coarse aggregate.

6) Admixtures.

7) Concrete producer has verified compatibility of constituent materials in design mix.

d. Test Reports:

1) Cement: Chemical analysis report.

2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.

3) Water-Soluble Chloride-Ion Content in Hardened Concrete: Unless otherwise permitted, in accordance with ASTM C1218/C1218M at an age between twenty-eight (28) days and forty-two (42) days.

4) Shrinkage Test Results: In accordance with ASTM C157/C157M as modified herein.

e. Aggregates:

1) Coarse Aggregate Gradation: List gradings and percent passing through each sieve.

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2) Fine Aggregate Gradation: List gradings and percent passing through each sieve.

3) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.

4) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.

f. Admixtures: Manufacturer's catalog cut sheets and product data sheets for each admixture used in proposed mix designs.

2. Product Data: Specified ancillary materials.

3. Detailed plan for hot weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:

a. Use of retarding admixture.

b. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.

c. Curing methods, including use of evaporation retardant.

d. Procedures for measuring and recording concrete temperatures.

4. Concrete repair techniques.

B. Informational Submittals:

1. Manufacturer's application instructions for bonding agent and bond breaker.

2. Manufacturer's Certificate of Compliance to specified standards:

a. Bonding agent.

b. Repair materials.

3. Statement of Qualification:

a. Batch Plant: Certification as specified herein.

b. Mix designer.

c. Installer.

d. Testing agency.

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4. Field test reports.
5. Recorded temperature data from concrete placement.
6. Concrete Delivery Tickets:
    a. For each batch of concrete before unloading at Site.
    b. In accordance with ASTM C94/C94M, including requirements 14.2.1. through 14.2.10.
    c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.04 QUALITY ASSURANCE

A. Concrete construction shall conform to requirements of ACI 117 and ACI 301, except as modified herein.

B. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
3. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, for testing indicated.
    a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
    b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

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PART 2 PRODUCTS

2.01 MATERIALS

A. Cementitious Materials:

1. Cement:

a. Portland Limestone Cement:

1) Unless otherwise specified, conform to requirements of ASTM C595/C595M.

2) Portland cement used in blended hydraulic cement, conform to requirements of ASTM C150/C150M.

b. Furnish from one source.

2. Supplementary Cementitious Materials (SCM):

a. Fly Ash (Pozzolan): Class C or Class F fly ash in accordance with ASTM C618, except as modified herein:

1) Shall not be produced from process that has utilized hazardous or potentially hazardous materials.

2) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.

b. Ground Granulated Blast Furnace Slag: In accordance with ASTM C989, Grade 100 or Grade 120.

1) Shall not be produced from process that has utilized hazardous or potentially hazardous materials.

c. Silica Fume: ASTM C1240.

B. Aggregates: Furnish from one source for each aggregate type used in a mix design.

1. Normal-Weight Aggregates:

a. In accordance with ASTM C33/C33M, except as modified herein.

b. Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.

c. Alkali Silica Reactivity: See Article Concrete Mix Design.

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2. Fine Aggregates:
    a. Clean, sharp, natural sand.
    b. ASTM C33/C33M.
    c. Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
        1) Limit material finer than 75-µm (No. 200) sieve to 3 percent mass of total sample.
3. Coarse Aggregate:
    a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
    b. Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.

C. Admixtures: Unless otherwise permitted, furnish from one manufacturer.

1. Characteristics:
    a. Compatible with other constituents in mix.
    b. Contain at most, only trace amount chlorides in solution.
    c. Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
2. Air-Entraining Admixture: ASTM C260/C260M.
3. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
    a. Manufacturers and Products:
        1) MasterBuilders Inc.; MasterPozzolith.
        2) Euclid Chemical Co., Cleveland, OH; Eucon Series.
        3) GCP ; Adva Series.
4. Retarding Admixture: ASTM C494/C494M, Type B.
5. Accelerating Admixture: ASTM C494/C494M, Type C.

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6. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
    a. Manufacturers and Products:
        1) Master Builders; MasterGlenium Series, or Rheobuild 1000.
        2) Euclid Chemical Co., Cleveland, OH; Eucon Series or Plastol Series.
        3) GCP; ADVA Series.
7. Plasticizing Admixture: ASTM C494 Type F.
8. Corrosion Inhibiting Admixtures: ASTM C1582/C1582M.
9. Shrinkage Reducing Admixture:
    a. Manufacturers and Products:
        1) BASF Admixtures Inc., Shakopee, MN; MasterLife SRA 20.
        2) Euclid Chemical Co., Cleveland, OH; Eucon SRA Series.
        3) GCP; Eclipse Series.
10. Do not use calcium chloride as an admixture.
11. Admixtures with no standard, ASTM or other, designation may be used where permitted.

D. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.

1. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
    a. Chloride Content: 500 ppm.
    b. Sulfate Content as SO4: 3,000 ppm.
    c. Alkalis as (Na2O + 0.658 K2O): 600 ppm.
    d. Total Solids by Mass: Less than 50,000 ppm.

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2.02 ANCILLARY MATERIALS

A. Bonding Agent: Unless otherwise specified, in accordance with the following:

1. ASTM C881/C881M, Type V.
2. Two-component, moisture insensitive, 100 percent solids epoxy.
3. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
4. Manufacturers and Products:
    a. Master Builders., Shakopee, MN; MasterEmaco ADH 326.
    b. Euclid Chemical Co., Cleveland, OH; Euco #352 Epoxy System LV.
    c. Prime Resins, Conyers, GA; Prime Bond 3900 Series.
    d. Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.

B. Repair Material: In accordance with requirements of Section 03 01 33, Repair of Horizontal Concrete Surfaces.

C. Repair Material:

1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
3. Obtain Manufacturer's Certificate of Compliance that products selected are appropriate for specific applications.
4. Repair mortar shall be site mixed.
5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.

D. Crack Repair: In accordance with requirements of Section 03 64 23, Epoxy Resin Injection Grouting.

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2.03 CONCRETE MIX DESIGN

A. General:

1. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301, unless otherwise specified.
2. Selection of constituent materials and products in mix design are optional, unless specified otherwise.
3. Use water-reducing admixture or high-range, water-reducing admixture or plasticizing admixture to achieve fresh properties that facilitate handling, placing, and consolidating of concrete, and specified hardened properties.
4. Use water-reducing and retarding admixture when anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
5. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.

2.04 CONCRETE MIX DESIGN, CLASS 5000F1S1W0C0

A. Mix Locations: Typical, unless otherwise specified.

B. Exposure Categories and Classifications: F2S2W1C1.

C. Mix Properties:

1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.40.
2. Minimum concrete compressive strength (f'c) shall be 5,000 psi at twenty-eight (28) days.

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3. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in.‡	Air Content (%)*
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0
3§	4.5

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is +1-1/2 percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2 inch sieve in accordance with ASTM C231/C231M.

4. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in mix design, as follows:

   a. Fly Ash and other Pozzolans: 25 percent.

   b. Ground Granulated Blast Furnace Slag: 50 percent.

   c. Silica Fume: 10 percent.

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5. Provide cementitious materials in accordance with the following:
    a. ASTM C595/C595M Type 1L.
        1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at six (6) months.
6. Unless otherwise permitted, minimum cementitious materials content in mix design shall be as follows:
    a. 515 pounds per cubic yard for concrete with 1-1/2-inch nominal maximum size aggregate.
    b. 535 pounds per cubic yard for 1-inch nominal maximum size aggregate.
    c. 560 pounds per cubic yard for 3/4-inch nominal maximum size aggregate.
    d. 580 pounds per cubic yard for 1/2-inch nominal maximum size aggregate.
    e. 600 pounds per cubic yard for 3/8-inch nominal maximum size aggregate.
    f. Unless otherwise permitted, limit cementitious materials content to 100 pounds per cubic yard greater than specified minimum cementitious materials content in mix design.
7. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
    a. Limits are stated in terms of chloride ions in percent by weight of cement.
    b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between twenty-eight (28) days and forty-two (42) days.

D. Potential Alkali-Aggregate Reactivity of Concrete:

1. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).

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2. Aggregates shall have been tested to determine potential alkali-aggregate reactivity in concrete in accordance with ASTM C1260 or ASTM C1567.

    a. Aggregates that indicate expansion greater than 0.10 percent at sixteen (16) days after casting shall not be used unless they have been shown to be nondeleteriously reactive in accordance with ASTM C1293, with less than 0.04 percent expansion at one (1) year for cement-aggregate combinations or less than 0.04 percent expansion at two (2) years for combinations with pozzolan or slag.

    b. Alkali content of cement used in proposed concrete mixture shall not be greater than alkali content of cement used in test for potential alkali-aggregate reactivity.

E. Proportions:

1. Design mix to meet aesthetic, durability, and strength requirements.

2. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.

F. Slump Range at Site:

1. Prior to submitting mix design, consult with concrete producer and select a target slump value at point of delivery, for each application of each design mix. Unless otherwise permitted, target slump value will then be enforced for duration of Project. Unless otherwise permitted, target slump value is 4 inches at point of delivery, for concrete without high-range, water reducing admixture.

2. Design mixes that include a high-range, water-reducing or a plasticizing admixture shall have a minimum slump of 2 inches prior to addition of admixture. Unless otherwise permitted, slump shall be 8 inches maximum at point of delivery, for concrete with a high-range, water-reducing admixture.

3. Slump tolerance shall meet requirements of ACI 117.

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G. Combined Aggregate Gradation:

1. Combined Gradation Limits: Limits shown are for coarse aggregates and fine aggregates mixed together (combined). Select one of the gradations shown in the following table:

Sieve Sizes	Combined Gradation Percentage Passing		
	1-1/2" Max.	1" Max.	3/4" Max.
2"	100	-	-
1-1/2"	95 - 100	100	-
1"	65 - 85	90 - 100	100
3/4"	55 - 75	70 - 90	92 - 100
1/2"	-	-	68 - 86
3/8"	40 - 55	45 - 65	57 - 74
No. 4	30 - 45	31 - 47	38 - 57
No. 8	23 - 38	23 - 40	28 - 46
No. 16	16 - 30	17 - 35	20 - 36
No. 30	10 - 20	10 - 23	14 - 25
No. 50	4 - 10	2 - 10	5 - 14
No. 100	0 - 3	0 - 3	0 - 5
No. 200	0 - 2	0 - 2	0 - 2

2.05 CONCRETE MIXING

A. General: In accordance with ACI 301, except as modified herein.

B. Truck Mixers:

1. For every truck, test slump of samples taken per ASTM C94/C94M, paragraph 12.5.1.

2. Where specified slump is more than 4 inches, and if slump tests differ by more than 2 inches, discontinue use of truck mixer, unless causing

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condition is corrected and satisfactory performance is verified by additional slump tests.

2.06 SOURCE QUALITY CONTROL

A. Source Quality Control Inspection: Engineer shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and Subcontractors, providing products included in this section.

PART 3 EXECUTION

3.01 PLACING CONCRETE

A. Preparation: Meet requirements ACI 301, except as modified herein.

B. Inspection: Notify Engineer at least one (1) full working day in advance before starting to place concrete.

C. Placement into Formwork:

1. Reinforcement: Secure in position before placing concrete.
2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs which shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
4. Use placement devices, for example chutes, pouring spouts, and pumps as required to prevent segregation.
5. Vertical Free Fall Drop to Final Placement:
    a. Forms 8 Inches or Less Wide: 5 feet.
    b. Forms Wider than 8 Inches: 8 feet, except as specified.
6. For placements where drops are greater than specified, use placement device such that free fall below placement device conforms to required value.
    a. Limit free fall to prevent segregation caused by aggregates hitting steel reinforcement.

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7. Do not use aluminum conveying devices.
8. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
9. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
10. Cure concrete as specified in Section 03 39 00, Concrete Curing.

D. Conveyor Belts and Chutes:

1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
2. Do not use chutes longer than 50 feet.
3. Minimum Slopes of Chutes: Angled to allow concrete to readily flow without segregation.
4. Conveyor Belts:
    a. Approved by Engineer.
    b. Wipe clean with device that does not allow mortar to adhere to belt.
    c. Cover conveyor belts and chutes.

E. Retempering: Not permitted for concrete where cement has partially hydrated.

F. Pumping of Concrete:

1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
3. Replace pumping equipment and hoses (conduits) that are not functioning properly.

G. Maximum Size of Concrete Placements: Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.

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H. Minimum Time between Adjacent Placements:

1. Construction or Control Joints: Seven (7) days unless otherwise specified.

I. Consolidation and Visual Observation:

1. Consolidation Equipment and Methods: ACI 301.
2. Provide at least one standby vibrator in operable condition at Site prior to placing concrete.
3. Provide sufficient windows in forms or limit form height to allow for concrete placement through windows and for visual observation of concrete.
4. Vibrate concrete in vicinity of joints to obtain impervious concrete.

J. Hot Weather:

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
   a. Maintain concrete temperature below 90 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
   b. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
2. Concrete Curing: As specified in Section 03 39 00, Concrete Curing.

3.02 CONCRETE BONDING

A. Construction Joints at Existing Concrete:

1. Thoroughly clean and mechanically roughen existing concrete surfaces to roughness profile of 1/4 inch.
2. Saturate surface with water for twenty-four (24) hours prior to placing new concrete.

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3.03 REPAIRING CONCRETE

A. General:

1. Inject cracks that leak with crack repair epoxy as specified in Section 03 64 23, Epoxy Resin Injection Grouting.
2. Repair defective areas of concrete.
3. Repair horizontal concrete surfaces in accordance with Section 03 01 33, Repair of Horizontal Concrete Surfaces.
4. Repair vertical and overhead concrete surfaces in accordance with Section 03 01 32, Repair of Vertical and Overhead Concrete Surfaces.
5. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Engineer.
6. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
7. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Engineer.

B. Tie Holes:

1. Unless otherwise specified, fill with specified repair material.
    a. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.

C. Alternate Form Ties, Through-Bolts:

1. Mechanically roughen entire interior surface of through hole.
2. Apply bonding agent to roughened surface and drive elastic vinyl plug to half depth.
3. Dry pack entire hole from both sides of plug with nonshrink grout, as specified in Section 03 62 00, Grouting.

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4. Use only enough water to dry pack grout.
5. Dry pack while bonding agent is still tacky.
6. If bonding agent has dried, remove bonding agent by mechanical means and reapply new coat of bonding agent.
7. Compact grout using steel hammer and steel tool to drive grout to high density.
8. Cure grout with water.

D. Exposed Metal Objects:

1. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1 inch and then cutting or removing metal object.
2. Repair area of chipped-out concrete as specified for defective areas.

E. Blockouts at Pipes or Other Penetrations: Where shown install in accordance with requirements on Drawings.

3.04 CONCRETE FINISHES

A. Type W-1 (Ordinary Finish):

1. Patch tie holes.
2. Knock off projections.
3. Repair defective areas.
4. Inject cracks in accordance with requirements of Section 03 64 23, Epoxy Resin Injection Grouting.

3.05 FIELD QUALITY CONTROL

A. General:

1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first twenty-four (24) hours, and for additional time as may be required before transporting to test lab.
2. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.

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3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
4. Evaluation will be in accordance with ACI 301 and Specifications.
5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
6. Frequency of testing may be changed at discretion of Engineer.
7. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M.
8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of seven (7) days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of twenty-eight (28) days for acceptance.
2. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Engineer.

C. High-Range, Water-Reducer (Superplasticizer) Admixture Segregation Test: Test each truck prior to use on Project.

1. Segregation Test Objective: Concrete with 4-inch to 8-inch slump shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump test.
2. Test Procedure: Make slump test and check for excessive slump and observe to see if mortar or moisture flows from slumped concrete.
3. Reject concrete if mortar or moisture separates and flows out of mix.

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D. Tolerances: Measure and inspect vertical surfaces for compliance with tolerances specified in Section 03 10 00, Concrete Forming and Accessories.

3.06 PROTECTION OF INSTALLED WORK

A. After curing as specified in Section 03 39 00, Concrete Curing, and after applying final floor finish, cover slabs with plywood or particle board or plastic sheeting or other material to keep floor clean and protect it from material and damage as a result of other construction work.

B. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.07 SCHEDULE OF CONCRETE FINISHES

A. Form Tolerances: As specified in Section 03 10 00, Concrete Forming and Accessories.

B. Provide Concrete Finishes as Scheduled:

Area	Type of Finish
All formed concrete	W-1

END OF SECTION

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SECTION 03 35 00
CONCRETE FINISHING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM): C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-In. or 50-mm Cube Specimens).

1.02 SUBMITTALS

A. Action Submittals: Manufacturer's product data sheet(s).

B. Informational Submittals:

1. Statement of Qualifications: Application personnel.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Application Personnel: Four (4) previous projects of successful concrete finishing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

A. Finishing:

1. Hand or mechanically trowel surface while stiffening progresses, as indicated by loss of sheen.
2. Remove marks and pinholes in final raised trowel operation.

B. Curing: Apply curing compounds as soon as possible without marring the concrete surface.

END OF SECTION

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SECTION 03 39 00
CONCRETE CURING

PART 1 GENERALS

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 308.1, Specification for Curing Concrete.
2. ASTM International (ASTM):
   a. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   b. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturers' data indicating compliance with the requirements specified herein for the following products:
   a. Curing compound.

B. Informational Submittals:

1. Manufacturer's certification of compliance for the following:
   a. Curing compound showing moisture retention requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C309 Type 1 Class B.

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2. Manufacturers and Products:
    a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
    b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
    c. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
    d. Dayton Superior; Cure and Seal 30% J23WB.

B. Water: Clean and potable, containing less than 500 ppm of chlorides.

PART 3 EXECUTION

3.01 CONCRETE CURING

A. General:

1. Cure all concrete in accordance with project specifications and ACI308.1.
2. Where surfaces are to receive coatings, painting, cementitious material, or other similar finishes, use only water curing procedures.
3. Where curing compound cannot be used, water curing as described below or special methods using moisture shall be agreed upon by Engineer prior to placing concrete.
4. As required in Section 03 30 00, Cast-in-Place Concrete, if result of seven (7)-day concrete strength test is less than 50 percent of specified twenty-eight (28)-day strength, extend period of moist curing specified below, by seven (7) additional days.

B. Use one of the following methods as approved by Engineer:

1. Vertical Surfaces
    a. Method 1: Leave concrete forms in place and keep surfaces of forms and concrete wet for seven (7) days.
    b. Method 2: Apply curing compound, where allowed, immediately after removal of forms.
2. Horizontal Surfaces:
    a. Method 1: Protect surface by water ponding for seven (7) days.
    b. Method 2: Cover with burlap or cotton mats and keep continuously wet for 7 days.

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c. Method 3: Cover with 1-inch layer of wet sand, earth, or sawdust, and keep continuously wet for seven (7) days.

d. Method 4: Apply curing compound, immediately after final finishing when surface will no longer be damaged by traffic.

END OF SECTION

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SECTION 03 62 00
GROUTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

a. C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.

b. C307, Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings.

c. C531, Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

d. C579, Standard Test Methods for Compressive Grout Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.

e. C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

f. C939, Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).

g. C940, Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.

h. C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

i. C1181, Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

j. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

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1.02 SUBMITTALS

A. Action Submittals:

1. Product data of grouts.
2. Proposed method for keeping existing concrete surfaces saturated surface dry prior to placing nonshrink grout.
3. Forming method for fluid grout placements.
4. Curing method for grout.

B. Informational Submittals:

1. Manufacturer's Written Instructions: Mixing of grout.
2. Test Reports: Test report for twenty-four (24)-hour evaluation of nonshrink grout.
3. List of Contractor's installation staff trained experienced in:
   a. Nonshrink grout installation and curing.
   b. Epoxy grout installation and curing.

PART 2 PRODUCTS

2.01 NONSHRINK GROUT AND EPOXY GROUT SCHEDULE

A. Furnish nonshrink grout (Category II and III) and epoxy grout for applications as indicated in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 deg F to 100 deg F	20 Min.	Greater Than 20 Min.
Tanks	II	II	II
Machine bases	III or Epoxy Grout	III or Epoxy Grout	III or Epoxy Grout

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Application	Temperature Range	Max. Placing Time	
	40 deg F to 100 deg F	20 Min.	Greater Than 20 Min.
Baseplates and/or soleplates with vibration, thermal movement, etc.	III or Epoxy Grout	III or Epoxy Grout	III or Epoxy Grout

2.02 NONSHRINK GROUT

A. Category II:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
   a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
   b. Temperatures of 40 degrees F, 80 degrees F, and 90 degrees F.
5. One (1) hour after mixing, pass fluid grout through flow cone with continuous flow.
6. Minimum strength of fluid grout, 3,000 psi at one (1) day, 4,500 psi at three (3) days, and 7,500 psi at twenty-eight (28) days.
7. Maintain fluid consistency when mixed in 1-yard to 9-yard loads in ready-mix truck.
8. Manufacturers and Products:
   a. Sika Chemical; SikaGrout 928.
   b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
   c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
   d. Dayton Superior Corp., Miamisburg, OH; Sure-Grip High Performance Grout.
   e. US Spec Co., Denver, CO; US SPEC MP Grout.

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2.03 EPOXY GROUT

A. High-strength, nonshrink, high-temperature epoxy grouting material developed for the support of heavy equipment with vibratory loads.

B. Three-component mixture of a two-component epoxy resin system (100 percent solids) with a graded, precision aggregate blend.

C. Premeasured, prepackaged system.

D. Flowable.

E. Minimum compressive strength in accordance with ASTM C579 Method B, 9,500 psi at 75 degrees F at seven (7) days, 11,000 psi at post cure.

F. Maximum creep resistance in accordance with ASTM C1181 at 600 psi, 140 degrees F; 6.0 by 10^{-3} in/in.

G. Minimum bond strength in accordance with ASTM C882, 2,000 psi.

H. Minimum tensile strength in accordance with ASTM C307, 1,800 psi.

I. Maximum coefficient of thermal expansion in accordance with ASTM C531 at 73 degrees F to 210 degrees F, 23.0 by 10^{-6} in/in/degrees F.

J. Working Time: Minimum two (2) hours at 50 degrees F; one and one-half (1.5) hours at 70 degrees F; 50 minutes at 90 degrees F.

K. Good chemical resistance.

L. Good effective bearing area.

M. Noncorrosive.

N. Moisture insensitive.

O. Modify resin and aggregate content where recommended by epoxy grout manufacturer to provide desired epoxy grout flow properties.

P. Manufacturers and Products:

1. Sika Chemical; SikaFlow 648.

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2. Euclid Chemical Co., Cleveland, OH; E^3-Series.
3. Dayton Superior Corp., Miamisburg, OH; Pro-Poxy 2000 Normal Set.
4. Five Star Products Inc., Fairfield, CT; DP Epoxy Grout.

PART 3 EXECUTION

3.01 GENERAL

A. Unless otherwise specified, prepare and condition concrete substrate in accordance with grout manufacturer's placement instructions.

B. Mix, place, and cure grout in accordance with grout manufacturer's placement instructions.

C. Epoxy Grout: Concrete shall be fully cured for twenty-eight (28) days to ensure excess water has evaporated. Test concrete for moisture in accordance with ASTM D4263 before epoxy grout is placed.

D. Form Tie-Through Bolt Holes: Provide nonshrink grout, Category II, fill space with dry pack dense grout hammered in with steel tool and hammer. Through-bolt holes; coordinate dry pack dense grout application with vinyl plug in Section 03 10 00, Concrete Forming and Accessories, and bonding agent in Section 03 30 00, Cast-in-Place Concrete.

E. Form Snap-Tie Hole: Fill tie hole in accordance with requirements of Section 03 30 00, Cast-in-Place Concrete.

3.02 GROUTING MACHINERY BASES

A. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.

B. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.

C. Sandblast to bright metal all metal surfaces in contact with epoxy grout in accordance with manufacturer's written instructions.

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D. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.

E. Form with watertight forms at least 2 inches higher than bottom of plate.

F. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative's training instructions.

G. If grout cannot be placed from one edge and flowed to the opposite edge, air vents shall be provided through the plate to prevent air entrapment.

H. Chamfer corners of grout pad.

3.03 TANKS

A. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.

B. Clean metal surfaces of paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.

C. Set tank base in position and support using shims as needed.

D. Moisture condition existing concrete surfaces that will be in contact with grout.

1. Moisture condition surfaces of concrete substrate that will be covered by grout, plus 3 inches beyond edges of grout.
2. Saturate existing concrete substrate with water as required by grout manufacturer.
3. Surface of concrete substrate shall be damp but free of standing water at time of placement of grout.

E. Form with watertight forms at least 2 inches higher than bottom of plate.

F. Fill space between bottom of tank base and concrete substrate in accordance with manufacturer's representative's training instructions.

G. Cure grout in accordance with grout manufacturer's written instructions.

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3.04 FIELD QUALITY CONTROL

A. General:

1. Performed by Project representative's inspection staff.
2. Perform the following quality control inspections.

B. Evaluation and Acceptance of Nonshrink Grout:

1. Inspect surface preparation of concrete substrates onto which nonshrink grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
2. Inspect preparation and application of nonshrink grout form work for conformance to the manufacturer's recommendations.
3. Conduct a final review of completed nonshrink grout installation for conformance to these Specifications.
4. Provide a flow cone and cube molds with restraining plates onsite.
5. Perform flow cone and bleed tests, and make three 2-inch by 2-inch cubes for each 25 cubic feet of each type of nonshrink grout used. Use restraining caps for cube molds in accordance with ASTM C1107/C1107M.
6. For large grout applications, make three additional cubes and one more flow cone test. Include bleed test for each additional 25 cubic feet of nonshrink grout placed.
7. Consistency: As specified in Article Nonshrink Grout. Flow cone test in accordance with ASTM C939. Grout with consistencies outside range requirements shall be rejected.
8. Segregation: As specified in Article Nonshrink Grout. Grout when aggregate separates shall be rejected.
9. Nonshrink grout cubes shall test equal to or greater than minimum strength specified.
10. Strength Test Failures: Nonshrink grout work failing strength tests shall be removed and replaced.
11. Perform bleeding test in accordance with ASTM C940 to demonstrate grout will not bleed.

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12. Store cubes at 70 degrees F.
13. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C1107/C1107M.
14. All grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

C. Evaluation and Acceptance of Epoxy Grout:

1. Inspect ambient conditions during various phases of epoxy grouting installation for conformance with the epoxy grout manufacturer's requirements.
2. Inspect the surface preparation of concrete substrates onto which epoxy grout materials are to be applied, for conformance to the specified application criteria including, but not limited to, substrate profile, degree of cleanliness, and moisture.
3. Inspect the surface preparation of the metallic substrates onto which the epoxy primer is to be applied.
4. Inspect the epoxy-primed metallic substrate for coverage and adhesion.
5. Inspect preparation and application of epoxy grout form work for conformance to the manufacturer's recommendation.
6. Verify consistency obtained is sufficient for the proper field placement at the installed temperatures.
7. Inspect and record that the "pot life" of epoxy grout materials is not exceeded during the installation.
8. Inspect epoxy grout for cure.
9. Inspect and record that localized repairs made to grout voids are in conformance with the specification requirements.
10. Conduct a final review of completed epoxy grout installation for conformance to these Specifications.
11. Compression tests and fabrication of specimens for epoxy grout shall be made in accordance to ASTM C579, Method B, at intervals during construction as selected by the Project representative. Set of three specimens shall be made for testing at seven (7) days, and each earlier time period as appropriate.

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12. Independent testing laboratory shall prepare, store, cure, and test cubes in accordance with ASTM C579.
13. Grout, already placed, which fails to meet the requirements of these Specifications, is subject to removal and replacement at no additional cost to the Owner.

END OF SECTION

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SECTION 03 63 00
CONCRETE DOWELING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American National Standards Institute (ANSI).
2. ASTM International (ASTM):
    a. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
    b. E488, Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.
3. International Code Council (ICC):
    a. 2021 International Building Code (IBC).
    b. Evaluation Services Reports.

1.02 DEFINITIONS

A. ICC Evaluation Services Report: Published by ICC for products provided by concrete adhesive anchor manufacturers.

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: Manufacturer's catalog information.

B. Informational Submittals:

1. Manufacturer's instructions for preparation, placement, drilling of holes, installation of anchors and adhesive, and handling of cartridges, nozzles, and equipment.
2. ICC Evaluation Services Report: Specific to proposed doweling system manufacturer.

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1.04 DELIVERY, STORAGE, AND HANDLING

A. Container Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

B. Store adhesive components in accordance with manufacturer's written instructions.

C. Dispose of when:

1. Shelf life has expired.
2. Stored other than per manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Adhesive:

1. Approved by an ICC Evaluation Services Report for conformance to 2021 IBC requirements for doweling of steel reinforcing bars in cracked concrete.
2. Suitable for long-term loads as well as for wind and seismic loads.
3. Meet requirements of ASTM C881/C881M.
4. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
5. Disposable, Self-Contained Cartridge System:
    a. Capable of dispensing both components in proper mixing ratio.
    b. Fit into manually or pneumatically operated caulking gun.
6. Manufacturers and Products:
    a. Hilti, Inc., Tulsa, OK; HIT-RE 500 V3 (ESR-3814) or HIT HY 200 (ESR 3187) Adhesive Anchors.
    b. Powers Fasteners, Brewster, NY; Power PURE110+ Epoxy Adhesive Anchor System (ESR-3298).

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c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-3G Epoxy Adhesive Anchors (ESR-2508).

B. Mixing Nozzles: Disposable, manufactured in several sizes to accommodate size of reinforcing dowels.

C. Reinforcing Dowels: As specified in Section 03 21 00, Steel Reinforcement.

PART 3 EXECUTION

3.01 INSTALLATION

A. Drilling Equipment:

1. Drilling Hammers for Dowel Holes:
   a. Electric or pneumatic rotary type with medium or light impact.
   b. Hollow drills with flushing air systems are preferred.
2. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

B. Hole Diameter: Use drill bit diameter meeting ICC Evaluation Services Report requirements and as recommended by manufacturer.

C. Obstructions in Drill Path: When existing steel reinforcement is encountered during drilling, obtain Engineer approval for proposed fix.

D. Doweling:

1. Install per details shown on Drawings and in accordance with adhesive manufacturer's instructions.
2. When using epoxy anchors, dowels may be prebent prior to installation to 15 degrees to align with other bars. Do not heat dowels to bend.
3. Bent Bar Dowels: Where edge distances are critical and intersection with steel reinforcement or other obstruction is likely, slant drill to address edge distance or to clear obstruction. If drill must be slanted more than indicated in the manufacturer's installation instructions to clear obstruction, notify Engineer for direction on how to proceed.

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E. Adhesive:

1. Install in accordance with written manufacturer's instructions.
2. Dispense components through specially designed static mixing nozzle that thoroughly mixes components and places mixed adhesive at base of predrilled hole.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Proof Loading:

1. To be performed where determined by the Owner.
2. Testing will be performed by Owner's Independent Testing Agency.
3. Proof loading to be performed only after adhesive has achieved proper cure per manufacturer's requirements.
4. Testing will be conducted on minimum of 10 percent of installed dowels, with a minimum of two tension tests for each detailed or specified condition at each facility. Minimum of two cartridges per box or packaging unit will be tested.
5. Testing will be conducted in accordance with ASTM E488 and as follows:
    a. Performance of a static tension test of each test dowel.
    b. Test apparatus reaction base will not interfere with bond failure of dowel but will preclude a concrete pullout cone failure.
    c. Each test dowel will be tested at a proof load equal to the lesser of 80 percent of the yield strength of the dowel bar or 50 percent of calculated ultimate load based on adhesive bond strength.
    d. Test load to be maintained for a minimum of 30 seconds without visible signs of movement of dowel or drop in gauge reading.
6. Failure of dowel bar or failure within base concrete will cause dowel to be rejected. For each rejected dowel, two (2) additional dowels will be tested. Replace rejected dowels as approved by Engineer.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 00, Contractor Quality Control.

END OF SECTION

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SECTION 03 64 23
EPOXY RESIN INJECTION GROUTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
    a. C882, Standard Specification for Test Method for Bond Strength of Epoxy Resin System Used with Concrete by Slant Shear.
    b. D570, Standard Test Method for Water Absorption of Plastics.
    c. D638, Standard Test Method for Tensile Properties of Plastics.
    d. D648, Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edgewise Position.
    e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
    f. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
2. National Sanitation Foundation (NSF):
    a. Standard 60, Standard for Drinking Water Treatment and Chemicals – Health Effects.
    b. Standard 61, Standard for Drinking Water System Components – Health Effects.

1.02 DEFINITIONS

A. Crack: Complete or incomplete separation of concrete into two or more parts produced by breaking or fracturing.

B. Defective Area: As defined in Section 03 30 00, Cast-in-Place Concrete.

C. Injection: Method of bonding together, cracks or joints by installing resin under pressure to fill the void in crack or joint.

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D. Joint: A planned and formed discontinuity in concrete structure at junction of adjacent and sequential concrete placements and may contain embedded waterstops.

E. Narrow Cracks: Width equal to or less than 0.015 inch.

F. Wide Cracks: Wider than 0.015 inch.

1.03 SUBMITTALS

A. Action Submittals:

1. Physical and chemical properties for epoxy resin.
2. Technical data for metering, mixing, and injection equipment.
3. Depth of penetration, length, material used, and procedures where epoxy is approved for use.
4. Marked up drawings of proposed epoxy injection repair crack locations, widths, and lengths and direction on structure.
5. Sample bottle.

B. Informational Submittals:

1. Manufacturer's recommended surface preparation procedures and application instructions for epoxy resins.
2. Manufacturer's Certificate of Compliance and certified test results for each batch of epoxy resin.
3. Statements of Qualification for Epoxy Resin:
    a. Manufacturer's Site representative.
    b. Injection applicator.
    c. Injection pump operating technician.
4. Sample of epoxy resin two component ratio and injection pressure test records for concrete crack repair work.
5. Installation instructions for repairing core holes with repair mortar.
6. Epoxy resin two component ratio and injection pressure test records for concrete crack repair work.

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1.04 QUALITY ASSURANCE

A. Qualifications for Injection Staffs:

1. Injection Crew and Job Foreman:

a. Provide written and verifiable evidence showing compliance with the following requirements:

1) Licensed or certified by epoxy resin material manufacturer.

2) Minimum three (3) years' experience in successful epoxy injection for at least 10,000 linear feet of successful crack injection, including 2,000 linear feet of wet crack injection to stop water leakage.

B. Injected Epoxy Resin: Fill cracks with minimum resin depth penetration no less than 90 percent of full thickness of concrete section for cracks or joints.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping:

1. Package resin material in new sealed containers and label with following information:

a. Manufacturer's name.

b. Product name and lot number.

B. Storage and Protection: Store epoxy resin material containers in accordance with manufacturer's printed instructions and at ambient temperatures below 110 degrees F and above 45 degrees F.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials and accessories specified in this section shall be products of:

1. Sika Chemical; SCB Concresive 1350 that meet properties indicated in Paragraph Uncured Resin-Properties.

2. Sika Corp., Lyndhurst, NJ; Sikadur Series products that meet properties below.

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3. Euclid Chemical Co., Cleveland, OH; Euco Series (#452) products that meet properties below.

2.02 EPOXY INJECTION RESIN

A. Two-component A and B structural epoxy resin for injection into cracks or other voids in concrete structures for bonding or grouting.

B. Uncured Resin-Properties:

1. When mixed in ratio specified on resin container label:

	Test Method	Wide Cracks	Narrow Cracks
Pot Life (60-gram mass) @ 77, plus or minus 4 deg F	As specified in Article Source Quality Control	13 to 25 minutes	15 to 30 minutes
Pot Life (60-gram mass) @ 100, plus or minus 4 deg F	As specified in Article Source Quality Control	3 to 10 minutes	10 to 20 minutes
Viscosity @ 40, plus or minus 3 deg F	Brookfield RVT Spindle No. 4 @ 20 rpm	4,400 cps	600 cps
Viscosity @ 75 to 77 deg F	Brookfield RVT Spindle No. 2 @ 20 rpm	375 to 350 cps	175 to 140 cps

C. Epoxy Resin Properties: When cured for seven (7) days at 77 degree F, plus or minus 3 degrees F and conditioned at test temperature twelve (12) hours prior to test, unless otherwise specified.

	Test Method	Wide Cracks	Narrow Cracks
Ultimate Tensile Strength, psi	ASTM D368	8,000 min.	5,000 min.

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	Test Method	Wide Cracks	Narrow Cracks
Tensile Elongation @ Break, percent	ASTM D638	4.2 max.	3.0 max.
Flexural Strength, psi	ASTM D790	10,000 min.	10,000 min.
Flexural Modulus, psi	ASTM D790	5.5×10^5 min.	4.5×10^5 min.
Compressive Yield Strength, psi	ASTM D695*	15,000 min.	12,000 min.
Compressive Modulus, psi	ASTM D695*	4.0×10^5 min.	4.0×10^5 min.
Heat Deflection Temperature	ASTM D648*	130 deg F min.	140 deg F min.
Cured 3 days @ 40 deg F – Wet Concrete		3,500 psi min.	3,500 psi min.
Cured 1 day @ 77 deg F – Dry Concrete		5,000 psi min.	5,000 psi min.
Cured 3 days @ 77 deg plus or minus 3 deg F		5,000 psi min.	5,000 psi min.
*Cure test specimens so that peak exothermic temperature of resin does not exceed 100 degrees F. Note: See referenced Specifications for preparation method of test specimens.			

2.03 SURFACE SEAL

A. Sufficient strength and adhesion for holding injection fittings firmly in place and to resist pressures preventing leakage during injection.

B. Capable of removal after injection resin has cured.

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2.04 WATER

A. Clean and free from oil, acid, alkali, organic matter, or other deleterious substances, meeting federal drinking water standards.

2.05 SAMPLE BOTTLE

A. Five-inch natural wide mouth HDPE bottle or 4-ounce clear PVC cylinder bottle; supplied with caps.

2.06 SOURCE QUALITY CONTROL

A. Test Requirements: Perform tests for each batch of epoxy resin.

B. Pot Life Test:

1. Condition Component A and Component B to required temperature.
2. Measure components in ratio of Component B as stated on manufacturer's label into an 8-fluid ounce paper cup.
3. Mix components for 60 seconds using non-metallic stirring instrument. Scrape sides and bottom of cup periodically.
4. Probe mixture once with non-metallic stirring instrument every 30 seconds, starting 2 minutes prior to minimum specified pot life.
5. Pot Life Definition: Time at which a soft stringy mass forms in center of cup.

C. Slant Shear Test: Prepare specimens and perform tests in accordance with ASTM C882.

PART 3 EXECUTION

3.01 GENERAL

A. Unless permitted otherwise, structurally repair cracks listed below:

1. Cracks considered to be defective as defined in Section 03 30 00, Cast-in-Place Concrete.
2. All cracks caused by voids or honeycombs.
3. All cracks caused by construction overloading.

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4. All other cracks as a result of drying shrinkage to be repaired ninety (90) days or more after placement.

5. All cracks identified during the course of the construction that are to be repaired in accordance with the Crack Injection Repair Detail 1 on Drawings (S21) and to be included in Bid Item 3.

B. Do not proceed with injection work until Submittals have been reviewed and approved by Engineer.

C. Perform cracks injection work after removing defective surface materials and after performing surface preparation, but prior to applying surface repair material unless otherwise noted. See Section 03 01 33, Repair of Horizontal Concrete Surfaces, for concrete surface repair system.

D. Width of cracks may vary along length and through thickness of concrete section.

E. Remove all excess, unused epoxy resin materials on concrete surfaces exposed to view prior to end of Work.

3.02 EQUIPMENT

A. Portable, positive displacement type pumps with in-line metering to meter and mix two epoxy resin components and inject mixture into cracks or joints.

B. Pumps:

1. Electric or air powered with interlocks providing positive ratio control of proportions for the two components at nozzle.

2. Primary injection pumps for each material of different mix ratio, including a standby backup pump of similar ratio.

3. Capable of immediate compensation for changes in resins.

4. Do not use batch mix pumps.

C. Discharge Pressure: Automatic pressure controls capable of discharging mixed epoxy resin at pressures in accordance with epoxy resin manufacturer's printed instruction and able to maintain pressure.

D. Automatic Shutoff Control: Provide sensors on both Component A and Component B reservoirs for stopping machine automatically when only one component is being pumped to mixing head.

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E. Proportioning Ratio Tolerance: Maintain epoxy resin manufacturer's prescribed mix ratio within a tolerance of plus or minus 5 percent by volume at discharge pressure up to 160 psi.

F. Ratio/Pressure Check Device:

1. Two independent valve nozzles capable of controlling flow rate and pressure by opening or closing valve to restrict material flow.
2. Pressure gauge capable of sensing pressure behind each valve.

3.03 PREPARATION

A. Free cracks from loose matter, dirt, laitance, oil, grease, efflorescence, salt, and other contaminants.

B. Clean cracks in accordance with epoxy resin manufacturer's instructions.

C. Clean surfaces adjacent to cracks from dirt, dust, grease, oil, efflorescence, and other foreign matter detrimental to bond of surface seal system and to expose the full extent of cracks and joints in accordance with manufacturer's printed instruction by low pressure water cleaning using a pressure of 1,000 psi to 3,000 psi.

D. Do not use acids and corrosives for cleaning, other than those specified herein unless neutralized prior to injecting epoxy resin.

E. During installation and curing of materials, if ambient temperature is expected to drop below manufacturer's recommended minimum temperature, provide enclosures and heat as required.

F. Provide work platforms as required.

G. Dry out cracks or joints if required by manufacturer's instructions.

3.04 APPLICATION

A. All liquid is to be removed from hydraulic structure prior to commencing with epoxy injection, unless approved otherwise.

B. Entry Ports:

1. Establish openings for epoxy resin entry in surface seal along crack.

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2. Determine space between entry ports equal to thickness of concrete member to allow epoxy resin to penetrate to the full thickness of the member.
3. Drill injection holes at an angle between 45 degrees and 60 degrees from surface of concrete and perpendicular to alignment of cracks, to intersect crack at midpoint of concrete section, except as noted otherwise.
4. Locate drill holes on alternate sides of crack where possible, unless orientation of crack is known or has been verified by non-destructive testing techniques or core drilling.
5. Drill Hole Spacing: Do not to exceed concrete thicknesses or 12 inches maximum, except as noted otherwise.
6. Adjust location and angle of drill holes to suit orientation of crack and at commencement of drilling holes for injection.
7. Take measures to prevent drilling holes for injection too shallow or too deep.
8. Remove dust and debris in drill holes and on surface of structure resulting from drilling operation, by flushing with water prior to installing the injection packers or ports.
9. Space entry ports closer together to allow adjustment of injection pressure to obtain minimum loss of epoxy to soil at locations where:
    a. Cracks or joints extend entirely through concrete element.
    b. Backfill of walls on one side.
    c. Slab-on-grade.
    d. Difficult to excavate behind wall to seal both surfaces of crack.
10. Install injection packers or ports in drill holes in accordance with manufacturer's printed instructions with zerk coupling or other one-way ball or check valve, to permit testing for watertightness and acid flushing of cracks.

C. Application of Surface Seal along Cracks:

1. Apply surface seal in accordance with manufacturer's instructions to designated crack faces prior to injection. Seal surface of cracks to contain and prevent escape of injection epoxy.

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2. Cure surface seal in accordance with manufacturer's printed instructions before commencing inject work.

D. Epoxy Injection:

1. Ensure zerk coupling is not installed in ports or packers next to the one being injected.
2. Start injection into each crack at lowest elevation entry port or packer along vertical or diagonal crack, and at one end of horizontal crack.
3. Where injection entry ports or packers are used, continue injection at first port or packer until resin begins to flow out of port or packer at next highest elevation. Plug first port or packer and start injection at second port or packer until resin flows from next port or packer.
4. Inject entire crack with same sequence.
5. At no time inject more than 6 feet length of first vertical crack before verifying resin in sample bottle has start to set and cure.
6. Prior to commencing injection work along a horizontal crack in structure when processed using ports or packers with zerk couplings are used, remove zerk couplings from injection ports or packers except for two ports or packers located where injection work will commence. Commence injection work in first two ports or packers. Once clean resin is vented from third injection port or packer, cease injection at first port or packer, and install zerk coupling and commence injection at third port or packer. Repeat process for fourth and subsequent ports or packers until full length of crack has been injected.

E. Finishing:

1. Allow epoxy resin to cure in accordance with manufacturer's instruction after cracks have been completely injected to allow surface seal removal without draining or runback of uncured epoxy resin material from cracks.
2. Remove surface seal and injection packers from cured injection resin along crack.
3. Finish crack faces flush with adjacent concrete.
4. Indentations or protrusions caused by placement of entry ports, packers, drill holes, or damage from removal of surface seal is not acceptable.

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5. Grind off protrusions and patch indentations and holes from injection packers and entry ports with a suitable patch material to satisfaction of Engineer.
6. Remove surplus surface seal material splatters and injection resin material runs and spills from concrete surfaces.

3.05 FIELD QUALITY CONTROL

A. Epoxy Resin Two Component Ratio Tests:

1. Disconnect mixing head and pump two resin components simultaneously through ratio check device.
2. Adjust discharge pressure to 160 psi for both resin components.
3. Simultaneously discharge both resin components into separate calibrated containers.
4. Compare amounts simultaneously discharged into calibrated containers during same time period to determine mix ratio.
5. Complete test at 160 psi discharge pressure and repeat procedure for 0 psi discharge pressure.
6. Run ratio test for each injection unit at beginning and end of each injection work day, and when injection work has stopped for more than one (1) hour.
7. Document and maintain complete accurate records of ratios and pressure checks.

B. Injection Pressure Test:

1. Disconnect mixing head of injection equipment and connect two resin component delivery lines to pressure check device.
2. Pressure Check Device:
   a. Two independent valved nozzles capable of controlling flow rate and pressure by opening or closing of valve.
   b. Pressure gauge capable of sensing pressure buildup behind each valve.
3. Close valves on pressure check device and operate equipment until gauge pressure on each line reads 160 psi.

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4. Stop pumps and observe pressure; do not allow pressure gauge to drop below 150 psi within 3 minutes.
5. Run pressure test for each injection equipment unit:
    a. Beginning and end of each injection work day.
    b. When injection work stop for more than 45 minutes.
6. Check tolerance to verify equipment capable of meeting specified ratio tolerance.

C. Bottled Sample Tests:

1. During injection operation, provide at least one (1) sample of mixed epoxy resin for each injection pump per shift per injection work day in a sample bottle.
2. Provide sufficient sample to demonstrate sample material epoxy resin will set and cure correctly.
3. Label each bottled sample with Contractor's name, date, and time sample was taken, and location in structure where sample was taken. Record details of bottle sample tests.
4. Place filled sample bottle upright in a container and allow sample to cure.
5. After sample has been allowed to cure, cut bottled sample open and visually inspect contents to verify that epoxy resin material has completely reacted and cured.
6. Evaluation and Assessment of Test:
    a. Should bottled sample(s) indicate a problem; such as epoxy resin not cured or foreign liquid in sample bottle, take verifying core sample immediately from cracks, where material was used.
    b. Should above-referenced bottle sample(s) and core sample(s) indicate a problem with epoxy resin, arrange to have a Technical Representative of the epoxy resin manufacturer come to Site to review bottled sample(s) and core drilled sample(s) with Engineer and provide technical advice on corrective measures.
    c. Carry out further investigation work or corrective measures recommended by Technical Representative of epoxy resin manufacturer.

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D. Core Sample Tests:

1. Only where required by Engineer.
2. Initial Cores:
    a. Four-inch diameter for full crack depth along cracks taken from Engineer selected locations.
    b. Take three cores in first 100 linear feet of crack repaired and one core sample for each 500 linear feet thereafter.
    c. Label each core with core number, location, and date when core was obtained.
3. Provide suitable containers for storage, curing, and transportation of test specimens.
4. Methods of Testing Cores:
    a. Penetration: Visual examination.
5. Test Requirements:
    a. Penetration: Per performance requirements.
6. Evaluation and Acceptance of Tests:
    a. If initial cores pass tests as specified, epoxy resin injection work at area represented by cores will be accepted.
    b. If initial cores fail either by lack of penetration crack repair Work shall not proceed further until areas represented by cores are reinjected or repaired and retested for acceptance.
    c. Obtain verifying core samples, number, and location as selected by Engineer, after rework of areas represented by failed initial cores is complete.
7. Core Hole Repair:
    a. Correct work as result of testing upon notification from Engineer.
    b. Refill initial and verifying core holes with a suitable repair mortar, per Section 03 01 33, Repair of Horizontal Concrete Surfaces, tamped and rodded in-place to completely fill for full depth of core hole.
    c. Finish surface to blend with adjacent concrete.

END OF SECTION

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SECTION 05 05 19
POST-INSTALLED ANCHORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
    a. 318, Building Code Requirements for Structural Concrete.
    b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
    c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
3. American National Standards Institute (ANSI).
4. ASTM International (ASTM):
    a. A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    b. A143, Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
    c. A153/A153M, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    d. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
    e. A194/A194M, Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
    f. A380, Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
    g. A385, Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
    h. A563, Specification for Carbon and Alloy Steel Nuts.

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i. A780, Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

j. A967, Specification for Chemical Passivation Treatments for Stainless Steel Parts.

k. E488, Standard Test Methods for Strength of Anchors in Concrete Elements.

l. F436, Specification for Hardened Steel Washers.

m. F468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.

n. F568M, Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners.

o. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

p. F594, Specification for Stainless Steel Nuts.

q. F1554, Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.

6. International Code Council Evaluation Service (ICC-ES):

a. Evaluation Reports for Concrete and Masonry Anchors.

b. AC01, Acceptance Criteria for Expansion Anchors in Masonry Elements.

c. AC70, Acceptance Criteria for Fasteners Power-driven into Concrete, Steel and Masonry Elements.

d. AC106, Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements.

e. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.

f. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.

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7. Specialty Steel Industry of North America (SSINA):
    a. Specifications for Stainless Steel.
    b. Design Guidelines for the Selection and Use of Stainless Steel.
    c. Stainless Steel Fabrication.
    d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.

B. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.

C. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.

B. Informational Submittals:

1. Concrete Anchors:
    a. Manufacturer’s product description and installation instructions.
    b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.

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1.04 QUALITY ASSURANCE

A. Qualifications:

1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program, or equivalent.

2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package stainless steel items in a manner to provide protection from carbon impregnation.

B. Protect hot-dip galvanized finishes from damage as a result of metal banding and rough handling.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Stainless Steel:	
Threaded Rods	F593, AISI Type 316, Condition CW
Nuts*	F594, AISI Type 316, Condition CW
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.	

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2.02 POST-INSTALLED CONCRETE ANCHORS

A. General:

1. AISI Type 316 stainless.
2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.

B. Adhesive Anchors:

1. Threaded Rod:
   a. Diameter as shown on Drawings.
   b. Length as required to provide minimum depth of embedment indicated and thread projection required.
   c. Clean and free of grease, oil, or other deleterious material.
2. Adhesive:
   a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
   b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
3. Packaging and Storage:
   a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
   b. Store adhesive on pallets or shelving in a covered storage area.
   c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

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d. Dispose of When:

1) Shelf life has expired.

2) Stored other than in accordance with manufacturer's instructions.

4. Manufacturers and Products:

a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT RE 500 V3 (ESR-3814), or HIT-HY 200 (ESR-3187).

b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-3G Epoxy Adhesive Anchors (ESR-2508), or AT-3G Adhesive Anchors (IAPMO UES-263).

c. DeWalt/Powers Fasteners, Brewster NY; Pure 110+ Epoxy adhesive anchor system (ESR-3298).

PART 3 EXECUTION

3.01 CONCRETE ANCHORS

A. Begin installation only after concrete to receive anchors has attained design strength.

B. Locate existing reinforcing with Ground Penetrating Radar or other method approved by Engineer prior to drilling. Coordinate with Engineer to adjust anchor locations where installation would result in hitting reinforcing.

C. Install in accordance with written manufacturer's instructions.

D. Provide minimum embedment, edge distance, and spacing as indicated on Drawings.

E. Use only drill type and bit type and diameter recommended by anchor manufacturer.

F. Clean hole of debris and dust per manufacturer's requirements.

G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify Engineer for direction on how to proceed.

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H. Adhesive Anchors:

1. Unless otherwise approved by Engineer and adhesive manufacturer:

a. Do not install adhesive anchors when temperature of concrete is below 40 degrees F or above 100 degrees F.

b. Do not install prior to concrete attaining an age of twenty-one (21) days.

c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.

d. Do not disturb anchor during recommended curing time.

e. Do not exceed maximum torque as specified in manufacturer's instructions.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 00, Contractor Quality Control.

3.03 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Post-Installed Anchors		
All Areas	Stainless steel adhesive anchors	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application

B. Anti-seize Compound: Use on all stainless steel threads.

C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

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SECTION 05 05 23
WELDING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
    a. BPVC SEC V, Nondestructive Examination.
    b. BPVC SEC IX, Welding and Brazing Qualifications.
2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
4. American Welding Society (AWS):
    a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
    b. A3.0, Standard Welding Terms and Definitions.
    c. D1.1/D1.1M, Structural Welding Code—Steel.
    d. D1.8/D1.8M, Structural Welding Code—Seismic Supplement.
    e. D1.2/D1.2M, Structural Welding Code—Aluminum.
    f. D1.3/D1.3M, Structural Welding Code—Sheet Steel.
    g. D1.4/D1.4M, Structural Welding Code—Reinforcing Steel.
    h. D1.6/D1.6M, Structural Welding Code—Stainless Steel.
    i. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.

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B. CWI: Certified Welding Inspector.

1. Contractor's Welding Inspector: Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.

2. Verification Inspector: This independent inspection is the prerogative of the Owner, who may employ their own, independent CWI, or waive this supplementary, independent CWI inspection.

C. MT: Magnetic Particle Testing.

D. NDE: Nondestructive Examination.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

H. PT: Liquid Penetrant Testing.

I. Special Inspection: Nondestructive weld examination including MT, PT, UT, and RT.

1. Special Inspection personnel report to, and are retained by the Owner except as noted below:

a. Contractor and fabricator are required to complete nondestructive weld examinations for welded steel tanks, welded steel pipe, and process piping.

2. See additional requirements in Section 01 45 23, Testing and Inspecting Services.

J. RT: Radiographic Testing.

K. UT: Ultrasonic Testing.

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L. VT: Visual Inspection/Testing.

M. WPQ: Welder/Welding Operator Performance Qualification Record.

N. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

a. Shop and field WPSs and PQRs.

b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.

c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.

1) Show on Shop Drawings, or on a weld map, complete information regarding base metal ASTM specifications, and location, type, size, and length of welds.

2) Identify WPS to be used, and NDE requirements in tail of welding symbol.

3) Clearly distinguish between shop and field welds.

4) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.

5) Welding and NDE Symbols shall be in accordance with AWS A2.4. Welding terms and definitions shall comply with AWS A3.0.

B. Informational Submittals:

1. WPQs.

2. CWI credentials.

3. Testing agency NDE inspector credentials.

4. CWI visual inspection (VT) reports.

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5. Welding Documentation: Submit on forms provided in referenced welding codes.

1.04 QUALIFICATIONS

A. WPSs: In accordance with AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

B. WPQs: In accordance with AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

C. CWI: Certified in accordance with AWS QC1 and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.

D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Fabricator's CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded and as follows:

1. Verify conformance of specified job materials and proper storage.
2. Monitor conformance with approved WPSs.
3. Monitor welder performance and conformance with approved WPQs.
4. Inspect weld joint fit-up and perform in-process inspections.
5. Provide 100 percent visual inspection of completed welds.
6. Coordinate with nondestructive testing personnel and review NDE results.

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7. Maintain records and prepare reports documenting results of CWI VT and required NDE complies with the Work and referenced welding codes.

PART 3 EXECUTION

3.01 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Quality Control Inspection:

1. All Welds: 100 percent VT by Contractor's CWI.
2. Acceptance Criteria:
   a. All Welding: AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

B. Nondestructive Testing Requirements:

1. NDT frequency shall be as specified below, as required by referenced fabrication or welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
   a. Nontubular Connections:
      1) CJP Butt Joint Groove Welds: 10 percent random RT . Use UT for CJP butt joint groove welds that cannot be readily radiographed.
      2) All Other CJP Groove Welds: 10 percent random UT.
      3) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
   b. Tubular Connections:
      1) CJP butt joint groove welds made from one side without backing: 100 percent RT or UT in accordance with AWS D1.1,

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AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

2) CJP Butt Joint Groove Welds made with back-gouging: 10 percent random RT in accordance with AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

3) CJP Butt Joint Groove Welds made with backing and other butt joint groove welds that cannot be readily radiographed: 10 percent random UT in accordance with AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

4) All Other CJP Groove Welds: 10 percent random UT in accordance with AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

5) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT in accordance with AWS D1.1.

2. NDT Procedures and Acceptance Criteria:

a. Nontubular Connections:

1) RT: Perform in accordance with AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

2) UT: Perform in accordance with AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

3) PT and MT:

a) Perform on fillet and PJP groove welds in accordance with AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

b) Acceptance criteria per AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

b. Tubular Connections:

1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1, AWS D1.1,

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AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

3) PT and MT:

a) Perform on fillet and PJP groove welds in accordance with AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

b) Acceptance criteria per AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded.

3.03 FIELD QUALITY CONTROL

A. The Contractor's CWI shall be present whenever field welding is being done and shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1, AWS D1.1, AWS D1.2, AWS D1.3, AWS D1.4 or AWS D1.6 for the material being welded or referenced welding code and as follows:

1. Verify conformance of specified job materials and proper storage.
2. Monitor conformance with approved WPS.
3. Monitor welder performance and conformance with approved WPQs.
4. Inspect weld joint fit-up and perform in-process inspection.
5. Provide 100 percent visual inspection of all welds in accordance with Paragraph Quality Control Inspection.
6. Coordinate with nondestructive testing personnel and review test results.
7. Maintain records and prepare reports confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal have been deposited in accordance with appropriate welding codes.

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3.05 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this Specification.

1. Welding and Nondestructive Testing Table.

END OF SECTION

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WELDING AND NONDESTRUCTIVE TESTING						
Specification Section	Governing Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Required?	Submit Written NDT Procedure Specifications	NDT Requirements
03 21 00 Steel Reinforcement	AWS D1.4/D1.4 M, Structural Welding Code—Reinforcing Steel	Yes	Yes	Yes	Yes	100% VT and 100% MT of all rebar splices; also see Section 03 21 00
05 50 00 Metal Fabrications	AWS D1.1/D1.1 M, Structural Welding Code–Steel or AWS D1.2/D1.2 M, Structural Welding Code—Aluminum or AWS D1.6/D1.6 M, Structural Welding Code—Stainless Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 50 00

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
2. American Galvanizers Association (AGA):
   a. Inspection of Hot-Dip Galvanized Steel Products.
   b. Quality Assurance Manual.
3. American Iron and Steel Institute (AISI): Stainless Steel Types.
4. American Ladder Institute (ALI): A14.3, Ladders - Fixed - Safety Requirements.
5. American National Standards Institute (ANSI).
6. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
7. American Welding Society (AWS):
   a. D1.1/D1.1M, Structural Welding Code - Steel.
   b. D1.2/D1.2M, Structural Welding Code - Aluminum.
   c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
8. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48/A48M, Specification for Gray Iron Castings.
   c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

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f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.

g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

j. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

k. A276, Standard Specification for Stainless Steel Bars and Shapes.

l. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.

o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

p. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

q. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).

r. A489, Standard Specification for Carbon Steel Lifting Eyes.

s. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

t. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.

u. A563, Standard Specification for Carbon and Alloy Steel Nuts.

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v. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

w. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

x. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.

y. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.

z. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.

aa. A992/A992M, Standard Specification for Structural Steel Shapes.

bb. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).

cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

dd. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

ee. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

ff. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.

gg. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

hh. D1056, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

ii. F436, Standard Specification for Hardened Steel Washers.

jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.

kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

ll. F594, Standard Specification for Stainless Steel Nuts.

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mm. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

nn. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

9. NSF International (NSF): 61, Drinking Water System Components—Health Effects.

10. Occupational Safety and Health Administration (OSHA):

a. 29 CFR 1910.27, Fixed Ladders.

b. 29 CFR 1926.105, Safety Nets.

c. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.

11. Specialty Steel Industry of North America (SSINA):

a. Specifications for Stainless Steel.

b. Design Guidelines for the Selection and Use of Stainless Steel.

c. Stainless Steel Fabrication.

d. Stainless Steel Fasteners.

1.02 DEFINITIONS

A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.

B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals. Corrosive area includes areas exposed to corrosive atmosphere such as hydrogen sulfide from wastewater.

C. Exterior Area: Location not protected from weather by building or other enclosed structure.

D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.

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F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior below grade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Metal fabrications, including welding and fastener information.

B. Informational Submittals:

1. Passivation method for stainless steel members.
2. Galvanized coating applicator qualifications.
3. Hot-Dip Galvanizing: Certificate of compliance signed by galvanizer, with description of material processed and ASTM standard used for coating.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.

B. Package stainless steel items to provide protection from carbon impregnation.

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C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.

D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.01 GENERAL

A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

B. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A500, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy y6061-T6
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)

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Item	ASTM Reference
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
High-Strength	A325, Type 1 bolts, with A563 nuts
Anchor Bolts and Rods	F1554, Grade 36 or 55, with weldability supplement S1.
Eyebolts	A489
Threaded Rods	A36/A36M
Flat and Beveled Washers (Hardened)	F436
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Stainless Steel Bolts and Nuts	F593G or F593H as required by size
Stainless Steel Washers	ASTM A240, Type 316

C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, and aluminum material types as indicated in Article Fastener Schedule.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

A. Cast-In-Place Anchor Bolts:

1. Headed type, unless otherwise shown on Drawings.
2. Material type and protective coating as shown in Article Fastener Schedule.

B. Anchor Bolt Sleeves:

1. Plastic:
   a. Single unit construction with corrugated sleeve.

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b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.

c. Material: High-density polyethylene.

2.03 POST-INSTALLED CONCRETE AND MASONRY ANCHORS

A. See Section 05 05 19, Post-Installed Anchors.

2.04 PIPE SLEEVES

A. ASTM A312, Type 316 or 316L, Schedule 40 stainless steel pipe sleeves with continuously welded 3/16-inch-thick seep ring with outside diameter 3 inches greater than sleeve outside diameter.

2.05 EMBEDDED STEEL SUPPORT FRAMES FOR FLOOR PLATE AND GRATING

A. Steel angle support frames to be embedded in concrete shall be stainless steel, ASTM A276, AISI Type 316, unless indicated otherwise.

B. Welded anchors for stainless steel support frames shall also be stainless steel.

2.06 ACCESSORIES

A. Anti-seize Lubricant for Stainless Steel Threaded Connections:

1. Suitable for potable water supply.
2. Resists washout.
3. Manufacturers and Products:
   a. Bostik, Middleton, MA; Neverseez.
   b. Saf-T-Eze Div., STL Corp., Lombard, IL; Anti-Seize.

B. Neoprene Gasket:

1. ASTM D1056, 2C1, soft, closed-cell neoprene gasket material, suitable for exposure to sewage and sewage gases, unless otherwise shown on Drawings.
2. Thickness: Minimum 1/4-inch.

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3. Furnish without skin coat.
4. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK1111LD.

2.07 FABRICATION

A. General:

1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
3. Conceal fastenings where practical; where exposed, flush countersink.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
6. Fit and assemble in largest practical sections for delivery to Site.

B. Materials:

1. Use carbon steel shapes, unless otherwise noted on Drawings or Specifications.
2. Steel to be Hot-Dip Galvanized where noted on Drawings or Specifications: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.

C. Welding:

1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
4. Aluminum: Meet requirements of AWS D1.2/D1.2M.

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5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer's instructions.
7. Complete welding before applying finish.

D. Painting:

1. Shop prime with rust-inhibitive primer as specified in Section 09 90 00, Painting and Coating, unless otherwise indicated.
2. All new carbon steel and galvanized steel shall be painted with the Painting and Coating required in Section 09 90 00, Painting and Coating.
3. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
4. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

E. Galvanizing:

1. Galvanize steel as indicated on Drawings.
2. Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
3. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
4. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
5. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
6. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.

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7. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
8. Galvanized steel sheets in accordance with ASTM A653/A653M.
9. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.

F. Electrolytic Protection: Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.

G. Watertight Seal: Where required or shown, furnish neoprene gasket of a type that is satisfactory for use in contact with sewage. Cover full bearing surfaces.

H. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.

I. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.08 SOURCE QUALITY CONTROL

A. Visually inspect all fabrication welds and correct deficiencies.

1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
2. Aluminum: AWS D1.2/D1.2M.
3. Stainless Steel: AWS D1.6/D1.6M.

B. Hot-Dip Galvanizing:

1. An independent testing agency, shall be retained by Contractor and approved by Engineer to inspect and test hot-dip galvanized fabricated items in accordance with ASTM A123/A123M and ASTM A153/A153M.
2. Visually inspect and test for thickness and adhesion of zinc coating for minimum of three (3) test samples from each lot in accordance with ASTM A123/A123M and ASTM A153/A153M.

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3. Reject and retest nonconforming articles in accordance with ASTM A123/A123M and ASTM A153/A153M.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

A. General:

1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.
2. Install rigid, substantial, and neat in appearance.
3. Install manufactured products in accordance with manufacturer's recommendations.
4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.

B. Aluminum:

1. Do not remove mill markings from concealed surfaces.
2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.

C. Pipe Sleeves:

1. Provide where pipes pass through concrete or masonry.
2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
3. Provide center flange for water stoppage on sleeves in exterior or water-bearing walls.
4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.

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D. Steel Lintels and Shelf Angles: Provide as required for support of masonry and other construction not attached to structural steel framing, unless otherwise shown on Drawings.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Locate and hold anchor bolts in place with templates at time concrete is placed.

B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.

C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 ELECTROLYTIC PROTECTION

A. Aluminum and Galvanized Steel:

1. Coat surfaces of galvanized steel and aluminum fabricated items to be in direct contact with concrete, grout, masonry, or dissimilar metals, as specified in Section 09 90 00, Painting and Coating, unless indicated otherwise.
2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.
3. Allow coating to dry before installation of the material.
4. Protect coated surfaces during installation.
5. Should coating become marred, prepare and touch up in accordance with paint manufacturer’s written instructions.

B. Stainless Steel:

1. During handling and installation, take necessary precautions to prevent carbon impregnation of stainless steel members.
2. After installation, visually inspect stainless steel surfaces for evidence of iron rust, oil, paint, and other forms of contamination.
3. Remove contamination using cleaning and passivation methods in accordance with requirements of ASTM A380 and ASTM A967.

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4. Brushes used to remove foreign substances shall utilize only stainless steel or nonmetallic bristles.

5. After treatment, visually inspect surfaces for compliance.

3.04 PAINTING

A. Painted Galvanized Surfaces: Prepare as specified in Section 09 90 00, Painting and Coating.

B. Repair of Damaged Hot-Dip Galvanized Coating:

1. Conform to ASTM A780/A780M.

2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.

3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.

4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

C. All new carbon steel and galvanized steel shall be painted with the Painting and Coating required in Section 09 90 00, Painting and Coating.

3.05 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Owner-Furnished Quality Assurance:

1. In accordance with IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan in Supplement located at end of Section 01 45 23, Testing and Inspecting Services

2. Contractor responsibilities and related information on special inspection, observation, and testing are included in Section 01 45 23, Testing and Inspecting Services.

B. Contractor-Furnished Quality Control:

1. Inspection and testing required in Section 01 45 00, Contractor Quality Control.

2. Manufacturer's Certificate of Compliance for test results, or calculations, or drawings that ensure material and equipment design and design criteria

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meet requirements of Section 01 73 23, Structural Design and Anchorage for Non-Structural Components and Non-Building Structures.

3.06 FASTENER SCHEDULE

A. Unless indicated otherwise on Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks
1. Anchor Bolts Cast Into Concrete for Structural Steel, Metal Fabrications and Castings		
Interior Dry Areas	Stainless steel headed anchor bolts	
Exterior and Interior Wet Areas	Stainless steel headed anchor bolts	
Submerged and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating	See Section 09 90 00, Painting and Coating
2. Anchor Bolts Cast Into Concrete for Equipment Bases		
Interior Dry Areas	Stainless steel headed anchor bolts, unless otherwise specified with equipment	
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel headed anchor bolts with fusion bonded coating, unless otherwise specified with equipment	See Section 09 90 00, Painting and Coating
3. Post-Installed Anchors: See Section 05 05 19, Post-Installed Anchors		
4. Connections for Structural Steel Framing		

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Service Use and Location	Product	Remarks
Exterior and Interior Wet and Dry Areas	High-strength steel bolted connections	Use hot-dipped galvanized high-strength bolted connections for galvanized steel framing members.
5. All Others		
Exterior and Interior Wet and Dry Areas	Stainless steel fasteners	

B. Anti-seize Lubricant: Use on stainless steel threads.

END OF SECTION

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SECTION 05 52 16
ALUMINUM RAILINGS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Aluminum Association, Incorporated (AA): DAF45, Designation System for Aluminum Finishes.
2. American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete.
3. American Iron and Steel Institute (AISI).
4. ASTM International (ASTM):
   a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   b. A194/A194M, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   c. E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
   d. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
   e. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
5. International Code Council (ICC): International Building Code (IBC) as adopted by the Authority Having Jurisdiction.
6. Washington State Administrative Code: WAC 196-155, Safety Standards For Construction.

1.02 DEFINITIONS

A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.

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B. Railings: This term includes guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

C. Special Inspection: As defined by the ICC IBC.

D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 DESIGN REQUIREMENTS

A. Structural Performance of Railing Systems: Design, test, fabricate, and install railings to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in railing system components.

1. Top Rail: Capable of withstanding the following load cases applied:

a. Concentrated load of 200 pounds applied at any point and in any direction in accordance with ICC IBC and WAC 196-155.

b. Uniform load of 50 pounds per linear foot applied in any direction in accordance with ICC IBC.

c. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with ICC IBC.

2. In-Fill Area of Railing Systems:

a. Capable of withstanding a horizontally applied normal load of 50 pounds applied to 1 square foot at any point in system including panels, intermediate rails, balusters, and openings and space between railings.

b. Horizontal concentrated load need not be assumed to act concurrently with loads on top rails of railings.

3. Toeboard: Capable of withstanding, without failure, force of at least 50 pounds applied in downward or outward direction at any point along toeboard.

4. Calculated lateral deflection at top of posts shall not exceed 1 inch.

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1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.

b. Manufacturer's literature and catalog data of railing and components.

c. Design Data: Calculations or test data using specified design performance loads and including the following:

1) Bending stress in, and deflection of, posts in accordance with ASTM E985 as modified herein.

2) Design of post base connection.

3) Documentation that concrete anchors have been designed in accordance with one of the following:

a) ACI 318, Chapter 17.

b) ICC Evaluation Services Report for selected anchor.

B. Informational Submittals:

1. Manufacturer's assembly and installation instructions.

2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed anchors.

3. Test Reports: Test data may supplement load calculations providing data covers complete railing system, including anchorage:

a. Test data for railing and components showing load and deflection as a result of load, in enough detail to prove railing is strong enough and satisfies national, state, local standards, regulations, code requirements, and WAC 196-155, using design loads specified. Include test data for the following:

1) Railing and post connections.

2) Railing wall connections.

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3) Railing expansion joint connections.

4) Railing system gate assembly, including latch, gate stop, and hinges. Both gate latch and stop to support required loads applied independent of each other.

b. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with ICC IBC.

c. Deflection Criteria: In accordance with ASTM E985 and design loads specified, except as follows: maximum calculated lateral deflection at top of posts shall not exceed 1 inch.

d. Aluminum Rail Piping: Test data showing yield strength of pipe as delivered equals or exceeds specified values.

4. Manufacturer's written recommendations describing procedures for maintaining railings including cleaning materials, application methods, and precautions to be taken in use of cleaning materials.

1.05 QUALITY ASSURANCE

A. Qualifications: Calculations required for design data shall be stamped by a registered civil or structural engineer licensed in state where Project will be constructed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package and wrap railings to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to extent possible until railing is completely installed.

B. Delivery:

1. Shop assemble into practical modules of lengths not exceeding 24 feet for shipment.

2. Deliver toeboards loose for field assembly.

3. Deliver clear anodized railing pipe and posts with protective plastic wrap.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Thermal Movements: Allow for thermal movement resulting from the following maximum range in ambient temperature in design, fabrication, and installation

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of railings to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperature of material as a result of both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.

B. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

PART 2 PRODUCTS

2.01 ALUMINUM RAILINGS

A. General:

1. Furnish pre-engineered and prefabricated railing systems as shown on Drawings.
2. Railing systems using pop rivets or glued railing construction are not permitted.
3. Sand cast accessories and components are not permitted.
4. Fasteners shall be AISI Type 316 stainless steel, unless otherwise noted.

B. Rails, Posts, and Formed Elbows:

1. Extruded Alloy 6105-T5, 6061-T6, or equivalent.
2. Tensile Strength: 38,000 psi, minimum.
3. Yield Strength: 35,000 psi, minimum.
4. Nominal Wall Thickness: 0.145 inch, minimum.
5. Posts and railings shall be nominal 1-1/2-inch diameter (1.90-inch outside diameter).

C. Accessories:

1. Fittings and Accessories:
   a. Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements.

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b. Gauge metal components are not acceptable for load-resisting components.

c. Fittings shall match color of pipe in railings.

2. Miscellaneous Extruded Aluminum Parts: Alloy 6063-T6, Alloy 6061-T6, or Alloy 6105 T5 aluminum, or equivalent, and of adequate strength for all loads.

3. Castings for Railings:

a. Cast Al-mag with sufficient strength to meet load and test requirements.

b. Anodizable grade finish with excellent resistance to corrosion when subjected to exposure of sodium chloride solution intermittent spray and immersion.

4. Post Anchorages:

a. Refer to standard details for types of post anchorages and minimum requirements.

b. Bolts at anchorages shall be minimum 1/2-inch diameter.

5. Wall Brackets: Adjustable wall fitting, with provision for minimum three 3/8-inch diameter AISI Type 316 stainless steel bolts or concrete anchors.

6. Rail Terminals (including Wall Returns): Aluminum wall fitting with provision for three 3/8-inch Type 304 fasteners.

7. Railing System Gate:

a. Extruded aluminum rail components.

b. Hardware Manufacturers and Products:

1) Julius Blum & Co., Inc., Carlstadt, NJ; No. 782/3 gate hinges with springs, and No. 784 gate latch and stop.

2) CraneVeyor Corp., South El Monte, CA; No. C4370b gate hinges with spring, No. C4369 gate latch, and No. C4368 gate stop.

3) Moultrie Manufacturing Co., Moultrie, GA; Part No. W60006.

8. Toeboards:

a. Molded or extruded Alloy 6063-T6 or Alloy 6061-T6 aluminum.

b. Provide slotted holes for expansion and contraction where required.

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D. Metal Supports Embedded in Concrete: In accordance with Section 05 50 00, Metal Fabrications.

E. Finishes:

1. Pipe and Post: In accordance with AA DAF45, designation AA-M32-C22-A41.
2. Cast Fittings and Toeboards: In accordance with AA DAF45, designation AA-M10-C22-A41.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

A. Locknuts, Washers, and Screws:

1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): AISI 316 stainless steel.
2. Flat Washers: Molded nylon.

B. Bolts and Nuts for Bolting Railing to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type 316 stainless steel.

C. Concrete Anchors:

1. Stainless steel, AISI Type 304 or Type 316.
2. Post-installed anchors in accordance with Section 05 05 19, Post-installed Anchors, unless otherwise specified herein.
3. Bolt Diameter: 1/2-inch, minimum.

2.03 FABRICATION

A. Shop Assembly:

1. Post Spacing: Maximum 5-foot horizontal spacing.
2. Railing Posts Bolted to Metal or Concrete:
   a. In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
   b. Field fit-up is required.

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3. Free of burrs, nicks, and sharp edges when fabrication is complete.
4. Welding is not permitted.

B. Shop/Factory Finishing:

1. Use same alloy for uniform appearance throughout fabrication for railings.
2. Railing and Post Fittings: Match fittings with color of pipe in railing.

C. Shop Assembly:

1. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
2. Fit dowels tightly inside posts.

D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

3.01 GENERAL

A. Field fabrication of aluminum railing systems is not permitted.

B. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.

C. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.

D. Modification to supporting structure is not permitted where railing is to be attached.

E. Protection from Entrapped Water:

1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
2. For posts mounted in concrete, bends, and elbows occurring at low points, drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

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3.02 RAILING INSTALLATION

A. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.

B. Expansion Joints:

1. Maximum intervals of 54 feet on center and at structural joints.
2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

C. Posts and Rails:

1. Surface Mounted Posts:
   a. Bolt post baseplate connectors firmly in place.
   b. Shims, wedges, grout, and similar devices for railing post alignment not permitted.
2. Set posts plumb and aligned to within 1/8 inch in 12 feet.
3. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
4. Install posts and rails in same plane.
5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

D. Wall Brackets: Support wall rails on brackets spaced maximum 5 feet on centers as measured on the horizontal projection.

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E. Toeboard:

1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or at stairways unless shown otherwise.
2. Accurately measure in field for correct length; after railing post installation cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
4. Install plumb and aligned to within 1/8 inch in 12 feet.
5. Attach toeboards to posts via clamp that complies with design requirements while facilitating expansion and contraction. Do not screw directly to post or base.

3.03 FIELD FINISHING

A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces as specified in Section 09 90 00, Painting and Coating.

3.04 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Post-installed anchors supporting railing systems require special inspection.

B. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 00, Contractor Quality Control.

3.05 CLEANING

A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.

B. Do not use acid solution, steel wool, or other harsh abrasive.

C. If stain remains after washing, restore in accordance with railing manufacturer's recommendations or replace stained railings.

END OF SECTION

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SECTION 06 82 00
GLASS-FIBER-REINFORCED PLASTIC

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
    a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus.
    b. D570, Standard Test Method for Water Absorption of Plastics.
    c. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning Plastics in a Horizontal Position.
    d. D638, Standard Test Method for Tensile Properties of Plastics.
    e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
    f. D696, Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between minus 30 Degrees C and 30 Degrees C.
    g. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
    h. D792, Standard Test Methods for Density and Specific Gravity (Relative Density) by Plastics Displacement.
    i. D2344, Standard Test Method for Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short-Beam Method.
    j. D2583, Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
    k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
2. Building Officials and Code Administrators International (BOCA): National Building Code (NBC).

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3. International Conference of Building Officials (ICBO): Uniform Building Code (UBC).
4. Occupational Safety and Health Act (OSHA): 29 CFR 19.10, Code of Federal Regulations.
5. Southern Building Code Congress International (SBCCI): Standard Building Code (SBC).
6. UL: 94, UL Standard for Safety Test for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.02 DESIGN REQUIREMENTS

A. This section contains components and connectors that require Contractor design.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product Data: Catalog information and catalog cuts showing materials, design tasks, and showing load, span, and deflection; include manufacturer's specifications.
   b. Grating: Show dimensions, weight, size, and location of connections to adjacent grating, supports, and other Work.
   c. Grating Supports: Show dimensions, weight, size, location, and anchorage to supporting structure.
2. Samples: Each type of grating connection.

B. Informational Submittals:

1. Handling and storage requirements.
2. Manufacturer's installation instructions.
3. Manufacturer's Certification of Compliance for specified products.
4. Fabricator's qualification experience.
5. Manufacturer's qualification experience.

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6. Independent laboratory test report, dated within two (2) years of submittal date, of fire retardant testing conducted on exact type of grating proposed (not a resin test report).

1.04 QUALIFICATIONS

A. Designer: Calculations required for Contractor design shall be stamped by a registered engineer, licensed in state where Project will be constructed.

B. Fabricator: Minimum of five (5) years' experience.

C. Manufacturer: Minimum of five (5) years' experience in manufacturing of products meeting these specifications.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Shipment:

1. Insofar as is practical, factory assemble items provided hereunder.
2. Ladders shall be shipped fully shop-fabricated and assembled.
3. Package and clearly tag parts and assemblies that are of necessity shipped unassembled in a manner that will protect materials from damage, and facilitate identification and final assembly in field.

B. Storage and Handling: In accordance with manufacturer's recommendations and in such a manner as to prevent damage of any kind, including overexposure to sunlight.

PART 2 PRODUCTS

2.01 GENERAL

A. Like Items of Materials: Where possible, provide end products of one manufacturer in order to achieve standardization for appearance, maintenance, and replacement.

B. Unless otherwise specified, all products shall be manufactured by a pultruded process using vinyl ester resin.

C. Products shall be manufactured with ultra-violet (UV) inhibitor additives.

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D. Exterior surfaces shall have a synthetic surface veil covering.

E. Furnish molded products as an option where permitted by specifications.

F. Fire Retardance:

1. Flame spread shall be less than 25 as measured by ASTM E84.
2. Include combinations of aluminum trihydrate, halogen, and antimony trioxide, where required to meet fire retardance, in the resin system.
3. Meet self-extinguishing requirements of ASTM D635.

G. Color pigment shall be dispersed in resin system.

H. Fabricate FRP products exposed to outdoor conditions with an additional 1-mil thick UV coating to shield product from UV light.

I. All cut ends, holes, and abrasions of FRP shapes shall be sealed with resin to prevent intrusion of moisture.

2.02 FIBERGLASS COVERED GRATING

A. General:

1. 100 psf minimum, unless otherwise shown.
2. Maximum Deflection: 1/4 inch, unless otherwise shown.

B. Molded Type:

1. Nonskid fiberglass gritted plate fastened to each grating panel, providing skid resistance.
2. Load bars in both directions with equal stiffness.
3. Square mesh with 1-1/2-inch maximum spacing.

C. Pultruded Type:

1. Nonskid fiberglass gritted plate fastened to each grating panel, providing skid resistance.
2. Main bars joined by cross bars secured in holes drilled in main bars.

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3. Cross bars with 6-inch maximum spacing shall mechanically lock main bars in position such that they prevent movement.
4. Intersections: Bond using adhesive as corrosive-resistant as pultrusion resin.
5. Main Bar Ends: Minimum bearing support width of 1-1/2 inches.
6. Skid-Resistant Surface: Grit adhesively bonded, manufacturer's standard.
7. Provide extra stiffness around openings.

D. Hold-Down Clamps: Type 316 stainless steel.

E. Bolts and Connectors:

1. Corrosion-resistant FRP or Type 316 stainless steel.
2. Size and strength to meet UBC requirements.

F. Fabrications:

1. Field measure areas to receive grating. Verify dimensions of new fabricated supports, and fabricate to dimension required for specified clearances.
2. Section Length: Sufficient to prevent it falling through clear opening when oriented in span direction when one end is touching either concrete or vertical leg of grating support.

G. Manufacturers:

1. Fibergrate Composite Structures, Inc., Addison, TX.
2. IKG/Borden, Clark, NJ.
3. Strongwell Corp., Bristol Division, Bristol, VA or Chatfield Division, Chatfield, MN.
4. International Grating, Inc., Houston, TX.

H. Thermal Movement:

1. Allow for maximum range of ambient temperature change (difference between high or low and installation temperature).

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2. Base design on actual surface temperatures of materials due to both solar heat gain and night time sky heat loss.

3. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

PART 3 EXECUTION

3.01 GENERAL

A. Install in accordance with manufacturer's written instructions.

B. Install plumb or level, rigid and neat, as applicable.

C. Furnish fasteners and anchorages for complete installation.

D. Seal field cut holes, edges, and abrasions with catalyzed resin compatible with original resin.

3.02 GRATING

A. Anchor grating securely to supports to prevent displacement.

B. Install each grating section such that it is easily removable.

C. Clearance (Grating to Vertical Surfaces): 1/4 inch (plus or minus 1/8-inch tolerance).

3.03 STRUCTURAL SHAPES

A. Connect parts with approved connectors meeting manufacturer's design requirements and with corrosion resistance equal to structural shapes.

B. Provide supports and bracings required to comply with applicable codes and design requirements.

END OF SECTION

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SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):

a. C661, Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.

b. C834, Standard Specification for Latex Sealants.

c. C920, Standard Specification for Elastomeric Joint Sealants.

d. C1193, Standard Guide for Use of Joint Sealants.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Surface preparation instructions. Indicate where each product is proposed to be used.

2. Samples: Material proposed for use showing color available.

B. Informational Submittals:

1. Installation instructions.

2. Documentation showing applicator qualifications.

3. Manufacturer's Certificate of Compliance.

4. Special guarantee.

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1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum of five (5) years' experience installing sealants in projects of similar scope.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 degrees F and 80 degrees F (4 degrees C and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

1.05 SPECIAL GUARANTEE

A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction or, at the option of the Owner, removal and replacement of Work specified in this section found defective during a period of five (5) years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

B. Conditions: No adhesive or cohesive failure of sealant.

C. Sealed Joints: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.01 SEALANT MATERIALS

A. Characteristics:

1. Uniform, homogeneous.
2. Free from lumps, skins, and coarse particles when mixed.
3. Nonstaining, nonbleeding.
4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
5. Immersible may be substituted for nonimmersible.

B. Color: Unless specifically noted, match color of the principal material adjoining area of application.

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C. Type 1—Silicone, Nonsag, Nonimmersible:

1. Silicone base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Capable of withstanding movement up to 50 percent of joint width.
3. Manufacturers and Products:
    a. Dow Corning Corp.; No. 790.
    b. General Electric; Silpruf.
    c. BASF; Sonneborn, Omniseal-50.

D. Type 2—Multipart Polyurethane, Self-leveling, Immersible:

1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products:
    a. BASF; Sonneborn, SL-2.
    b. Pecora Corp.; Urexspan NR-200.
    c. Tremco; THC-900/901.
    d. Sika Chemical Corp.; Sikaflex 2c SL.

E. Type 3—Multipart Polyurethane, Nonsag, Immersible:

1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products:
    a. Pecora; DynaTrol II.
    b. Tremco; Dymeric 240.
    c. BASF; Sonneborn NP-2.
    d. Sika Chemical Corp.; Sikaflex 2c NS.

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F. Type 4—Multipart Polyurethane, Nonsag, Nonimmersible:

1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
2. Manufacturers and Products:
    a. BASF; Sonneborn NP-2.
    b. Pecora Corp.; Dynatrol II.
    c. Tremco; Dymeric 240.
    d. Sika Chemical Corp.; Sikaflex 2c NS.

G. Type 5—One-part Polyurethane, Immersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products for Nonsag:
    a. Sika Chemical Corp.; Sikaflex-1a.
    b. Tremco; Vulkem 116.
4. Manufacturers and Products for Self-leveling:
    a. BASF; MasterSeal, SL-1.
    b. Tremco; Vulkem 45.
    c. Sika Chemical Corp.; Sikaflex 1c SL.

H. Type 6—One-part Polyurethane, Nonimmersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Manufacturers and Products:
    a. Pecora Corp.; Dynatrol 1 XL.
    b. Tremco; Dymonic.
    c. BASF; Sonneborn, NP-I.

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I. Type 7—Multipart Polysulfide, Immersible:

1. Polysulfide base, two-component, chemical curing; ASTM C920, Type M, Grade P or NS, Class 25.
2. Capable of being continuously immersed in water.
3. For use above grade and below grade.
4. Manufacturers and Products:
    a. W. R. Meadows; Deck-O-Seal Gun Grade, two-part.
    b. BASF; Sonolastic, two-part Polysulfde.

J. Type 8—One-part Polysulfide, Nonsag, Nonimmersible:

1. Polysulfide base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 12 1/2.
2. Capable of withstanding movement up to 20 percent of joint width.
3. Manufacturer and Product: W. R. Meadows; Deck-O-Seal, one-part.

K. Type 9—One-part Acrylic Terpolymer, Nonsag, Nonimmersible:

1. Acrylic base, single-component, solvent curing; ASTM C834 nonsag.
2. Capable of withstanding movement up to 7.5 percent of joint width; Shore “A” hardness of 55 maximum.
3. Manufacturer and Product: Tremco; Mono 555.

L. Type 10—Sanitary Sealant:

1. Silicone sealant similar to Type 1, above, formulated to resist mold growth and repeated exposure to high humidity while retaining adhesion, flexibility, and color.
2. Manufacturers and Products:
    a. Dow Corning; 786.
    b. General Electric; Sanitary Sealant SCS1700.

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M. Type 11—Fire Penetration Seal:

1. Manufacturers and Products:
    a. 3M Corp.; Fire Barrier Caulk CP25 and Putty 303.
    b. General Electric; Pensil Sealant or Foam.
    c. Unifrax Corporation; Fyre Putty.
    d. Hilti USA; CP 604.

N. Type 12—One-part Polycarbonate, Immersible:

1. Polycarbonate base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturer and Product: Pro-Seal Products, Inc.; Pro-Seal 34.

O. Type 13—Tape Sealant:

1. Compressible polyurethane foam impregnated with polybutylene or polymer-modified asphalt.
2. Color: Black.
3. Size: 3/4-inch wide by length required by expanded thickness recommended by manufacturer for particular application.
4. Manufacturers and Products:
    a. Emseal Joint Systems, Ltd.; AST—High Acrylic.
    b. Dayton Superior; Polytite Standard.
    c. PARR Technologies; PARR Sealant EP-7212-T.

2.02 BACKUP MATERIAL

A. Nongassing, extruded, closed-cell round polyurethane foam or polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16-inch wide.

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C. Manufacturers and Products:

1. BASF; Sonneborn, Sonolastic Closed-cell Backing Rod.
2. Tremco; Closed-cell Backing Rod.
3. Pecora Corporation; Green Rod.

2.03 ANCILLARY MATERIALS

A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by sealant manufacturer.

B. Install joint sealants in accordance with ASTM C1193.

C. Horizontal and Sloping Joints up to 1 Percent Maximum Slope: Use self-leveling (Grade P) joint sealant.

D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use nonsag (Grade NS) joint sealant.

E. Use joint sealant as required for the applicable application and as follows:

Joint Size	Sealant Type
Less than 1"	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 12
Less than 2"	1, 2, 3, 4, or 7
Over 2"	Follow manufacturer’s recommendation

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3.02 PREPARATION

A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.

B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.

1. Mask adjacent surfaces where necessary to maintain neat edge.
2. Starting of work will be construed as acceptance of subsurfaces.
3. Apply primer to dry surfaces as recommended by sealant manufacturer.

C. Verify joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

E. Follow manufacturer's instructions for mixing multi-component products.

3.03 INSTALLATION

A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.

1. Install backup material as recommended by sealant manufacturer.
2. Where possible, provide full length sections without splices; minimize number of splices.
3. Tape sealant may be used as joint filler if approved by sealant manufacturer.

B. Use bond breaker where recommended by sealant manufacturer.

C. Seal joints around window, door and louver frames, expansion joints, control joints, and elsewhere as indicated.

D. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.

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E. Joints: Tool slightly concave after sealant is installed.

1. When tooling white or light color sealant, use a water wet tool.
2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

F. Tape Sealant: Compress to 50 percent of expanded thickness and install in accordance with manufacturer's instructions.

3.04 PREFORMED SEALS

A. Prepare joint surfaces clean and dry, free from oil, rust, laitance, and other foreign material.

B. Construct joints straight and parallel to each other and at proper width and depth.

C. Apply joint sealant manufacturer's approved primer and adhesive in accordance with manufacturer's instructions.

D. Install seal in accordance with manufacturer's instructions.

3.05 CLEANING

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

3.06 JOINT SEALANT SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of Project.

Joint Locations	Sealant Type(s)
Expansion/Contraction and Control Joints At:	
Concrete Walls (except water-holding and belowgrade portions of structures)	1, 3, 4, 5, 6, 12

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Joint Locations	Sealant Type(s)
Concrete Floor Slabs (except for water-holding Structures)	2, 5
Concrete Walls and Slabs immersed in water and/or below grade	7
Slabs Subject to Vehicle and Pedestrian Traffic	2, 5
Material Joints At:	
Wall Penetrations (Exterior)	1, 5, 6, 8, 12
Wall Penetrations (Interior)	1, 5, 6, 8
Floor Penetrations	5, 6, 7
Roof Penetrations	5
Sheet Metal Flashings	5, 13
Sheet Metal Roofing and Siding	5, 13
Other Joints:	
Threshold Sealant Bed	5
Between Counter Tops and Backsplashes	10
Around Plumbing Fixtures	10
Openings Around Pipes, Conduits, and Ducts Through Fire-Rated Construction	

END OF SECTION

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SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
    a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied.
    b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
    c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
    d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. Environmental Protection Agency (EPA).
3. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. NSF International (NSF): 61, Drinking Water System Components - Health Effects.
5. Occupational Safety and Health Act (OSHA).
6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.
7. The Society for Protective Coatings (SSPC):
    a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
    b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
    c. SP 1, Solvent Cleaning.
    d. SP 2, Hand Tool Cleaning.

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e. SP 3, Power Tool Cleaning.

f. SP 5, White Metal Blast Cleaning.

g. SP 6, Commercial Blast Cleaning.

h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.

i. SP 10, Near-White Blast Cleaning.

j. SP 11, Power Tool Cleaning to Bare Metal.

k. SP 13, Surface Preparation of Concrete.

l. SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.

m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. DFT: Dry Film Thickness.
3. FRP: Fiberglass Reinforced Plastic.
4. HCl: Hydrochloric Acid.
5. MDFT: Minimum Dry Film Thickness, mils.
6. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
7. Mil: Thousandth of an inch.
8. PPDS: Paint Product Data Sheet.
9. PSDS: Paint System Data Sheet.
10. PVC: Polyvinyl Chloride.
11. SFPG: Square Feet per Gallon.
12. SFPGPC: Square Feet per Gallon per Coat.
13. SP: Surface Preparation.

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1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Data Sheets:
        1) For each product, furnish a Paint Product Data Sheet (PPDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PPDS form is appended to the end of this section.
        2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
        3) Technical and performance information that demonstrates compliance with specification.
        4) Furnish copies of paint system Submittals to the coating applicator.
        5) Indiscriminate Submittal of only manufacturer's literature is not acceptable.
    b. Detailed chemical and gradation analysis for each proposed abrasive material.
2. Samples:
    a. Proposed Abrasive Materials: Minimum 5-pound sample for each type.
    b. Reference Panel:
        1) Surface Preparation:
            a) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
            b) Provide panel representative of the steel used; prevent deterioration of surface quality.
            c) Panel to be reference source for inspection upon approval by Engineer.

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2) Paint:

a) Unless otherwise specified, before painting work is started, prepare minimum 8-inch by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.

b) Furnish additional samples as required until colors, finishes, and textures are approved.

c) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.

2. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.

3. Manufacturer's written verification that submitted material is suitable for the intended use.

4. Coating for Faying Surfaces: Manufacturer's test results that show the proposed coating meets the slip resistance requirements of the AISC Specification for Structural Joints using ASTM A325 or ASTM A490 bolts.

5. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible.

6. Manufacturer's written instructions and special details for applying each type of paint.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum five (5) years' experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.

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2. Perform surface preparation and painting in accordance with recommendations of the following:

   a. Paint manufacturer's instructions.

   b. SSPC PA 10.

   c. Federal, state, and local agencies having jurisdiction.

C. Mockup:

1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.

2. After Engineer approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.

2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.

B. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.

2. Primed surfaces shall not be exposed to weather for more than two (2) months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.

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2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.

B. Minimum of five (5) years' verifiable experience in manufacture of specified product.

C. Each of the following manufacturers is capable of supplying most of the products specified herein:

1. Tnemec.

2.02 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: 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.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

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B. Products:

Product	Definition
Acrylic Latex	Single-component, finish as required
Acrylic Latex (Flat)	Flat latex
Acrylic Sealer	Clear acrylic
Alkyd (Semigloss)	Semigloss alkyd
Alkyd Enamel	Optimum quality, gloss or semigloss finish as required, medium long oil
Alkyd Wood Primer	Flat alkyd
Bituminous Paint	Single-component, coal-tar pitch based
Block Filler	Primer-sealer designed for rough masonry surfaces, 100% acrylic emulsion
Coal-Tar Epoxy	Amine, polyamide, or phenolic epoxy type 70% volume solids minimum, suitable for immersion service
DTM Acrylic Primer	Surface tolerant, direct-to-metal water borne acrylic primer
DTM Acrylic Finish	Surface tolerant, direct-to-metal water borne acrylic finish coat
Elastomeric Polyurethane	100% solids, plural component, spray applied, high build, elastomeric polyurethane coating, suitable for the intended service
Epoxy Filler/Surfacer	100% solids epoxy trowel grade filler and surfacer, nonshrinking, suitable for application to concrete and masonry. Approved for potable water contact and conforming to NSF 61, where required
Epoxy Nonskid (Aggregated)	Polyamidoamine or amine converted epoxies aggregated; aggregate may be packaged separately
Epoxy Primer—Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments

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Product	Definition
Epoxy Primer—Other	Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated
Fusion Bonded Coating	100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service
TFE Lube or Grease Lube	Tetrafluoroethylene, liquid coating, or open gear grease as supplied by McMaster-Carr Supply Corporation, Elmhurst, IL
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat
Inorganic Zinc Primer	Solvent or water based, having 85% metallic zinc content in the dry film; follow manufacturer's recommendation for topcoating
Latex Primer Sealer	Waterborne vinyl acrylic primer/sealer for interior gypsum board and plaster. Capable of providing uniform seal and suitable for use with specified finish coats
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61
Epoxy, High Solids	Polyamidoamine epoxy, 80% volume solids, minimum, suitable for immersion service
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish
Organic Zinc Rich Primer	Epoxy or moisture cured urethane with 85-percent zinc content in the dry film, meeting the requirements of RCSC Specification for Structural Joints using High Strength Bolts, Class A or Class B, as required.
Rust-Inhibitive Primer	Single-package steel primers with anticorrosive pigment loading
Sanding Sealer	Co-polymer oil, clear, dull luster

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Product	Definition
Silicone/Silicone Acrylic	Elevated temperature silicone or silicone/acrylic based
Stain, Concrete	Acrylic, water repellant, penetrating stain
Stain, Wood	Satin luster, linseed oil, solid or transparent as required
Varnish	Nonpigmented vehicle based on a variety of resins (alkyd, phenolic, urethane) in gloss, semigloss, or flat finishes, as required
Water Base Epoxy	Two-component, polyamide epoxy emulsion, finish as required

2.04 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

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PART 3 EXECUTION

3.01 GENERAL

A. Provide Engineer minimum seven (7) days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Engineer unless Engineer grants prior approval to perform the Work in Engineer's absence.

C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

3.02 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.
2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

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D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

A. Field Abrasive Blasting:

1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
2. Refer to coating systems for degree of abrasive blasting required.
3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

B. Surface Contamination Testing:

1. A surface contamination analysis test shall be performed every 500 square feet by means of a Chlor Test CSN Salts, or approved equivalent.
2. Surface with chloride levels exceeding 3 µg/square centimeter for submerged surfaces and 5 µg/square centimeter for exposed surfaces shall be treated with a liquid soluble salt remover equivalent to CHLOR*RID (CHLOR*RID International, Chandler, AZ).
3. Follow manufacturer's recommendations and procedures for the use of this product to remove the surface contamination.

C. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:
    a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
    b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.

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c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.

d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.

e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

f. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.

g. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

h. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.

i. SP 16, Brush Blasting of Non-Ferrous Metals: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).

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2. The words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” and “blast cleaning,” or similar words of equal intent in these Specifications or in paint manufacturer’s specification refer to the applicable SSPC Specification.
3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.
4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
7. Welds and Adjacent Areas:
    a. Prepare such that there is:
        1) No undercutting or reverse ridges on weld bead.
        2) No weld spatter on or adjacent to weld or any area to be painted.
        3) No sharp peaks or ridges along weld bead.
    b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.
8. Preblast Cleaning Requirements:
    a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
    b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
    c. Clean small, isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
    a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer’s recommendations.

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b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.

c. Use only dry blast cleaning methods.

d. Do not reuse abrasive, except for designed recyclable systems.

e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.

10. Post-Blast Cleaning and Other Cleaning Requirements:

a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.

b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

D. Existing Painted Surfaces to be Repainted Surface Preparation:

1. Detergent wash and freshwater rinse.

2. Clean loose, abraded, or damaged coatings to substrate by hand or power tool, SP 2 or SP 3.

3. Feather surrounding intact coating.

4. Apply one spot coat of specified primer to bare areas, overlapping prepared existing coating.

5. Apply one full finish coat of specified primer to entire surface.

6. If an aged, plural-component material is to be topcoated, contact coating manufacturer for additional surface preparation requirements.

7. Application of Cosmetic Coat:

a. It is assumed that existing coatings have oxidized sufficiently to prevent lifting or peeling when overcoated with paints specified.

b. Check compatibility by application to a small area prior to starting painting.

c. If lifting or other problems occur, request disposition from Engineer.

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8. Perform blasting as required to restore damaged surfaces. Materials, equipment, procedures shall meet requirements of SSPC.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.
5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Acid Etching:

1. After precleaning, spread the following solution by brush or plastic sprinkling can:
   a. One part commercial muriatic acid reduced by two parts water by volume. Adding acid to water in these proportions gives an approximate 10 percent solution of HCl.
2. Application:
   a. Rate: Approximately 2 gallons per 100 square feet.
   b. Work acid solution into surface by hard-bristled brushes or brooms until complete wetting and coverage is obtained.
   c. Acid will react vigorously for a few minutes, during which time brushing shall be continued.
   d. After bubbling subsides (10 minutes), hose down remaining slurry with high pressure clean water.

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e. Rinse immediately to avoid formation on the surface of salts that are difficult to remove.

f. Thoroughly rinse to remove any residual acid surface condition that may impair adhesion.

3. Ensure surface is completely dry before application of coating.

4. Apply acid etching to obtain a “grit sandpaper” surface profile. If not, repeat treatment.

C. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.

2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. The intention of these Specifications is for existing, exterior metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise.

2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.

3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer’s written instructions for these requirements. Do not immerse coating until completion of curing cycle.

4. Apply coatings in accordance with these Specifications and paint manufacturers’ printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.

5. Sand wood lightly between coats to achieve required finish.

6. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

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7. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
8. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
9. Water-Resistant Gypsum Board: Use only solvent type paints and coatings.
10. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.
11. Keep paint materials sealed when not in use.
12. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Film Thickness and Coverage:

1. Number of Coats:
    a. Minimum required without regard to coating thickness.
    b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
    a. Do not exceed coating manufacturer's recommendations.
    b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
    a. Perform with properly calibrated instruments.
    b. Recoat and repair as necessary for compliance with specification.
    c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.

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6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the followings schedule. In the event, of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. System No. 28 Roof Beam and Rake Arm Mechanism Coatings:

Surface Prep.	Paint Material	Min. Coats, Cover
As per manufacturer	Prime Coat, Tnemec Series N69	1 coat, 3-6 MDFT
	Intermediate Coat, Tnemec Series N69	1 coat, 3-6 MDFT
	Final Coat, Tnemec Series N69	1 coat, 3-6 MDFT

1. Use on the following items or areas:
   a. Clarifier rake arms, mechanisms, and platforms.
   b. Primary clarifier roof beams.
   c. Scum box and submerged scum piping.

3.08 COLORS

A. Provide as designated herein.

B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

C. Equipment Colors:

1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.

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2. Paint nonsubmerged portions of equipment the same color as the piping it serves, except as itemized below:

   a. Dangerous Parts of Equipment and Machinery: OSHA Orange.

   b. Fire Protection Equipment and Apparatus: OSHA Red.

   c. Radiation Hazards: OSHA Purple.

   d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

D. Pipe Identification Painting:

1. Color code nonsubmerged metal piping, except electrical conduit. Paint ductile iron fittings and valves the same color as pipe, except equipment isolation valves.

2. Pipe Color Coding: As shown in table below.

3. Pipe Supports: Painted light gray, as approved by Engineer.

4. Polyvinyl chloride (PVC) pipe located inside of buildings and enclosed structures shall not be painted. PVC pipe shall be labeled using self-adhesive pipe markers colored per Table Pipe System Color Code and labeled with designated Pipe System. Labels shall be affixed along pipe axis at connections to equipment, valves, or branch fittings, at wall boundaries, and at intervals along piping not greater than 9 feet on center.

E. Pipe System Color Code:

Pipe System	Color
Rake Arms, Mechanisms, and Platforms	Black
Roof Beams	Grey
Note: Contractor shall match color with existing pipe system colors and shall coordinate with Owner on color selection.	

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3.09 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide calibrated electronic type dry film thickness gauge to test coating thickness specified in mils.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
    a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of eight (8) hours after application of coating.
    b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
    c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
    d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

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D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.
4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.10 MANUFACTURER'S SERVICES

A. Coating manufacturer's representative shall be present at Site as follows:

1. As required to resolve field problems attributable to or associated with manufacturer's product.
2. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.11 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

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B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.12 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Paint System Data Sheet (PSDS).
2. Paint Product Data Sheet (PPDS).

END OF SECTION

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PAINT SYSTEM DATA SHEET (PSDS)

Complete this PSDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PSDS.

Paint System Number (from Spec.):		
Paint System Title (from Spec.):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	Product Name/Number (Proprietary)	Min. Coats, Coverage

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PAINT PRODUCT DATA SHEET (PPDS)

Complete and attach manufacturer's Technical Data Sheet to this PPDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio: _____

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.: _____ max.: _____

Surface Temperature Limitations: min.: _____ max.: _____

Surface Profile Requirements: min.: _____ max.: _____

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SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR ODOR CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Moving and Conditioning Association, Inc. (AMCA): 203, Field Performance Measurement of Fan Systems.
2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): HVAC Applications Handbook.
3. Associated Air Balance Council (AABC): National Standards for Field Management and Instrumentation Total System Balance.
4. National Environmental Balancing Bureau (NEBB):
   a. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
   b. Procedural Standards for Measuring Sound and Vibration.
5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): HVAC Testing, Adjusting, and Balancing Manual.
6. TABB: Testing, Adjusting, and Balancing Bureau.

1.02 SUBMITTALS

A. Submittal Information: Contractor shall provide Submittals using the procedures defined in the Division 01 , General Requirements, Specifications.

B. Informational Submittals:

1. Documentation of current AABC, NEBB, or TABB certifications for those technicians in responsible charge of the work under this Contract.
2. Written verification of calibration of testing and balancing equipment.
3. Balancing Log Report following completion of system adjustments including test results, adjustments, and rebalancing procedures.

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1.03 QUALITY ASSURANCE

A. Air Balancing and Test Agency Qualifications: Certification by AABC, NEBB, or TABB for testing, adjusting and balancing of HVAC systems.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide materials, tools, test equipment, computers and instrumentation required to complete the work included.

B. Test Hole Plugs: Plug test holes in ducts with plugs made for that purpose and replace any insulation removed to specified conditions.

PART 3 EXECUTION

3.01 GENERAL

A. Adjust and balance air systems in accordance with standard procedures and recognized practices of the AABC or SMACNA.

B. Adjust and balance the following systems:

1. Primary Clarifier No. 1 and No. 2 foul air exhaust and fresh air duct system.
2. Secondary Clarifier No. 1 and No. 2 foul air exhaust duct system and fresh air supply system.

3.02 ODOR CONTROL EXHAUST

A. Primary Clarifiers No. 1 and No. 2:

1. Balance air flow to design conditions from each source by adjustment of balancing dampers as shown on Drawings.
    a. Exhaust flow rate of 4,520 CFM from Primary Clarifier No. 1.
    b. Exhaust flow rate of 4,520 CFM from Primary Clarifier No. 2.
    c. Contractor shall adjust airflows such that the measured total airflow quantity from each Primary Clarifier is within minus 10 percent and plus 25 percent of each other.

B. Secondary Clarifiers No. 1 and No. 2: Record air flows from each drop leg for both the foul air and fresh air before removal and replacement of ductwork.

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Contractor shall adjust airflows such that the measured total airflow quantity from each drop leg is within minus 10 percent and plus 25 percent of each other.

3.03 ADJUSTING AND BALANCING AIR SIDE

A. Preparation:

1. Prior to beginning the Work, perform the following activities:
    a. Review shop drawings and installed system for adequate and accessible balancing devices and test points.
    b. Verify proper startup procedures have been completed on the system.
    c. Verify controls installation is complete and system is in stable operation under automatic control.
    d. Verify test instruments have been calibrated to a recognized standard and are within manufacturer's recommended calibration interval before beginning the Work.

B. General:

1. When adjustments are made to a portion of a fan system, reread other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.
2. Lock and mark final positions of balancing dampers with permanent felt pen.

C. Air Inlets:

1. In each system at least one air path from fan to final branch duct termination shall have dampers fully open.
2. Adjust air volumes on exhaust inlets, to the quantity shown on Drawings, as close as reasonably possible without adjusting fan speed.
3. After final adjustments are made secure dampers to prevent movement and mark final positions with permanent felt pen.

3.04 FIELD QUALITY CONTROL

A. General: Perform functional tests as required by this Section.

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B. Balancing Log Report Requirements:

1. Include narrative description for each system explaining TAB methodology and assumptions used. Clearly identify test conditions for tests performed. Include control setpoint.
2. Log and record operational information from every test for each system, as necessary to accomplish services described.
3. Include equipment data for units tested.
4. Report percent airflow variation between design and actual readings in percent in addition to design and actual readings.
5. Include reduced set of Mechanical Drawings or system schematic diagrams with each element uniquely identified and indexed to balance log.
6. Indicate recorded site values, and velocity and mass correction factors used to provide equivalent standard air quantities.
7. Include separate section in log, if necessary, describing operating difficulties in air or water systems that could not be eliminated by specified procedures. Identify these problems by system and location within building; include outline or summary of condition and its effect on building, and describe corrective actions attempted and recommended.

C. Quality Control Verification:

1. After adjustments have been completed and balance logs submitted, balancing and testing agency shall be available to demonstrate the following:
    a. Air balancing procedures and verification of test results.
    b. Perform spot tests on a maximum of 20 percent of total exhaust air inlets, with measuring equipment used in original tests, at random points selected by Project Engineer.
    c. Results of these spot tests shall agree with balance logs within plus or minus 10 percent. Where this accuracy cannot be verified, rebalance portions of system as requested by Project Engineer.
    d. At completion of rebalance procedures, perform another spot test if required to verify results.

END OF SECTION

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SECTION 23 31 13.05
METAL PROCESS DUCTWORK

PART 1 GENERAL

1.01 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 Iron and Steel Institute (AISI).
3. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
    a. HVAC Systems and Equipment Handbook, Duct Construction Chapter.
    b. Fundamentals Handbook.
4. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
5. ASTM International (ASTM):
    a. A36/A36M, Standard Specification for Carbon Structural Steel.
    b. A193 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service,
    c. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
    d. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
    e. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
    f. F594, Standard Specification for Stainless Steel Nuts.
6. American Society for Nondestructive Testing (ASNT): SNT TC 1A, Recommended Practice for Personal Qualification and Certification in Nondestructive Testing.

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7. American Welding Society (AWS):
    a. D1.1/D1.1M, Structural Welding Code - Steel.
    b. D9.1/D9.1M, Sheet Metal Welding Code.
    c. QC1, Standard for AWS Certification of Welding Inspectors.
8. Factory Mutual Research: 4922, Fume Exhaust Ducts or Fume and Smoke Exhaust Ducts.
9. 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. 91, Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.
    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.
10. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
    a. Accepted Industry Practice for Industrial Duct Construction.
    b. HVAC Air Duct Leakage Test Manual.
    c. HVAC Round Industrial Duct Construction Standards.
    d. Seismic Restraint Manual: Guidelines for Mechanical Systems.
11. UL 181, Standard for Safety Factory-Made Air Ducts and Connectors.

1.02 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.

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3. MDFT: Mean dry film thickness.
4. PCF: Pounds per cubic foot.
5. ppm: Parts per million by volume.
6. WC: Water column.

B. Ductwork Dimensions: Net free, inside dimensions of duct.

C. Sealing Requirements:

1. For non-welded duct systems and components, the following definitions apply:
   a. Joints, duct surface connections including:
      1) Girth joints.
      2) Branch and subbranch intersections.
      3) Duct collar tap-ins.
      4) Fitting subsections.
      5) Louver and air terminal connections to ducts.
      6) Access door, and access panel frames and jambs.
      7) Duct, plenum, and casing abutments to building structures.
   b. 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.

1.03 SUBMITTALS

A. Submittal Information: Contractor shall provide Submittals using the procedures defined in the Division 01, General Requirements, Specifications.

B. Action Submittals:

1. Product Data:
   a. Ductwork:
      1) Schedules of duct systems, materials, joints, sealing, gage and reinforcement.

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2) SMACNA figure numbers for each shop fabricated item.

3) Reinforcing details and spacing.

4) Seam and joint construction details.

5) Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

b. Ductwork Accessories:

1) 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, including the following items:

a) Fittings and volume control damper installation (both manual and automatic) details.

b) Gasket and sealing materials.

c) Drains for ducts carrying mists or condensate.

d) Dampers: Include leakage, pressure drop, and maximum back pressure data.

2. Duct Fabrication Drawings:

a. Prepare after actual Job measurements are obtained.

b. Draw to a scale not smaller than 1/4-inch equals 1 foot, on Drawing sheets same size as Drawings.

c. Include the following features:

1) Fabrication, assembly, and installation details including plans, elevations, sections, details of components, and attachments to other work.

2) Ductwork layout, indicating pressure classifications, slopes, drain and test port locations, and sizes in plan view.

3) Ductwork material and thickness.

4) Fittings and volume control damper installation (both manual and automatic) details.

5) Reinforcing details and spacing.

6) Seam and joint construction details.

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7) Penetrations through fire-rated and other partitions.

8) Ductwork accessories and control devices such as manual dampers, regulators, and air distribution devices.

9) Hangers, braces and supports, including methods for building attachment, seismic bracing, vibration isolation, and ductwork attachment.

10) Coordination with ceiling suspension members.

11) Spatial coordination with other systems installed in same space with duct systems.

12) Coordination of ductwork with sprinkler piping and other mechanical and electrical services, and equipment.

3. Shop Fabricated Welded Duct:

a. Detailed fabrication or spool drawings showing special fittings and bends, dimensions, and other pertinent information.

b. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.

4. Equipment anchorage, bracing and support drawings and cut sheets indicating size, material, spacing, embedment and edge distances of anchors and other relevant information.

5. Provide duct and fitting performance data upon request.

C. Informational Submittals:

1. Qualifications:

a. Manufacturer: List of references substantiating experience.

b. Installer: Manufacturer's certification that installer is qualified for installation work.

c. Nondestructive Testing Personnel: SNT-TC-1A, Level II certification and qualifications.

d. AWS QC1 Certified Welding Inspector: Submit evidence of current certification prior to commencement of welding activities.

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e. Welders:

1) Continuity log for welders and welding operators.

2) Welder qualification test records conducted by Contractor or manufacturer.

2. Welder certifications for sheet metal welders per AWS D9.1/D9.1M, Sheet Metal Welding Code.

3. Operation and Maintenance Data: In accordance with General Conditions and section 01 78 23.

4. Record Drawings: Include duct systems routing, fittings details, and installed accessories and devices.

1.04 QUALITY ASSURANCE

A. Industry Standards:

1. Unless otherwise indicated on Drawings or specifications, provide supports and seismic restraint in compliance with SMACNA, Seismic Restraint Manual: Guidelines for Mechanical Systems. Use Seismic Hazard Level (SHL) C.

2. Unless otherwise indicated or specified, on Drawings or Specifications, provide ductwork and supports constructed and installed in accordance with SMACNA HVAC Round Industrial Duct Construction Standards.

3. Comply with ASHRAE Fundamentals Handbook and ASHRAE HVAC Systems and Equipment Handbook recommendations, except as otherwise indicated.

4. Comply with NFPA 90A and NFPA 90B.

B. Manufacturers:

1. Factory Fabricated Ductwork: Firms regularly engaged in manufacture of ductwork products of types, materials, and sizes required, whose products have been satisfactorily used in service similar to that required for this Project for not less than five (5) years.

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C. Suppliers of Duct and Fitting Components:

1. Provide the following information on request:

a. Laboratory performance data for duct, including leakage rate, bursting strength, collapse strength, seam strength, and pressure loss.

b. Laboratory performance data for fittings, including zero-length dynamic losses.

D. Qualifications:

1. Independent Inspection and Testing Agency:

a. Ten (10) years' experience in field of welding and welded duct and fittings' testing required for this Project.

b. Calibrated instruments and equipment, and documented standard procedures for performing specified testing.

c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.

d. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

e. Verification Welding Inspector: AWS QC1 Certified.

2. Welding Procedures: In accordance with ASME BPVC SEC IX (Forms QW-482 and QW-483) or AWS D9.1/D9.1M (Annex N Forms).

3. Welder Qualifications: In accordance ASME BPVC SEC IX (Form QW-484) or AWS D1.1/D1.1M (Annex N Forms).

4. Contractor's CWI: Certified in accordance with AWS QC1, and having prior experience with specified welding codes. Alternate welding inspector qualifications require approval by Project Engineer.

E. Quality Assurance: Provide services of independent inspection and testing agency for welding operations.

1. Presence of Owner's Special Inspector or Verification CWI does not relieve Contractor from performing their own quality control, including 100 percent visual inspection of welds.

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F. Installation Firm: Five (5) years' minimum experience of successful installation on ductwork systems similar to that required for this Project.

G. Changes or alterations to layout or configuration of duct system:

1. Specifically approved in writing by Project Engineer.
2. Provide designer's confirmation that proposed layout will provide original design results, without increasing system total pressure.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect ductwork from dirt, water, and debris. During storage on Job Site, keep ends of ductwork covered to prevent foreign objects and water from entering ductwork.

B. Protect fabricated ductwork and fittings from damage during shipping, storage, and handling. Provide shrink-wrapped duct seal, applied to ends of ductwork and fittings to prevent end damage and prevent dirt and moisture from entering.

C. Separately package each piece of ductwork without internal nesting of ductwork or fitting pieces.

D. For nonflanged components, use either rigid plugs inside ends to prevent deflection or protect with wooden boxes.

E. Crate materials whenever practical prior to shipment.

F. Firmly fasten and pad components shipped to prevent shifting or flexing of components while in transit.

G. Inspect shipments upon delivery. Note damages and discrepancies on bill of lading and notify manufacturer within twenty-four (24) hours.

H. Deliver sealant materials to Site in original unopened containers labeled with manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

I. Store and handle sealant materials in compliance with manufacturers' recommendations to prevent deterioration or damage as a result of moisture, high or low temperatures, contaminants, or other causes.

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PART 2 PRODUCTS

2.01 GENERAL

A. Service Conditions:

1. Materials suitable for inside airstream containing foul air with H2S concentration exceeding 1 ppm.
2. SMACNA Pressure Class: Minus 2 to plus 2 inches water.
3. SMACNA Duct System Class: Class 5 (corrosive, moist, non-abrasive), for foul air duct systems.
4. Location: Inside.
5. Ambient Temperature: Minus 30 degrees F to 120 degrees F.
6. Seismic Requirements: As indicated on structural drawings.
7. Wind and Snow Loads: As indicated on structural drawings.

B. For indicated Pressure Class and System Class, design and install ductwork, fittings, and components to meet applicable requirements of SMACNA HVAC Round Industrial Duct Construction Standards.

C. Provide components of this ductwork system, including facings, mastics, and adhesives, with a fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, tested in accordance with ASTM E84 and NFPA 255 methods.

D. Minimize number of joints in ductwork system.

E. Ductwork thinner than 22-gauge will not be allowed.

F. 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: External.
4. For ductwork that is required to be reinforced, use only external reinforcing.

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G. Supports, Anchorage, and Restraints:

1. General:

a. When supports, anchorages, and seismic restraints for equipment and supports and seismic restraints for ductwork are not shown on Drawings, Contractor is responsible for their design.

2. Supports:

a. Provide supports for ductwork in accordance with SMACNA RIDC.

b. Type: As indicated on Drawings.

c. Maximum Duct Deflection: 1/2 inch.

d. Support spacing as indicated on Drawings and the following maximum spacing:

1) Interior Ductwork: 8 feet, maximum.

2) Exterior Ductwork: 8 feet, maximum.

3. Suspended Ductwork: Provide seismic restraints as shown on Drawings.

a. Brace Spacing: As shown on Drawings.

2.02 SHOP FABRICATED DUCTWORK

A. Ductwork, Fittings, and Accessories: Construct and install in accordance with SMACNA Round Industrial duct construction standards, as applies, for pressure and system classification indicated.

B. Round Ducts:

1. Butt-welded seam construction.

2. Joints: Provide welded Van Stone type connections to facilitate assembly and future maintenance. Designate proposed locations on Shop Drawings.

C. Elbows: Radius type, stamped or multiple gore, minimum 1.5 radius to diameter ratio.

1. Provide a minimum radius to diameter ratio of 2.0 or above for ducts with velocities above 2,000 feet per minute.

D. Provide gradual transitions and branches. Design ducts with velocities above 2,000 feet per minute for constant velocity.

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E. Shop-welded Ductwork Seams, Joints, and Stiffeners:

1. Welded by AWS certified welders.
2. Welds: Partial penetration welds in accordance with SMACNA Managers Guide to Welding, and per AWS D9.1.

F. Aluminum Ductwork and Split Support Straps:

1. Comply with ASTM B209.
2. Aluminum Sheet: Alloy 3003-H14, unless indicated otherwise.
3. Aluminum Connectors and Bar Stock: Alloy 6061-T6, or equivalent.
4. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.03 FABRIBATED DUCTWORK

A. Ductwork, Fittings, and Accessories: Construct and install in accordance with SMACNA Round Industrial duct construction standards, as applies, for pressure and system classification indicated.

B. Round Ducts:

1. Spiral-lock or grooved seam lock.
2. Joints: Welded flanged connectors to facilitate assembly and future maintenance. Designate proposed locations on Shop Drawings.

C. Elbows: Radius type, stamped or multiple gore, minimum 1.5 radius to diameter ratio.

1. Provide a minimum radius to diameter ratio of 2.0 or above for ducts with velocities above 2,000 feet per minute.

D. Provide gradual transitions and branches. Design ducts with velocities above 2,000 feet per minute for constant velocity.

E. Shop-welded Ductwork Seams, Joints, and Stiffeners:

1. Welded by AWS certified welders.

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2. Welds: Partial penetration welds in accordance with SMACNA Managers Guide to Welding, and per AWS D9.1.

F. Aluminum Ductwork and Split Support Straps:

1. Comply with ASTM B209.
2. Aluminum Sheet: Alloy 3003-H14, unless indicated otherwise.
3. Aluminum Connectors and Bar Stock: Alloy 6061-T6, or equivalent.
4. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.04 MISCELLANEOUS MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements, including proper connection of ductwork and equipment.

B. Nuts, Bolts, and Washers: AISI Type 316 stainless steel.

C. Provide 1/8-inch thick HMWPE or PTFE pad between lower 3 inch wide split strap and ductwork to achieve dielectric separation.

D. Gaskets:

1. Use on all flanged joints.
2. Gore-Tex Joint Sealant; W.L. Gore and Associates, Inc., Elkton, MD.
3. Description: Form in-place, fully expanded 100 percent PTFE gasket material, size as recommended by manufacturer.
4. Full-face, thickness as recommended by ductwork manufacturer.

E. Drains:

1. Provide at low points on SMACNA System Class 5 duct systems.
2. Weld couplings to bottom of main and branch ducts that are trapped and/or where shown on Drawings, to allow removal of condensed liquids.
3. Predetermine locations of ductwork drains prior to manufacturer's fabrication.

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2.05 DUCTWORK HANGERS AND SUPPORTS

A. General:

1. Attachments, hangers, bracing and supports for ductwork shall be in accordance with the details provided on Drawing.
2. Hanger and Brace Spacing: unless otherwise shown on Drawings, 8 feet, maximum.

B. Construction Materials:

1. Supporting devices including, but not limited to, channels used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:
    a. Aluminum Ductwork:
        1) Aluminum 3003-H14 unless otherwise shown on Drawings.
        2) HMWPE or PTFE pad between aluminum split strap and ductwork, to achieve dielectric separation.

C. Duct Attachment to Aluminum Split Straps at Braced Supports: 3M Scotch Weld Epoxy Adhesive DP125.

D. Duct Supports: Stainless steel unless otherwise shown on Drawings.

1. All Thread Rod: 1/2-inch diameter, ASTM 193, Grade B8M, Type 316 stainless steel with SST nuts and washers.
2. Plate Washers at Roof: 1/4-inch by 3-inch outside diameter, Type 316 stainless steel.
3. All Other Bolts: ASTM F593, Alloy Group 2, Condition CW, Type 316 stainless steel.
4. All Other Nuts: ASTM F594, Alloy Group 2, Condition CW, Type 316 stainless steel.
5. All Other Washers: ASTM A316.

E. Transverse and Longitudinal Braces:

1. Channel: 1-5/8 inch by 1-5/8 inch, 12 GA, stainless steel.

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2. Plate Washers at Roof: 1/4-inch by 3-inch outside diameter, Type 316 stainless steel.

3. Fittings:

a. Hinged: Unistrut P1354AW electro galvanized complete with clamping spring nuts and stainless steel bolts, approved equal.

b. Swivel Fitting: AFCON Figure AF777, electro galvanized, approved equal.

4. All Other Bolts: ASTM F593, Alloy Group 2, Condition CW, Type 316 stainless steel.

5. All Other Nuts: ASTM F594, Alloy Group 2, Condition CW, Type 316 stainless steel.

F. All Other Washers: Type 316 stainless steel.

2.06 EXPANSION JOINTS/ FLEXIBLE CONNECTIONS

A. Provide where indicated on Drawings or as required for proper ductwork installation or thermal expansion.

B. Configuration:

1. Type: Slip-on type, or as indicated on Drawings.

2. Material: Hypalon.

3. Backing Rings: 3/8-inch thick, 2 inches wide, AISI Type 316 stainless steel.

4. Drilling Pattern: Match adjacent ductwork or equipment connection.

5. Length: 6 inches, flange-to-flange.

6. Extension: 2 inches.

7. Compression: 1/2 inch.

8. Lateral Offset: 1 inch.

9. Thickness: 1/4 inch, minimum.

C. Manufacturer and Product: Holz Rubber Company, Inc.; Style 945.

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2.07 MANUAL DAMPERS

A. Butterfly Manual Dampers:

1. Fabricate from two gauges heavier than duct in which installed.
2. Materials to match ductwork requirements.
3. AISI Series 300 stainless steel shaft.
4. Aluminum blade and axle.
5. PTFE or Viton blade seals.
6. PTFE or Viton shaft seals.
7. Flange layout and dimensions to match ductwork flanges.
8. Actuators:
    a. Sizes 24 inches and Smaller:
        1) Manual multi-position locking quadrant handle with no larger than 5 degree increments or continuous slot quadrant.
        2) Align locking operating handle with damper blade.
        3) Provide locking bolt.
9. Manufacturer and Product: Ruskin; Model CDRS82.

2.08 DUCTWORK IDENTIFICATION

A. Painted Identification Materials:

1. Stencils: Standard metal stencils, prepared for required applications with letter sizes generally comply with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch-high letters for ductwork and not less than 3/4-inch-high letters for access door signs and similar operational instructions.
2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray can form and grade.
3. Identification Paint: Standard identification enamel of colors indicated or in accordance with ASME A13.1 for colors for systems not identified herein.

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B. Plastic Duct Markers:

1. General:

a. Provide manufacturer's standard laminated plastic, color-coded duct markers. Conform to the following color code:

1) Black Text on Yellow Background: Odorous air.

C. Nomenclature: Include direction of air flow.

D. Manufacturers:

1. W.H. Brady, Co.
2. Seton Identification Products.
3. Craftmark.
4. Brimar Industries, Inc.

2.09 SOURCE QUALITY CONTROL

A. Factory Inspection: Inspect fabrications for required construction, intended function, and conformance with referenced standards.

B. Inspection of products is required prior to shipment, unless specifically waived in writing by Project Engineer.

C. Notify Project Engineer one (1) week prior to estimated date of inspection.

D. Repairs authorized by Project Engineer to be re-inspected before final acceptance, unless specifically waived.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify dimensions and conditions in field.

B. Layout routing in straight lines parallel to building lines, unless otherwise indicated.

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C. Avoid diagonal runs wherever possible.

D. Coordinate support locations with layout and joints.

3.02 GENERAL INSTALLATION

A. Miscellaneous:

1. Slope to drain. Provide drains at low points.
2. Install ductwork in accordance with SMACNA Construction Standards, NFPA 90A, and NFPA 90B.
3. Install ductwork in accordance with manufacturer's recommendations using manufacturer's recommended gaskets and accessories.
4. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth.
5. Install and torque flange and clamp bolts to manufacturer's recommendations.
6. Interface Between Ductwork and Equipment: Install necessary transitions between ductwork and equipment cabinet connections in accordance with SMACNA guidelines.

B. Ductwork Location:

1. Locate ductwork runs vertically and horizontally where shown on Drawings, 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 necessary to install all bracing to the sloping FRP roof system.
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.

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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: Allow 1-inch clearance between duct and sleeve.
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.
   c. Same gauge and material as duct.
   d. Grind edges of collar smooth.
   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 accessories, dampers, equipment, controls, and other associated work of ductwork system.
2. Configure, position, and install ductwork to permit light fixture installation as indicated on Drawings.
3. Coordinate ductwork layout with suspended ceiling, lighting and sprinkler head layouts and similar finished work.
4. Do not run hazardous exhaust through fire or smoke rated penetrations.

3.03 DUCTWORK INSTALLATION

A. Inspection:

1. Examine areas and conditions under which ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

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2. Prior to assembling, examine components to determine if any have been damaged.

3. Holes and Dents: Replace components having holes or dents.

B. Provide flanges at each ducting connection to equipment to facilitate installation and removal.

C. Install duct so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

D. Installation:

1. Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal space between construction openings and ductwork with sheet metal flanges of same material and gauge as duct. Overlap opening on all sides by at least 1-1/2 inches.

2. Provide drains with corrosion resistant drain plugs on SMACNA System Class 5 duct systems and other systems where water or other liquids could accumulate.

3. Provide test ports at all branches suitable for system balancing.

E. Flanged Joints:

1. Install perpendicular to duct centerline.

2. Bolt Holes: Straddle vertical centerlines aligned with connecting equipment flanges or as shown.

3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.

4. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast-iron flange.

5. Verify compatibility of mating flange to adapter flange gasket prior to selecting adapter flanging.

6. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.

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7. Threaded flanged joints shall be shop-fabricated and delivered to Site with flanges in-place and properly faced.
8. Manufacturer: Same as duct manufacturer for factory fabricated duct.

3.04 SHOP WELDING

A. Perform in accordance with SMACNA Industrial Standards.

B. Weld Identification: Keep paper record of which welder welded each joint.

C. All welds shall conform to these standards:

1. SMACNA Managers Guide to Welding, 2nd Edition.
2. SMACNA RIDCS for pressure and system classification indicated.
3. AWS D9.1.

D. Surfaces:

1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
2. Do not use carbon steel cleaning tools on stainless or aluminum welds.
3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to deposition of each additional layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:

1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out-of-roundness.
2. Root Opening of Joint: As stated in qualified welding procedure.
3. Minimum Spacing of Circumferential Butt Welds: 1 inch.

F. Tack Welds: Performed by qualified welder using same procedure as for completed weld, made with electrode similar or equivalent to electrode to be used for first weld pass, and not defective. Remove those not meeting requirements prior to commencing welding procedures.

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G. Surface Defects: Chip or grind out those affecting soundness of weld.

H. Weld Quality: Meet requirements of governing welding codes.

3.05 DUCTWORK HANGERS AND SUPPORTS

A. All supports shall have corrosion-resistance equivalent to that of duct supported.

B. Install ductwork with support systems in accordance with SMACNA Industrial Manuals and manufacturer's recommendations. Provide supports designed to handle accumulations of liquid and particulate where indicated by system classification or as noted on Drawings.

C. Aluminum Split Strap:

1. Aluminum Ductwork System:

a. Bond aluminum 12GA split straps to duct with 3M SCOTCH WELD EPOXY ADHESIVE DP125. Thoroughly clean and lightly abrade all faying surfaces prior to applying the epoxy adhesive to the braced supports.

2. Support ducts rigidly with suitable ties, braces, hangers, and anchors which will hold ducts true-to-shape and prevent buckling.

D. Install additional bracing on ductwork as required, to prevent ballooning or breathing.

E. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

F. Support vertical ducts at maximum interval of 15 feet and at each floor.

G. Install seismic restraints on ductwork systems and sway bracing as shown in the details provided on Drawings.

3.06 EXPANSION JOINTS/FLEXIBLE CONNECTIONS

A. Flexible Collars and Connections: Provide as indicated on Drawings.

B. Install such that flexible molded boot is not concave or otherwise twisted or deformed during normal operating conditions.

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3.07 DAMPERS

A. General:

1. Inspection:
    a. Inspect areas to receive dampers.
    b. Notify Project Engineer of conditions that would adversely affect installation or subsequent utilization of dampers.
    c. Do not proceed with installation until unsatisfactory conditions are corrected.
2. Install dampers at locations indicated on Drawings and in accordance with manufacturer's installation instructions.
3. Install with damper shaft in horizontal position.
4. Install square and level.
5. Handle damper using sleeve or frame. Do not lift damper using blades or jack-shaft.
6. Confirm that damper blades and hardware operate freely without obstruction.
7. Damper blades and hardware that bind within frame or obstructed by adjacent construction will not be acceptable.
8. Provide gasketed damper frames to eliminate leakage between duct and damper frames.
9. Suitable for installation in mounting arrangement shown.
10. Do not compress or stretch damper frame into duct or opening.

B. Manual Dampers:

1. Provide balancing dampers for foul air inlets as indicated on Drawings or in branch duct as near main as possible.
2. Add or remove balancing dampers as requested by air balancing firm for necessary control of air.

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3.08 DUCT SEALING

A. If no specific duct sealing requirements are specified, seal in accordance with SMACNA Construction Standards.

B. Seal all audible leaks.

3.09 BALANCING OF AIR SYSTEMS

A. Perform air balancing in accordance with requirements of Section 23 05 93, Testing, Adjusting, and Balancing for Odor Control.

3.10 PROTECTION OF INSTALLED WORK

A. Cover open ends of installed ductwork systems to prevent dust, foreign objects, and water from entering ductwork.

B. Do not use ductwork systems for air conveyance until adequate air filtration devices are installed in air handling equipment, to prevent ingress of construction dust.

3.11 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

1. Qualifications of Manufacturer's Representative: Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer.
2. Present at Site or classroom designated by Owner, for minimum time listed below, travel time excluded:
    a. 1 person for eight (8) hours within regular Contractor working hours, for installation assistance, including pre-installation training of Contractor personnel in joint assembly and inspection.

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b. 1 person for eight (8) hours within regular Contractor working hours, for field testing and completion of Manufacturer's Certificate of Proper Installation.

1) When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by equipment manufacturer's representative.

2) Such form shall certify signing party is a duly authorized representative of manufacturer, is empowered by manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to ensure equipment is complete and operational.

B. Manufacturer's onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
3. Providing, on a daily basis, copies of manufacturers' representatives field notes and data to Owner.
4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Project Engineer.
5. Resolution of assembly or installation problems attributable to or associated with respective manufacturer's products and systems.
6. Assistance during functional and performance testing, and facility startup and evaluation.
7. Training of Owner's personnel in the operation and maintenance of respective product as required.

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3.12 CLEANING

A. Clean ductwork of rust, dust, and debris, both internally and externally, before placing in operation.

B. Confirm that dampers are smooth, clean, and free of dirt when installed.

3.13 SUPPLEMENTS

A. The supplement listed below, following “End of Section,” are a part of this Specification.

1. Manufacturer’s Certificate of Proper Installation.

END OF SECTION

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MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER: _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functional tests.
- ☐ System has been performance tested, and meets or exceeds specified Performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate their equipment and (iii) authorized to make recommendations required to ensure equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

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SECTION 26 05 02
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
2. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    b. Z535.4, Product Safety Signs and Labels.
3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.03 DESIGN REQUIREMENTS

A. Provide anchorage and bracing design drawings, calculations, and related information where required under Section 01 73 23, Structural Design and Anchorage for Non-Structural Components and Non-Building Structures.

1.04 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
    a. Electrical service components.
    b. Nameplates, signs, and labels.

B. Informational Submittals: Common Product Requirements.

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1.05 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.

C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.06 ENVIRONMENTAL CONDITIONS

A. The following areas are classified hazardous Class I, Division 1, Group D, because of the potential for occurrence of hazardous concentrations of combustible gases, and for exposure to corrosive environment. Use materials and methods required for such areas.

1. Primary Clarifiers.

B. The following areas are classified hazardous, Class I, Division 2, Group D, because of the potential for accumulation of hazardous concentrations of combustible gases, and for exposure to corrosive environment. Use materials and methods required for such areas.

1. As noted on Drawings.
2. Primary pump room.

C. The following areas are classified nonhazardous, wet, and corrosive. Use materials and methods required for such areas.

1. Secondary Clarifiers.

D. The following areas are classified nonhazardous and wet. Use materials and methods required for such areas.

1. As noted on Drawings.
2. Secondary pump room.

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E. All other interior areas use dust-tight and oil-tight NEMA 12 materials and methods.

PART 2 PRODUCTS

2.01 GENERAL

A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.

2.02 EQUIPMENT FINISH

A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with light gray color finish as approved by Engineer.

2.03 NAMEPLATES

A. Material: Laminated plastic.

B. Attachment Screws:

1. Stainless steel.
2. Use adhesive on air purge pressurized, NEMA 7, NEMA 4 or NEMA 4X enclosures only.

C. Color: Black, engraved to a white core.

D. Letter Height:

1. Other Electrical Equipment: 3/8 inch.

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PART 3 EXECUTION

3.01 GENERAL

A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.

B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.

C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Keep openings in boxes and equipment closed during construction.

E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.02 ANCHORING, BRACING, AND MOUNTING

A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for Project design criteria to meet the requirements of Section 01 73 23, Structural Design and Anchorage for Non-Structural Components and Non-Building Structures.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

A. Drawings show each homerun circuit to be provided. Do not combine power or control circuits into common raceways without authorization of Engineer.

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B. Homerun circuits shown on Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements only if approved by the owner:

1. Analog control circuits from devices in same general area to same destination.
    a. No power or AC discrete control circuits shall be combined in same conduit with analog circuits.
    b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, paging system circuits shall be combined with power or Class 1 circuits.
    c. Analog circuits shall be continuous from source to destination. Do not add TJB, splice, or combine into a multi-pair cable without authorization of Engineer.
    d. Raceways: Shall be sized per General Circuit and Raceway Schedule, or as shown on Drawings, and do not exceed 40 percent fill.
    e. Changes shall be documented on Drawings.
2. Discrete control circuits from devices in the same general area to the same destination.
    a. No power or analog control circuits shall be combined in same conduit with discrete circuits.
    b. No Class 2 or Class 3 circuits including, but not limited to, HVAC control circuits, fire alarm circuits, and paging system circuits shall be combined with power or Class 1 circuits.
    c. Raceways: Shall be sized per the General Circuit and Raceway Schedule, or as shown on Drawings, and do not exceed 40 percent fill.
    d. Changes shall be documented on Drawings.
3. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
    a. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

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3.04 NAMEPLATES, SIGNS, AND LABELS

A. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.05 CLEANING AND TOUCHUP PAINTING

A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.

B. Touchup Paint:

1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.06 PROTECTION FOLLOWING INSTALLATION

A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.

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B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

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SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
    a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
    b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
    b. C12.1, Code for Electricity Metering.
    c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
    d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
    e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
    f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

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7. UL:
    a. 98, Standard for Enclosed and Dead-Front Switches.
    b. 248, Standard for Low Voltage Fuses.
    c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
    d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
    e. 508, Standard for Industrial Control Equipment.
    f. 810, Standard for Capacitors.
    g. 943, Standard for Ground-Fault Circuit-Interrupters.
    h. 1059, Standard for Terminal Blocks.
    i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
    a. Luminaires.
    b. Conductors and Cables.
    c. Conduit.
    d. Boxes and fittings.
    e. Disconnect switches.
    f. Control stations, buttons, and indicating lights.

PART 2 PRODUCTS

2.01 SUPPORT AND FRAMING CHANNELS

A. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum with all hardware of Type 316 stainless steel.

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B. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.

2.02 ENCLOSURES

A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.

B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.

C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

D. Enclosure Selections:

1. Except as shown otherwise, provide electrical enclosures according to the following table:

Enclosures			
Location	Finish	Environment	NEMA 250 Type
Indoor	Finished	Dry	1
Indoor	Unfinished	Dry	1
Indoor	Unfinished	Industrial Use	12
Indoor and Outdoor	Any	Wet	4
Indoor and Outdoor	Any	Denoted "WP"	3R
Indoor and Outdoor	Any	Wet and Corrosive	4X 304 Stainless Steel
Indoor and Outdoor	Any	Wet, Dust or Oil	13

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Enclosures			
Location	Finish	Environment	NEMA 250 Type
Indoor and Outdoor	Any	Hazardous Gas	7, or pressurized 4X
Indoor and Outdoor	Any	Hazardous Dust	9

PART 3 EXECUTION

3.01 GENERAL

A. Install equipment in accordance with manufacturer's recommendations.

3.02 SUPPORT AND FRAMING CHANNEL

A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.

B. Channel Type:

1. All Locations: Type 316 stainless steel.

C. Raceways and Boxes: Type 316 stainless steel.

END OF SECTION

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SECTION 26 05 05
CONDUCTORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
2. ASTM International (ASTM):
    a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
    b. B3, Standard Specification for Soft or Annealed Copper Wire.
    c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
    d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
    b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
    c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
4. Insulated Cable Engineer’s Association, Inc. (ICEA):
    a. S-58-679, Standard for Control Cable Conductor Identification.
    b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
    c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.

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5. National Electrical Manufacturers' Association (NEMA):
    a. CC 1, Electric Power Connectors for Substations.
    b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
    c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
    d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.
    e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
6. National Fire Protection Association (NFPA):
    a. 70, National Electrical Code (NEC).
    b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
8. UL:
    a. 13, Standard for Safety for Power-Limited Circuit Cables.
    b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
    c. 62, Standard for Safety for Flexible Cord and Cables.
    d. 486A-486B, Standard for Safety for Wire Connectors.
    e. 486C, Standard for Safety for Splicing Wire Connectors.
    f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
    g. 854, Standard for Safety for Service-Entrance Cables.
    h. 1072, Standard for Safety for Medium-Voltage Power Cables.
    i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
    j. 1569, Standard for Safety for Metal-Clad Cables.
    k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

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1.02 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Wire and cable.

b. Wire and cable accessories.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. All Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2, except for sizes No. 6 and larger, with XHHW-2 insulation.

2.02 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.

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2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
   b. 20 AWG, seven-strand tinned copper drain wire.
   c. Insulation: 15-mil nominal PVC.
   d. Jacket: 4-mil nominal nylon.
   e. Color Code: Pair conductors, black and red.
5. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

2.03 300-VOLT RATED CABLE

A. General:

1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.

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2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 105 degrees C.
5. Passes Vertical Tray Flame Test.
6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 20, 16 AWG, Twisted, Shielded Pair Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57.

1. Outer Jacket: 35-mil nominal.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.26-inch nominal OD.
4. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
    b. 20 AWG, seven-strand tinned copper drain wire.
    c. Insulation: 15-mil PVC.
    d. Color Code: Pair conductors black and white.
5. Manufacturers:
    a. Okonite Co.
    b. Alpha Wire Corp.

C. Type 22, 18 AWG, Multitwisted, Shielded Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.

1. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
    b. Tinned copper drain wires.

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c. Pair drain wire AWG 20, group drain wire AWG 18.

d. Insulation: 15-mil PVC.

e. Color Code: Pair conductors black and white; white conductor numerically printed for group identification.

f. Individual Pair Shield: 1.35-mil aluminum/mylar.

g. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

2. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	50
8	0.66	60
12	0.79	60
16	0.91	60
24	1.13	70
36	1.31	70
50	1.55	80

3. Manufacturers:

a. Okonite Co.

b. Alpha Wire Corp.

c. Belden.

2.04 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.

B. Direct Buried: Bare stranded copper.

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2.05 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:
    a. 30-mil, elastomer.
    b. Manufacturers and Products:
        1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
        2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

1. Sleeve:
    a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
    b. Manufacturers and Products:
        1) Raychem; Type D-SCE or ZH-SCE.
        2) Brady; Type 3PS.
2. Heat Bond Marker:
    a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
    b. Self-laminating protective shield over text.
    c. Machine printed black text.
    d. Manufacturer and Product: 3M Co.; Type SCS-HB.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.

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4. Tie-On Cable Marker Tags:
    a. Chemical-resistant white tag.
    b. Size: 1/2 inch by 2 inches.
    c. Manufacturer and Product: Raychem; Type CM-SCE.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
    a. Manufacturers and Products:
        1) Thomas & Betts; Sta-Kon.
        2) Burndy; Insulug.
        3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
    a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
    b. Seamless.
    c. Manufacturers and Products:
        1) Thomas & Betts; Sta-Kon.
        2) Burndy; Insulink.
        3) ILSCO; ILSCONS.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
    a. UL 486C.
    b. Plated steel, square wire springs.
    c. Manufacturers and Products:
        1) Thomas & Betts.
        2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
    a. Two (2) piece compression type with set screw in brass barrel.

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b. Insulated by insulator cap screwed over brass barrel.

c. Manufacturers:

1) 3M Co.

2) Thomas & Betts.

3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:

a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

b. Manufacturers and Products:

1) Thomas & Betts; Color-Keyed.

2) Burndy; Hydent.

3) ILSCO.

4. Uninsulated, Bolted, Two-Way Connectors and Terminators:

a. Manufacturers and Products:

1) Thomas & Betts; Locktite.

2) Burndy; Quiklug.

3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.

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4. Manufacturers and Products:
    a. Thomas & Betts; SHRINK-KON.
    b. Raychem; RNF-100 and ES-2000.

2.06 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

3.01 GENERAL

A. Conductor installation shall be in accordance with manufacturer's recommendations.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

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3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.

2. 8 AWG and Smaller: Provide colored conductors.

3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	Grey Brown Orange Yellow
120Vac Control	Power Neutral	Red White
DC Control	Positive Negative	Blue White w/Blue stripe

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System	Conductor	Color
Signal (4-20mA, 1-5Vdc)	Positive	White
	Negative	Black
Note: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pullboxes, and terminal boxes.

B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.

C. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

D. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:
   a. Identify with marker plates or tie-on cable marker tags.
   b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

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B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
    a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
    b. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Insulate uninsulated connections.
2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.

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3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.

F. Cap spare conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Cable Protection:
   a. Under Infinite Access Floors: May install without bundling.
   b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2 inch in diameter.
   c. Maintain integrity of shielding of instrumentation cables.
   d. Ensure grounds do not occur because of damage to jacket over shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

END OF SECTION

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SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product data for the following:
      1) Mechanical connectors.
      2) Compression connectors.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by UL:
   a. Confirm conformance with UL standards.
   b. Supply with an applied UL listing mark.

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PART 2 PRODUCTS

2.01 GROUNDING CONDUCTORS

A. As specified in Section 26 05 05, Conductors.

2.02 CONNECTORS

A. Compression Type:

1. Compress-deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
5. Manufacturers and Products:
    a. Burndy Corp.; Hyground Irreversible Compression.
    b. Thomas and Betts Co.
    c. ILSCO.

B. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
    a. Burndy Corp.
    b. Thomas and Betts Co.

PART 3 EXECUTION

3.01 GENERAL

A. Grounding: In compliance with NFPA 70 and IEEE C2.

B. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

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C. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

D. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1-inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amperes use minimum 5/16-inch diameter bolt.

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3.03 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Motors Less Than 10 hp: Use furnished ground lug in motor connection box. If none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.

D. Motors 10 hp and Above: Use furnished ground lug in motor connection box. If none furnished, tap motor frame or equipment housing; furnish compression, 1-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

E. Circuits 20 Amperes or Above: Tap motor frame or equipment housing. Install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 CONNECTIONS

A. General:

1. Above grade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.

B. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.

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C. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

END OF SECTION

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SECTION 26 05 33
RACEWAY AND BOXES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
    a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
    b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
    c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
    d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
    e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
5. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    b. C80.1, Electrical Rigid Steel Conduit (ERSC).
    c. C80.3, Steel Electrical Metallic Tubing (EMT).
    d. C80.5, Electrical Rigid Aluminum Conduit (ERAC).

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e. C80.6, Electrical Intermediate Metal Conduit (EIMC).

f. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

g. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.

h. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

i. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.

j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

k. VE 1, Metallic Cable Tray Systems.

6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

7. UL:

a. 1, Standard for Safety for Flexible Metal Conduit.

b. 5, Standard for Safety for Surface Metal Raceways and Fittings.

c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.

d. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.

e. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.

f. 514A, Standard for Safety for Conduit, Tubing, and Cable Fittings.

g. 651, Standard for Safety for Schedule 40 and 80 Rigid PVC Conduit and Fittings.

h. 651A, Standard for Safety for Type EB and A Rigid PVC Conduit and HDPE Conduit.

i. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.

j. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.

k. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.

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l. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

m. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's Literature:

a. Rigid stainless steel conduit.

b. Flexible, nonmetallic, liquid-tight conduit.

c. Device boxes for use in hazardous areas.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

2. Materials and equipment manufactured within scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

A. Rigid Stainless Steel Conduit (SS):

1. Meet requirements of NEMA C80.1 and UL 6A.

2. Material: Type 316 stainless steel.

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B. Flexible Metal, Liquid-Tight Conduit:

1. UL 360 listed for 105 degrees C insulated conductors.
2. Material: Type 316 stainless steel.

2.02 FITTINGS

A. Rigid Stainless Steel Conduit:

1. General:
   a. Meet requirements of UL 514A.
   b. Type: Threaded, Type 316 stainless steel. Set screw and threadless compression fittings not permitted.

2.03 ACCESSORIES

A. Identification Devices:

1. Raceway Tags:
   a. Material: Type 316 Stainless steel.
   b. Shape: Round.
   c. Raceway Designation: Pressure stamped, embossed, or engraved.
   d. Tags relying on adhesives or taped-on markers not permitted.

B. Heat Shrinkable Tubing:

1. Material: Heat-shrinkable, cross-linked polyolefin.
2. Semi-flexible with meltable adhesive inner liner.
3. Color: Black.
4. Manufacturers:
   a. Raychem.
   b. 3M.

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PART 3 EXECUTION

3.01 GENERAL

A. Rigid Type 316 stainless steel conduit used in all areas.

B. Conduit and tubing sizes shown are based on use of copper conductors.

C. Comply with NECA Installation Standards.

D. Crushed or deformed raceways not permitted.

E. Maintain raceway entirely free of obstructions and moisture.

F. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

G. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

H. Group raceways installed in same area.

I. Proximity to Heated Piping: Install raceways minimum twelve (12) inches from parallel runs.

J. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

K. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

L. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.

M. Install watertight fittings in outdoor, underground, or wet locations.

N. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

O. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.

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P. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.

Q. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

R. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.02 REUSE OF EXISTING CONDUITS

A. Where Drawings indicate existing conduits may be reused, they may be reused only where they meet the following criteria.

1. Conduit is in useable condition with no deformation, corrosion, or damage to exterior surface.
2. Conduit is sized per the NEC.
3. Conduit is of the type specified in Contract Documents.
4. Conduit is supported as specified in Contract Documents.

B. Conduit shall be reamed with wire brush, then with a mandrel approximately 1/4 inch smaller than raceway inside diameter then cleaned prior to pulling new conductors.

3.03 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. Interior, Exposed: Rigid Type 316 stainless steel.

C. Hazardous Gas Areas: Rigid Type 316 stainless steel.

3.04 FLEXIBLE CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by Engineer where flexible connection is required to minimize vibration:

1. Conduit Size Four (4) Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over Four (4) Inches: Nonflexible.

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3. Wet or Corrosive Areas: Flexible, nonmetallic flexible metal liquid-tight.
4. Dry Areas: Flexible, metallic liquid-tight.
5. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.

B. Suspended Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Flexible Conduit Length: Eighteen (18) inches minimum, sixty (60) inches maximum; sufficient to allow movement or adjustment of equipment.

3.05 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed ten (10) feet in any application. Do not support from piping, pipe supports, or other raceways.

B. Application/Type of Conduit Strap:

1. Rigid Steel Conduit: Type 316 stainless steel.
2. Nonmetallic Conduit: Type 316 stainless steel.

C. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Wood: Wood screws.
2. Hollow Masonry Units: Toggle bolts.
3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
4. Steelwork: Machine screws.
5. Location/Type of Hardware:
    a. Dry, Noncorrosive Areas: Type 316 stainless steel.
    b. Wet, Noncorrosive Areas: Type 316 stainless steel.
    c. Corrosive Areas: Type 316 stainless steel.

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D. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

E. Support aluminum conduit on concrete surfaces with stainless steel or nonmetallic spacers, or aluminum or nonmetallic framing channel.

3.06 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than twenty (20) times cable diameter, fifteen (15) inches minimum.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.07 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Install manufacturer’s premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Motor Control Center and Free-Standing Enclosures:

1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
2. Terminate PVC conduit entering bottom with bell end fittings.

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3.08 JUNCTION AND PULLBOXES

A. General:

1. Type 316 stainless steel only.
2. Install plumb and level.
3. Installed boxes shall be accessible.
4. Do not install on finished surfaces.
5. Use outlet boxes as junction and pullboxes wherever possible and allowed by applicable codes.
6. Use conduit bodies as junction and pullboxes where no splices are required and allowed by applicable codes.
7. Install pullboxes where necessary in raceway system to facilitate conductor installation.
8. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
9. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

B. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

C. Mounting Hardware:

1. Noncorrosive Dry Areas: Type 316 stainless steel.
2. Noncorrosive Wet Areas: Type 316 stainless steel.
3. Corrosive Areas: Type 316 stainless steel.

D. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.

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2. Install bar hangers in frame construction or fasten boxes directly as follows:
    a. Wood: Wood screws.
    b. Concrete or Brick: Bolts and expansion shields.
    c. Hollow Masonry Units: Toggle bolts.
    d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Boxes embedded in concrete or masonry need not be additionally supported.

3.09 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify Raceway Schedule designation.
2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every fifty (50) feet, whether in ceiling space or surface mounted.
3. Install tags at each terminus for concealed raceways.
4. Provide noncorrosive wire for attachment.

3.10 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

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SECTION 26 20 00
LOW-VOLTAGE AC INDUCTION MOTORS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. This section applies to low-voltage AC induction motors, whether or not referenced by a motor-driven equipment specification. If equipment specification section deviates from this section in requirements such as, application, horsepower, enclosure type, mounting, shaft type, or synchronous speed, then those listed requirements shall take precedence over this section.

1.02 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).

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5. 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.

1.03 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. Inverter Ready Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Part 31.4.4.2.

F. 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.

G. ODP: Open drip-proof enclosure.

H. TEFC: Totally enclosed, fan-cooled enclosure.

I. TENV: Totally enclosed, nonventilated enclosure.

J. VPI: Vacuum pressure impregnated.

K. WPI: Open weather protected enclosure, Type I.

L. WPII: Open weather protected enclosure, Type II.

1.04 SUBMITTALS

A. Action Submittals:

1. Descriptive information.

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2. Nameplate data in accordance with NEMA MG 1.
3. Additional Rating Information:
    a. Service factor.
    b. Locked rotor current.
    c. No load current.
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

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. General Electric.
2. MagneTek.
3. Siemens Energy and Automation, Inc., Motors and Drives Division.
4. Baldor.
5. U.S. Electrical Motors.
6. TECO-Westinghouse Motor Co.

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7. Toshiba International Corp., Industrial Division.
8. WEG Electric Motors Corp.

2.02 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. Provide motors 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. Provide motors suitable for operating conditions without reduction in nameplate rated horsepower or exceeding rated temperature rise.
2. Overspeed in either direction in accordance with NEMA MG 1.

2.03 HORSEPOWER RATING

A. As designated in motor-driven equipment specification.

B. Constant Speed Applications: Brake horsepower of driven equipment not to exceed motor nameplate horsepower rating, excluding service factor.

C. Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake not to exceed motor nameplate horsepower rating, excluding service factor.

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2.04 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.

2.05 VOLTAGE AND FREQUENCY RATING

A. System Frequency: 60 Hz.

B. Voltage Rating:

1. 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.

2.06 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: Tested in accordance with NEMA MG 1, Paragraph 12.59.

2. Power Factor: Guaranteed minimum at full load shall be manufacturer's standard or as indicated in motor-driven equipment specification.

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2.07 INSULATION SYSTEMS

A. Single-Phase, Fractional Horsepower Motors: Manufacturer's standard winding insulation system.

B. Motors Rated Over 600 Volts: VPI windings in accordance with NEMA MG 1.

2.08 ENCLOSURES

A. Conform to NEMA MG 1.

B. TEFC and TENV: Furnish with drain hole with porous drain/weather plug.

C. Explosion-Proof (EXP):

1. TEFC listed to meet UL 674 and NFPA 70 requirements for Class I, Division 2, Group D hazardous locations.
2. Drain holes with drain and breather fittings.
3. Integral thermostat opening on excessive motor temperature in accordance with UL 2111 and NFPA 70.
4. Terminate thermostat leads in terminal box separate from main terminal box.

2.09 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.

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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.

2.10 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. For Direct Drive Equipment: Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.
4. For Belt Driven Equipment: Minimum 30,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.

B. Regreasable Antifriction Bearings:

1. Readily accessible, grease injection fittings.
2. Readily accessible, removable grease relief plugs.

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C. 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.

D. Inverter Duty Rated Motors Larger than 50 hp, Bearing Isolation: Provide electrically isolated bearings to prevent stray current damage.

2.11 NOISE

A. Measured in accordance with NEMA MG 1.

B. Maximum Sound Level for Motors Controlled by Adjustable Frequency Drive Systems: 3 dBA higher than NEMA MG 1.

2.12 BALANCE AND VIBRATION CONTROL

A. In accordance with NEMA MG 1, Part 7.

2.13 EQUIPMENT FINISH

A. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.14 SPECIAL FEATURES AND ACCESSORIES

A. Screen Over Air Openings: Corrosion-resistant on motors with ODP, WPI, and WPII enclosures meeting requirements for guarded machine in NEMA MG 1 and attached with stainless steel screws.

B. 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.

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C. Anchor Bolts: Provide meeting manufacturer's recommendations and of sufficient size and number for specified seismic condition.

2.15 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.
   c. On motors of 100 hp and smaller, furnish certified copy of motor efficiency test report on an identical motor.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A-1.

PART 3 EXECUTION

3.01 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.

END OF SECTION

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SECTION 26 24 19
LOW-VOLTAGE MOTOR CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which shall be followed for this section:

1. Institute of Electrical and Electronics Engineers (IEEE):
    a. C2, National Electrical Safety Code (NESC).
    b. C37.20.7, Guide for Testing Metal Enclosed Switchgear Rated up to 38 kV for Internal Arcing Faults.
2. National Electrical Contractors Association (NECA): 402, Standard for Installing and Maintaining Motor Control Centers.
3. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1,000 volts maximum).
    b. ICS 1, Industrial Control and Systems: General Requirements.
    c. ICS 2, Controllers, Contactors, and Overload Relays Rated 600 Volts.
    d. ICS 2.3, Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers Rated Not More Than 600V.
    e. ICS 18, Motor Control Centers.
    f. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. UL:
    a. 98, Enclosed and Dead-Front Switches.
    b. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
    c. 845, Motor Control Centers.

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1.02 DEFINITIONS

A. LCD: Liquid Crystal Display.

B. N.C.: Normally Closed.

C. N.O.: Normally Open.

D. SPD: Surge Protection Device.

1.03 SUBMITTALS

A. Action Submittals:

1. Descriptive information.
2. Itemized Bill of Material.
3. Protective Devices and overloads: Copies of time-current characteristics.
4. Typed Tabulation:
    a. Motor name; tag (equipment) numbers as shown on Drawings.
    b. Motor horsepower.
    c. Nameplate full load current.
    d. Measured load current and voltage.
    e. Overload model number and setting.
    f. Protective device trip settings.
    g. Manufacturer's solid state starter switch or dip switch or program settings.
    h. Attach above typed, tabulated data to a copy of starter manufacturer's overload relay or setting selection tables for starters provided.
5. Control diagrams.
6. Schematic (elementary) diagrams.
7. Outline diagrams.

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1.04 QUALITY ASSURANCE

A. Provide products manufactured within scope of UL that conform to UL Standards and have applied UL Listing Mark.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide materials, equipment, and accessories specified in this section.

2.02 GENERAL

A. Make adjustments necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.

B. Controllers: NEMA ICS 1, NEMA ICS 2, Class A.

C. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

D. Anchor Bolts: Type 316 stainless steel.

E. Seismic Zone and Importance Factor.

F. Operating Conditions:

1. Ambient Temperature: Maximum 40 degrees C.
2. Altitude: 500 feet above sea level.
3. Equipment to be fully rated.

2.03 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Applicable Standards: NEMA ICS 18, UL 845, and NEC Article 430, Part VIII.
2. Perform standard factory inspection and tests in accordance with NEMA requirements to verify components have been designed to Specification, assembled in accordance with applicable standards, and each unit functions in accordance with electrical diagrams.

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3. Actual operation shall be performed wherever possible. Otherwise, inspect and perform continuity checks.
4. Verify component devices operated correctly in circuits as shown on diagrams or as called for in Specification.
5. Control Circuits and Devices:
    a. Energize circuit at rated voltage.
    b. Operate control devices.
    c. Perform continuity check.
6. Perform dielectric tests on primary circuits and equipment, except potential transformers.
    a. Tests: Phase-to-phase and phase-to-around with 60-cycle test voltages applied for 1 second at 2,640 volts.
7. Verify equipment passed tests and inspection.
8. Provide standard factory inspection and test checklists, and final certified and signed test report.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install equipment in accordance with NEMA ICS 2.3, IEEE C2, NECA 402, Submittals, and manufacturer's written instructions and recommendations.
2. Install equipment plumb and in longitudinal alignment with pad or wall.
3. Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.

END OF SECTION

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SECTION 40 05 15
PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
2. American Society of Mechanical Engineers (ASME): B31.1, Power Piping.
3. ASTM International (ASTM):
    a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
    c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
4. International Code Council (ICC):
5. International Building Code (IBC).
6. International Mechanical Code (IMC).
7. Manufacturers' Standardization Society (MSS):
    a. SP 58, Pipe Hangers and Supports—Materials, Design and Manufacture.
    b. SP 127, Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, and Application.

1.02 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 1-foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

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1.03 SUBMITTALS

A. Action Submittals:

1. Catalog information and drawings of piping support system, locating each support, sway brace, seismic brace, hanger, guide, component, and anchor for piping 6 inches and larger and 4 inches and smaller. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
2. Calculations for each type of pipe support, attachment and anchor.
3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.
4. Seismic anchorage and bracing drawings and cut sheets, as required by Section 01 73 23, Structural Design and Anchorage for Non-Structural Components and Non-Building Structures.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by Section 01 73 23, Structural Design and Anchorage for Non-Structural Components and Non-Building Structures
2. Component and attachment testing seismic certificate of compliance as required by Section 01 45 23, Testing and Inspecting Services.
3. Maintenance information on piping support system.

1.04 QUALIFICATIONS

A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a Registered Professional Engineer in the state where the Work is to be installed.

1.05 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.

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2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
3. Piping 30 Inches and Larger: Support systems have been designed for piping shown.
4. Meet requirements of MSS SP 58 and ASME B31.1 or as modified by this section.

B. Pipe Support Systems:

1. Design pipe support systems for gravity and thrust loads imposed by weight of pipes or internal pressures, including insulation and weight of fluid in pipes.
2. Seismic loads in accordance with governing codes.
3. Wind loads in accordance with governing codes.
4. Maximum Support Spacing and Minimum Rod Size: In accordance MSS SP 58 Table 3 and Table 4.
    a. Ductile-iron Pipe 8 Inches and Under: Maximum span limited to that for standard weight steel pipe for water service.
    b. Ductile-iron Pipe 10 Inches and Larger: Maximum span limited to 20 feet.
5. Electrical Conduit Support: Include in design of framing support system.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

D. Vertical Sway Bracing: 10-foot maximum centers or as shown.

E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show they are adequate for additional load, or if they are strengthened to support additional load.

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PART 2 PRODUCTS

2.01 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated.

B. Special support and hanger details may be required for cases where standard catalog supports are not applicable.

C. Materials: In accordance with Table 1, attached as Supplements at end of section.

2.02 HANGERS

A. Clevis: MSS SP 58, Type 1:

1. Anvil; Figure 260 for steel pipe and Figure 590 for ductile-iron pipe, sizes 1/2 inch through 30 inches.
2. Insulated Steel Pipe: Anvil; Figure 260 with insulated saddle system (ISS), sizes 1/2 inch through 16 inches.
3. B-Line; Figure B3100, sizes 1/2 inch through 30 inches.

B. Adjustable Swivel Split-Ring Pipe Clamp: MSS SP 58, Type 6:

1. Anvil; Figure 104, sizes 3/4 inch through 8 inches.
2. B-Line; Figure B3171, sizes 3/4 inch through 8 inches.

C. Steel Yoke Pipe Rolls and Roller Supports: MSS SP 58, Type 41 or Type 43:

1. Anvil; Figure 181 for sizes 2-1/2 inches through 24 inches, and Figure 171 for sizes 1 inch through 30 inches.
2. B-Line; Figure B3110 for sizes 2 inches through 24 inches and Figure B3114 for 30 inches.

D. Pipe Rollers and Supports: MSS SP 58, Type 44:

1. Anvil; Figure 175, sizes 2 inches through 30 inches.
2. B-Line; Figure B3120, sizes 2 inches through 24 inches.

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2.03 WALL BRACKETS, SUPPORTS, AND GUIDES

A. Welded Steel Wall Bracket: MSS SP 58, Type 33 (heavy-duty):

1. Anvil; Figure 199, 3,000-pound rating.
2. B-Line; Figure B3067, 3,000-pound rating.

B. Adjustable "J" hanger MSS SP 58, Type 5:

1. Anvil; Figure 67, sizes 1/2 inch through 8 inches.
2. B-Line; Figure B3690, sizes 1/2 inch through 8 inches.

C. Offset Pipe Clamp: Anvil; Figure 103, sizes 3/4 inch through 8 inches.

D. Channel Type:

1. Unistrut.
2. Anvil; Power-Strut.
3. B-Line; Strut System.
4. Aickinstrut (FRP).

2.04 PIPE SADDLES

A. Provide 90-degree to120-degree pipe saddle for pipe 6 inches and larger with baseplates drilled for anchors bolts.

1. In accordance with Standard Detail 4005-515.
2. Sizes 20 inches though 60 inches, Piping Technology & Products, Inc.; Fig. 2000.

B. Saddle Supports, Pedestal Type:

1. Minimum standard weight pipe stanchion, saddle, and anchoring flange.
2. Nonadjustable Saddle: MSS SP , Type 37 with U-bolt.
   a. Anvil; Figure 259, sizes 4 inches through 36 inches with Figure 63C base.
   b. B-Line; Figure B3095, sizes 1 inch through 36 inches with B3088S base.

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3. Adjustable Saddle: MSS SP 58, Type 38 without clamp.
    a. Anvil; Figure 264, sizes 2-1/2 inches through 36 inches with Figure 62C base.
    b. B-Line; Figure B3092, sizes 3/4 inch through 36 inches with Figure B3088S base.

2.05 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, or 1-1/2-inch wide, minimum FRP.

B. Members and Connections: Design for loads using one-half of manufacturer's allowable loads.

C. Fasteners: Vinyl ester fiber, polyurethane base composite nuts and bolts, or encapsulated steel fasteners.

D. Manufacturers and Products:

1. B-Line; Strut System.
2. Unistrut.
3. Anvil; Power-Strut.
4. Aickinstrut (FRP System).
5. Enduro-Durostrut (FRP Systems).

2.06 FRP PIPE SUPPORTS SYSTEMS

A. General:

1. FRP with UV additive, protective veil, and vinyl ester resins resistance to chemicals listed in Supplement at end of section.
2. Fire Retardant: ASTM E84.
3. Include hangers, rods, attachments, and fasteners.

B. Clevis Hangers:

1. Factor of Safety: 3 to 1.
2. Minimum Design Load: 200 pounds.

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C. Design:

1. Design pipe supports spacing, hanger rod sizing based upon manufacturer's recommendations.
2. Identify and highlight non-FRP fasteners or components in Shop Drawing.

D. Manufacturers:

1. Aickinstrut.
2. Enduro.
3. Century Composite.

2.07 PIPE CLAMPS

A. Riser Clamp: MSS SP 58, Type 8.

1. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
2. B-Line; Figure B3373, sizes 1/2 inch through 30 inches.

2.08 ELBOW AND FLANGE SUPPORTS

A. Elbow with Adjustable Stanchion: Sizes 2 inches through 18 inches, Anvil; Figure 62C base.

B. Elbow with Nonadjustable Stanchion: Sizes 2-1/2 inches through 42 inches, Anvil; Figure 63A or Figure 63B base.

C. Flange Support with Adjustable Base: Sizes 2 inches through 24 inches, Standon; Model S89.

2.09 INTERMEDIATE PIPE GUIDES

A. Type: Hold down pipe guide.

1. Manufacturer and Product: B-Line; Figure B3552, 1-1/2 inches through 30 inches.

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B. Type: U-bolts with double nuts to provide nominal 1/8-inch to 1/4-inch clearance around pipe; MSS SP 58, Type 24.

1. Anvil; Figure 137 and Figure 137S.
2. B-Line; Figure B3188 and Figure B3188NS.

2.10 PIPE ALIGNMENT GUIDES

A. Type: Spider.

B. Manufacturers and Products:

1. Anvil; Figure 255, sizes 1/2 inch through 24 inches.
2. B-Line; Figure B3281 through Figure B3287, sizes 1/2 inch through 24 inches.

2.11 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturer and Product: B-Line; Figure B3147A or Figure B3147B.

2.12 SEISMIC RESTRAINTS

A. Solid pipe bracing attachment to pipe clevis with clevis cross brace and angle rod reinforcement.

B. Manufacturers:

1. Mason Industries.
2. B-Line.
3. Anvil.

2.13 ACCESSORIES

A. Anchor Bolts:

1. Size and Material: Sized by Contractor for required loads and as specified in Section 05 50 00, Metal Fabrications.

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2. Bolt Length (Extension Above Top of Nut):

    a. Minimum Length: Flush with top of nut preferred. If not flush, shall be no more than one thread recessed below top of nut.

    b. Maximum Length: No more than a full nut depth above top of nut.

B. Dielectric Barriers:

1. Plastic coated hangers, isolation cushion, or tape.
2. Manufacturer and Products:
    a. B-Line; B1999 Vibra Cushion.
    b. B-Line; Iso Pipe, Isolation Tape.

C. Insulation Shields:

1. Type: Galvanized steel or stainless steel, MSS SP 58, Type 40.
2. Manufacturers and Products:
    a. Anvil; Figure 167, sizes 1/2 inch through 24 inches.
    b. B-Line; Figure B3151, sizes 1/2 inch through 24 inches.

D. Welding Insulation Saddles:

1. Type: MSS SP 58, Type 39.
2. Manufacturers and Products:
    a. Anvil; Figure Series 160, sizes 1 inch through 36 inches.
    b. B-Line; Figure Series B3160, sizes 1/2 inch through 24 inches.

E. Plastic Pipe Support Channel:

1. Type: Continuous support for plastic pipe and to increase support spacing.
2. Manufacturer and Product: B-Line; Figure Series B3106V, sizes 1/2 inch through 6 inches with Figure B3106 Vee bottom hanger.

F. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

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G. Attachments:

1. I-Beam Clamp: Concentric loading type, MSS SP 58, Type 21, Type 28, Type 29, or Type 30, which engage both sides of flange.
2. Concrete Insert: MSS SP 58, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
3. Welded Beam Attachment: MSS SP 58, Type 22.
    a. Anvil; Figure 66.
    b. B-Line; Figure B3083.
4. U-Channel Concrete Inserts: As specified in Section 05 50 00, Metal Fabrications.
5. Concrete Attachment Plates:
    a. Anvil; Figure 47, Figure 49, or Figure 52.
    b. B-Line; Figure B3084, Figure B3085, or Figure B3086.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP 58, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not use adhesive anchors for attachment of supports to ceiling or walls.

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8. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
9. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
10. Install lateral supports for seismic loads at changes in direction.
11. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
12. Repair mounting surfaces to original condition after attachments are completed.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
   a. Single Pipes: Clevis hangers or adjustable swivel split-ring.
   b. Grouped Pipes: Trapeze hanger system.
2. Horizontal Piping Supported from Walls:
   a. Single Pipes: Wall brackets, or attached to wall, or to wall mounted framing with anchors.
   b. Stacked Piping: Wall mounted framing system and "J" hangers acceptable for pipe smaller than 3-inch.
   c. Pipe clamp that resists axial movement of pipe through support is not acceptable. Use pipe rollers supported from wall bracket.
3. Horizontal Piping Supported from Floors:
   a. Saddle Supports:
      1) Pedestal Type, elbow and flange.
      2) Provide minimum 1-1/2-inch grout beneath baseplate.
   b. Floor Mounted Channel Supports:
      1) Use for pipe smaller than 3-inch running along floors and in trenches at pipe elevations lower than can be accommodated using pedestal pipe supports.
      2) Attach channel framing to floors with baseplate on minimum 1-1/2-inch nonshrink grout and with anchor bolts.

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3) Attach pipe to channel with clips or pipe clamps.

c. Concrete Cradles: Use for pipe larger than 3 inches along floor and in trenches at pipe elevations lower than can be accommodated using stanchion type.

4. Insulated Pipe:

a. Pipe hanger and support shall be on outside of insulation. Do not enclose within insulation.

b. Provide precut 120-degree sections of rigid insulation (minimum length same as shield), shields and oversized hangers or insulated saddle system (ISS).

c. Wall-mounted pipe clips not acceptable for insulated piping.

5. Vertical Pipe: Support with wall bracket and elbow support, or riser clamp on floor penetration.

C. Standard Attachments:

1. New Concrete Ceilings: Concrete inserts, concrete attachment plates, or concrete anchors as limited below:

a. Single point attachment to ceiling allowed only for 3/4-inch rod and smaller (8 inches and smaller pipe).

b. Where there is vibration or bending considerations, do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.

2. Existing Concrete Ceilings: Channel type support with minimum of two anchor points, concrete attachment plates or concrete anchors as limited below:

a. Single point attachment to ceiling is allowed only for 3/4-inch rod and smaller (8 inches and smaller pipe).

b. Where there is vibration or bending considerations do not connect a single pipe support hanger rod directly to a drilled concrete anchor (single point attachment) regardless of size.

3. Steel Beams: I-beam clamp or welded attachments.

4. Wooden Beams: Lag screws and angle clips to members not less than 2-1/2 inches thick.

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5. Concrete Walls: Concrete inserts or brackets or clip angles with concrete anchors.

6. Concrete Beams: Concrete inserts, or if inserts are not used attach to vertical surface similar to concrete wall. Do not drill into beam bottom.

D. Saddles for Steel or Concrete Pipe: Provide 90-degree to120-degree pipe saddle for pipe sizes 6 inches and larger when installed on top of steel or concrete beam or structure, pipe rack, trapeze, or where similar concentrated point supports would be encountered.

E. Intermediate and Pipe Alignment Guides:

1. Provide pipe alignment guides, or pipe supports that provide same function, at expansion joints and loops.

2. Guide pipe on each side of expansion joint or loop at 4 pipe and 14 pipe diameters from each joint or loop.

3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

F. Accessories:

1. Insulation Shield: Install on insulated piping with oversize rollers and supports.

2. Welding Insulation Saddle: Install on insulated steel pipe with oversize rollers and supports.

3. Dielectric Barrier:

a. Provide between painted or galvanized carbon steel members and copper or stainless steel pipe or between stainless steel supports and nonstainless steel ferrous metal piping.

b. Install rubber wrap between submerged metal pipe and oversized clamps.

3.02 FIELD FINISHING

A. Paint atmospheric exposed surfaces hot-dip galvanized steel components as specified in Section 09 90 00, Painting and Coating.

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3.03 SUPPLEMENTS

A. The supplement listed below, following "End of Section," is a part of this Specification:

1. Table 1: Nonchemical Areas.

END OF SECTION

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Table 1
Nonchemical Areas

Exposure Conditions	Support Material
Office Areas	Galvanized steel or precoated steel, plastic coated hangers for uninsulated copper or stainless steel piping
Shops and Warehouse Areas	Galvanized steel or precoated steel, plastic coated hangers for uninsulated copper or stainless steel piping
Pipe Galleries	Galvanized steel or precoated steel, plastic coated hangers for uninsulated copper or stainless steel piping
Headworks	Stainless steel or FRP
Process Areas: High Humidity or Hydrogen sulfide	Stainless steel or FRP
Process Areas: Wetted or Submerged	Stainless steel or FRP

Notes:

1. Precoated steel to be fusion bonded epoxy or vinyl copolymer (Plastisol).
2. Stainless steel to be Type 304.
3. Galvanized steel to be per ASTM A653/A653M, Class G90, or hot-dip galvanized after fabrication to ASTM A123/A123M.
4. Do not use galvanized steel or aluminum where lime dust can accumulate on these surfaces.

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SECTION 40 27 00
PROCESS PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

1. Air Force: A-A-58092, Tape, Antiseize, Polytetrafluorethylene.
2. American Society of Mechanical Engineers (ASME):
    a. B31.3, Process Piping.
3. ASTM International (ASTM):
    a. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
    b. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
    c. D413, Standard Test Methods for Rubber Property-Adhesion to Flexible Substrate.
    d. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
    e. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
    f. D1330, Standard Specification for Rubber Sheet Gaskets.
    g. D1784, Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
    h. D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
    i. D2000, Standard Classification System for Rubber Products in Automotive Applications.

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j. D2464, Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

k. D2466, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

l. D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

m. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

n. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.

o. D3222, Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.

p. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

q. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.

r. F437, Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

s. F439, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

t. F441/F441M, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

u. F493, Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

v. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

4. FM Global (FM).

5. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP-43, Wrought and Fabricated Butt-Welding Fittings for Low-Pressure, Corrosion Resistant Applications.

6. NSF International (NSF): 61 Drinking Water System Components—Health Effects.

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7. National Electrical Manufacturers Association (NEMA): LI 1, Industrial Laminating Thermosetting Products.
8. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.02 DEFINITIONS

A. Submerged or Wetted:

1. Zone below elevation of:
    a. Top face of clarifier walkways.
    b. Liquid surface or within one (1) foot above top of liquid surface.

1.03 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:

1. ASME B31.3, normal fluid service unless otherwise specified.

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Fabricated Piping:
    a. Detailed pipe fabrication or spool drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
    b. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
2. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.
3. Anchorage and bracing drawings and cut sheets, as required by Section 01 73 23, Structural Design and Anchorage for Non-Structural Components and Non-Building Structures.

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B. Informational Submittals:

1. Anchorage and bracing calculations as required by Section 01 73 23, Structural Design and Anchorage for Non-Structural Components and Non-Building Structures.
2. Qualifications:
    a. Nondestructive Testing Personnel: SNT-TC-1A Level II certification and qualifications.
    b. AWS QC1 Certified Welding Inspector: Submit evidence of current certification prior to commencement of welding activities.
    c. Welders:
        1) Continuity log for welders and welding operators.
        2) Welder qualification test records conducted by Contractor or manufacturer.
3. Welding Procedures: Qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX for weld type(s) and base metal(s).
4. Nondestructive inspection and testing procedures.
5. Test logs.
6. Component and attachment testing seismic certificate of compliance as required bySection 01 45 23, Testing and Inspecting Services.
7. Torquing requirements and procedures, including torque values, for flanged piping assemblies.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Independent Inspection and Testing Agency:
    a. Ten (10) years' experience in field of welding and welded pipe and fittings' testing required for this Project.
    b. Calibrated instruments and equipment and documented standard procedures for performing specified testing.
    c. Certified in accordance with ASNT SNT-TC-1A for testing procedures required for this Project.

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d. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

e. Verification Welding Inspector: AWS QC1 Certified.

2. Welder Qualifications: In accordance ASME BPVC SEC IX (Form QW-484) or AWS D1.1/D1.1M (Annex N Forms).

3. Contractor's CWI: Certified in accordance with AWS QC1 and having prior experience with specified welding codes. Alternate welding inspector qualifications require approval by Engineer.

B. Quality Assurance: Provide services of independent inspection and testing agency for welding operations.

1. The presence of Owner's Special Inspector or Verification CWI does not relieve Contractor from performing own quality control, including 100 percent visual inspection of welds.

1.06 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01 66 00, Shipment Protection and Storage, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.

2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.

3. Linings and Coatings: Prevent excessive drying.

4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.

5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.01 GENERAL

A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the

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maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.

1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

A. As specified on Piping Data Sheet(s) Piping Schedule located at the end of this section as Supplement.

B. Diameters Shown:

1. Standardized Products: Nominal size.
2. Fabricated Steel Piping (Except Cement-Lined): Outside diameter, ASME B36.10M.
3. Cement-Lined Steel Pipe: Lining inside diameter.

2.03 JOINTS

A. Grooved End System:

1. Rigid type.
2. Use of flexible grooved joints allowed where shown on Drawings or with prior approval by Engineer.
3. Flanges: When required, furnish with grooved type flange adapters of same manufacturer as grooved end couplings.

B. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher-pressure rating than required for piping.

C. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

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D. Mechanical Joint Anchor Gland Follower:

1. Ductile iron anchor type, wedge action, with break-off tightening bolts.
2. Thrust rated to 250 psi minimum.
3. Rated operating deflection not less than:
    a. Three (3) degrees for sizes through twelve (12) inches.
    b. Two (2) degrees for sizes fourteen (14) inches through sixteen (16) inches.
    c. 1.5 degrees for sizes eighteen (18) inches through 24 inches.
    d. One (1) degree for sizes thirty (30) inches through 48 inches.
4. UL and FM approved.

E. Flexible Mechanical Compression Joint Coupling:

1. Stainless steel, ASTM A276, Type 305 bands.
2. Manufacturers:
    a. Fernco Joint Sealer Co.
    b. Approved equal.

F. Mechanical connections of high-density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through-flanged connections consisting of the following:

1. Polyethylene stub end thermally butt-fused to end of pipe.
2. ASTM A240/A240M, Type 304 stainless steel backing flange, 125-pound, ASME B16.1 standard. Use insulating flanges where shown.
3. Bolts and nuts of sufficient length to show a minimum of three complete threads when joint is made and tightened to manufacturer's standard. Retorque nuts after four (4) hours.
4. Gaskets as specified on Data Sheet.

2.04 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and no substitute or approved equal will be allowed.

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2.05 FABRICATION

A. Mark each pipe length on outside with the following:

1. Size or diameter and class.
2. Manufacturer's identification and pipe serial number.
3. Location number on laying drawing.
4. Date of manufacture.

B. Code markings according to approved Shop Drawings.

C. Shop fabricate flanged pipe in shop, not in field, and delivered to Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

3.02 PREPARATION

A. See Piping Schedule for additional requirements.

B. Notify Engineer at least two (2) weeks prior to field fabrication of pipe or fittings.

C. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

3.03 INSTALLATION—GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

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C. Flanged Joints:

1. Install perpendicular to pipe centerline.
2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
5. Grooved Joint Flange Adapters: Include stainless steel washer plates as required for mating to serrated faces and lined valves and equipment.
6. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast-iron flange.
7. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
8. Flange fillers are to be avoided, but, if necessary, may be used to make up for small angles up to six (6) degrees and for filling gaps up to two (2) inches between flanges. Stacked flange fillers shall not be used.
9. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
10. Manufacturer: Same as pipe manufacturer.

D. Pipe Connections at Concrete Structures: As specified in Article Piping Flexibility Provisions, in Section 40 27 01, Process Piping Specialties.

E. PVC and CPVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

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3.04 INSTALLATION—EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 40 05 15, Piping Support Systems.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:

1. Over Walkway and Stairs: Minimum of seven (7) feet six (6) inches measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum three (3) feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
4. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
5. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.

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6. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.05 BRANCH CONNECTIONS

A. Do not install branch connections smaller than 1/2-inch nominal pipe size, including instrument connections, unless shown otherwise.

B. When line of lower pressure connects to a line of higher pressure, requirements of Piping Data Sheet for higher pressure rating prevails up to and including first block valve in the line carrying the lower pressure, unless otherwise shown.

C. Threaded Pipe Tap Connections:

1. Ductile Iron Piping: Connect only with service saddle or at tapping boss of a fitting, valve body, or equipment casting.
2. Welded Steel or Alloy Piping: Connect only with welded threadolet or half-coupling as specified on Piping Data Sheet.
3. Limitations: Threaded taps in pipe barrel are unacceptable.

3.06 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Application and Installation: As specified in Section 40 27 01, Process Piping Specialties.

3.07 CLEANING

A. Following assembly and testing, and prior to final acceptance, flush pipelines, except as stated below, with water at 2.5 fps minimum flushing velocity until foreign matter is removed.

B. If impractical to flush large diameter pipe at 2.5 fps or blow at 4,000 fpm velocity, clean in-place from inside by brushing and sweeping, then flush or blow line at lower velocity.

C. Insert cone strainers in flushing connections to attached equipment and leave in-place until cleaning is complete.

D. Remove accumulated debris through drains two (2) inches and larger or by removing spools and valves from piping.

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3.08 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Piping Schedule Legend.
2. Piping Schedule.
3. Data Sheets.

Number	Title
40 27 00.01	Glass-Lined Ductile Iron Pipe and Fittings
40 27 00.10	Polyvinyl Chloride (PVC) Pipe and Fittings

END OF SECTION

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PIPING SCHEDULE LEGEND

SERVICE

A	Air
AHP	Air-High Pressure
ALP	Air-Low Pressure
RD	Roof Drain
SD	Storm Drain
SS	Sanitary Sewer
V	Vents
C1	Potable Domestic Water
C2	Non-Potable Domestic Water (Air-Gapped)
C3	Treatment Plant Effluent for In-plant Use

EXPOSURE

ALL	All
BUR	Buried
EXP	Exposed
SUB	Submerged
ENC	Concrete Encased

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MATERIAL

CLDI	Cement-Lined Ductile Iron
CMP	Corrugated Metal Pipe
COP	Copper
CPVC	Chlorinated PVC
DI	Ductile Iron
FRPX	Fiberglass Reinforced Plastic Pipe Type (X = 1 to 3)
GLDI	Glass-Lined Ductile Iron
GSP	Galvanized Steel Pipe
HDPE	High-Density Polyethylene
PCCP	Prestressed Concrete Cylinder Pipe
PSTL	PVDF-Lined Steel
PVC	Polyvinyl Chloride
PVDF	Polyvinylidene Fluoride
RCP	Reinforced Concrete Pipe
RSTL	Rubber-Lined Steel
SST	Stainless Steel
STL	Steel
VC	Vitrified Clay Pipe
WS	Fabricated Welded Steel

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JOINT TYPE

FL	Flanged
GR	Grooved
HU	Hub and spigot
PRJ	Proprietary Restrained
RM	Restrained Mechanical
S	Screwed
W	Welded (including solvent and fusion)

PRESSURE TEST

G	Gravity Service: Test pressure is not shown on gravity services. Test to highest liquid level that pipe can be subject to.
H	Hydrostatic
I	In Service
P	Pneumatic
PC	Test per Uniform Plumbing Code
NA	Not Applicable

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PIPING SCHEDULE										
Service	Legend	Size(s) (In.)[1]	Exposure	Piping Material	Specification Section	Joint Type	Lining/ Coating	Test Pressure and Type (psig-x), x = Type indicated in Legend	Pipe Color and Label	Remarks
SS		6	SUB	PVC	40 27 00.10	FL	N/A	120 psi	N/A	Filter Backwash Piping
SS		6	ENC	GLDI	40 27 00.01	FL	Glass	250 psi	N/A	Primary Scum
SS		6	ENC	GLDI	40 27 00.01	FL	Glass	250 psi	N/A	Secondary Scum

[1]">" Greater Than
"<" Less Than
"<=" Less Than or Equal To
">=" Greater Than or Equal To
"All" All Sizes

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SECTION 40 27 00.01 GLASS-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	Description
General	Materials in contact with potable water shall conform to NSF 61 acceptance. Pipe manufacturer shall submit certification that source manufacturing facility has been producing ductile iron pipe of specified diameters, dimensions, and standards for a period of not less than ten (10) years. Testing of pipe required by AWWA C151/A21.51 shall be conducted in testing and laboratory facilities located in the USA and operating under USA laws and regulations. Pipe shall be handled during manufacture and shipped without nesting (without insertion of one pipe inside another).
Pipe	Exposed Pipe Using Grooved End and Flange Joints: AWWA C115/A21.15, thickness Class 53 minimum, 250 psi minimum working pressure.
Lining	Glass: ASTM B1000.
Fittings	Lined and coated same as pipe. Flange: AWWA C110/A21.10 ductile iron, faced and drilled, Class 125 flat face. Gray cast iron will not be allowed.
Joints	Flange: Dimensions per AWWA C110/A21.10 flat face, ductile iron, threaded conforming to AWWA C115/A21.15. Gray cast iron will not be allowed. Branch connections, three (3) inches and smaller from glass-lined pipe shall be made with glass-lined tee with a flanged branch for adapting to branch piping.
Couplings	Grooved End: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic. Grooved End Adapter Flanges: 250 psi minimum working pressure, malleable iron per ASTM A47/A47M or ductile iron per ASTM A536; Victaulic.

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SECTION 40 27 00.01 GLASS-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	Description
Bolting	Mechanical, Proprietary Restrained, and Grooved End Joints: Manufacturer's standard. Flanged: ASTM A307, Grade B carbon steel heavy hex head or stud bolts, ASTM A563, Grade A carbon steel heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Stud bolts are not allowed when bolting to tapped flanges. Torque bolts per gasket manufacturer recommendations.
Gaskets	General: Gaskets in contact with potable water shall be NSF ANSI 61 certified. Flanged, Water, Sewage and Hot Air Services: Full face, 1/8-inch-thick, homogeneous black rubber (EPDM), hardness 60-80 (Shore A), rated to 275 degrees F, conforming to ASME B16.21 and ASTM D1330. Blind flanges shall be epoxy-lined in accordance with the system specified above. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.
Joint Lubricant	Manufacturer's standard.

END OF SECTION

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SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
General	All	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454 conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One-piece, molded hub type PVC flat face flange in accordance with Fittings above, ASME B16.1, Class 125 drilling.
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M heavy hex head or stud bolts, ASTM A194/A194M Grade 8M heavy hex head nuts and ASTM F436 Type 3 alloy washers at nuts and bolt heads. Torque bolts per gasket manufacturer recommendations. With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B heavy hex head or stud bolts, ASTM A563 Grade A heavy hex head nuts and ASTM F436 hardened steel washers at nuts and bolt heads. Torque bolts per gasket manufacturer recommendations.

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SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch-thick Garlock Gylon 3510. Raised Face Mating Flange: Flat ring 1/8-inch Garlock Gylon 3510, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	Socket type joints shall be made employing solvent cement that meets or exceeds requirements of ASTM D2564 and primer that meets or exceeds requirements of ASTM F656, chemically resistant to the fluid service, and as recommended by pipe and fitting manufacturer. Solvent weld cement for PVC pipe joints in chemical service shall be free of silica filler and shall be certified by the manufacturer to be suitable for the intended service, IPS Weld-On 724 , approved equal. Solvent cement and primer shall be listed by NSF 61 for contact with potable water.
Thread Lubricant	All	Teflon Tape.

END OF SECTION

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SECTION 40 27 01
PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
    a. B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.
2. American Water Works Association (AWWA):
    a. C110/A21.10, Ductile-Iron and Gray-Iron Fittings.
    b. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
3. National Fire Protection Association (NFPA): 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer’s data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable).
2. Metal Bellows Field Finishing:
    a. Manufacturer’s recommended weld procedures for joining welded carbon steel piping to stainless steel bellows.
    b. Welder qualifications for joining welded carbon steel piping to stainless steel bellows.

B. Informational Submittals:

1. Coupling Harness:
    a. Details, ratings, calculations and test reports for thrust restraints relying on welded bars or rings.

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b. Weld procedure qualifications.

c. Load proof-testing report of prototype restraint for any size coupling.

C. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide required piping specialty items, whether shown or not shown on Drawings, as required by applicable codes and standard industry practice.

B. Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.

2.02 CONNECTORS

A. Teflon Bellows Connector:

1. Type: Two convolutions, unless otherwise shown, with metal reinforcing bands.
2. Flanges: Ductile iron, drilled 150 psi ASME B16.5 standard.
3. Working Pressure Rating: 140 psi, minimum, at 120 degrees F.
4. Thrust Restraint: Limit bolts to restrain force developed by specified test pressure.
5. Manufacturers and Products:
   a. Garlock; Style 214.
   b. Resistoflex; No. R6904.
   c. Unisource Manufacturing, Inc.; Style 112.
   d. Proco Products, Inc.; Series 442.

B. Elastomer Bellows Connector:

1. Type: Fabricated spool, with single filled arch.
2. Materials: Nitrile tube and wrap-applied neoprene cover.

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3. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with full elastomer face and steel retaining rings.
4. Working Pressure Rating: 140 psig, minimum, at 180 degrees F for sizes 12 inches and smaller.
5. Thrust Restraint: Control rods to limit travel of elongation and compression.
6. Manufacturers and Products:
    a. Goodall Rubber Co.; Specification E-1462.
    b. Garlock; Style 204.
    c. Unisource Manufacturing, Inc.; Style 1501.
    d. Proco Products, Inc.; Series 220.

C. Metal Bellows Connector:

1. Type: Single-ply, annular corrugated metal bellows with limit rods. Circumferential convolution welds not permitted.
2. Material: Type 316 stainless steel.
3. End Connections: ANSI 150-pound carbon steel flanges.
4. Minimum Design Working Pressure: 50 psig at 300 degrees F.
5. Length: Minimum of four convolutions and minimum manufacturer recommendation for vibration isolation.
6. Manufacturers and Products:
    a. U.S. Bellows, Inc.; Universal Tied Expansion Joint.
    b. Metraflex; Model MN.
    c. Senior Flexonics Pathway, Inc.; Expansion Joints.

D. Flexible Metal Hose Connector:

1. Type: Close pitch, annular corrugated with single braided jacket.
2. Material: Bronze.
3. End Connections: Female copper solder joint.
4. Minimum Burst Pressure: 500 psig at 70 degrees F.

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5. Length: Minimum manufacturer recommendation for vibration isolation.
6. Manufacturers:
    a. U.S. Hose Corp.; Series 300.
    b. Anamet Industrial, Inc.
    c. Unisource Manufacturing, Inc.
    d. Proco Products, Inc.

2.03 COUPLINGS

A. General: Couplings shall be rated for working pressure not less than indicated in Piping Schedule for the service and not less than 150 psi.

B. Flexible Sleeve Type Coupling:

1. Manufacturers and Products:
    a. Ductile Iron Pipe:
        1) Dresser Piping Specialties; Style 253.
        2) Smith-Blair, Inc.; Style 441.

C. Transition Coupling for Steel Pipe:

1. Manufacturers and Products:
    a. Dresser Piping Specialties; Style 162.
    b. Smith-Blair, Inc.; Style 413.

D. Flanged Coupling Adapter:

1. Anchor studs where required for thrust restraint.
2. Manufacturers and Products:
    a. Ductile Iron Pipe:
        1) Dresser Piping Specialties; Style 128.
        2) Smith-Blair, Inc.; Style 912.

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E. Restrained Flange Adapter:

1. Pressure Rating:
    a. Minimum Working Pressure Rating: Not less than 150 psi.
    b. Safety Factor: Not less than two times working pressure and shall be supported by manufacturer's proof testing.
2. Thrust Restraint:
    a. Provide hardened steel wedges that bear against and engage outer pipe surface and allow articulation of pipe joint after assembly while wedges remain in their original setting position on pipe surface.
    b. Products employing set screws that bear directly on pipe will not be acceptable.
3. Manufacturer and Product: EBAA Iron Sales Co.; Mega-Flange.

F. Restrained Dismantling Joints:

1. Pressure Rating:
    a. Minimum working pressure rating shall not be less than rating of the connecting flange.
    b. Proof testing shall conform to requirements of AWWA C219 for bolted couplings.
2. Manufacturers and Products:
    a. Dresser Piping Specialties; Style 131.
    b. Smith Blair, Inc.; Model 975.

G. Exposed Metallic Piping Plain End Couplings:

1. Plain end pipe couplings shall be self-restrained against hydrostatic thrust forces equal to not less than two times the working pressure rating of the coupling. Couplings shall accommodate 4 degrees angular deflection at the time of installation and subsequent to pressurization.
2. Casing, bolts, and nuts shall be Type 304 or Type 316 stainless steel. The sealing sleeve shall be EPDM or NBR elastomer as best suited for the fluid service.

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3. Couplings manufacturer and products shall be Straub Couplings, Grip-L or Metal Grip, approved equal.

2.04 EXPANSION JOINTS

A. Elastomer Bellows:

1. Type: Reinforced molded wide arch.
2. End Connections: Flanged, drilled 125-pound ASME B16.1 standard, with split galvanized steel retaining rings.
3. Washers: Over retaining rings to help provide leak-proof joint under test pressure.
4. Thrust Protection: Control rods to protect the bellows from overextension.
5. Bellows Arch Lining: Buna-N, nitrile, or butyl.
6. Rated Temperature: 250 degrees F.
7. Rated Deflection and Pressure:
   a. Lateral Deflection: 3/4 inch, minimum.
   b. Burst Pressure: Four times the working pressure.
   c. Compression deflection and minimum working pressure as follows:

Size (inch)	Deflection (inch)	Pressure (psig)
2-1/2 to 12	1.06	150
14	1.65	130
16 to 20	1.65	110

8. Manufacturers and Products:
   a. General Rubber Corp.; Style 1015 Maxijoint.
   b. Mercer; Flexmore Style 450.
   c. Goodall Rubber Co.; Specification E-711.
   d. Unisource Manufacturing, Inc.; Series 1500.
   e. Proco Products, Inc.; Series 251.

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B. Teflon Bellows:

1. Type: Three convolutions, with metal reinforcing bands.
2. Flanges: Ductile iron, drilled 150 psi ASME B16.5 standard.
3. Working Pressure Rating: 100 psig, minimum, at 120 degrees F.
4. Thrust Restraint: Limit bolts to restrain force developed by specified test pressure.
5. Manufacturers and Products:
    a. Garlock; Style 215.
    b. Resistoflex; No. R6905.
    c. Unisource Manufacturing, Inc.; Style 113.
    d. Proco Products, Inc.; Series 443.

C. Metal Bellows:

1. Type: Single-ply, annular corrugated metal bellows with limit rods. Circumferential convolution welds not permitted.
2. Material: Type 316 stainless steel.
3. End Connections: ASME 150-pound carbon steel flanges.
4. Minimum Design Working Pressure: 50 psig at 300 degrees F.
5. Length: Minimum of eight convolutions and minimum axial compression of 3/4 inches.
6. Manufacturers and Products:
    a. U.S. Bellows, Inc.; Universal Tied expansion joint.
    b. Metraflex, Model MN.
    c. Senior Flexonics Pathway, Inc.; Expansion Joints.

2.05 FLEXIBLE EXPANSION JOINTS

A. Design:

1. Ball and socket type for earth settlement compensation.

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2. Joints shall be double ball assemblies rated for 15-degree minimum deflection and not less than 4 inches offset from centerline of connecting piping.
3. Assembly shall accommodate up to 4 inches of expansion in length.
4. Ductile iron conforming to AWWA C153/A21.53.
5. Rated for 350 psi.
6. Components shall be lined and coated by manufacturer with fusion-bonded epoxy on all surfaces not bearing gaskets.
7. End Connections: Flanged or mechanical joint as shown and as required by connecting pipe and fittings.
8. Joint connecting to mechanical joint shall be thrust restrained.
9. Bonding:
    a. Manufacturer shall factory install thermite welded joint bonds for assembled expansion joint.
    b. Provide 24-inch bond wires for field bonds to adjacent metallic piping.
    c. Bond wires shall be 2 AWG with two 12-inch-long THHN insulated 12 AWG wire pigtails.

B. Manufacturer and Product: EBAA Iron Sales Co.; Flex-Tend.

2.06 PIPE SLEEVES

A. Steel Pipe Sleeve:

1. Minimum Thickness: 3/16 inch.
2. Seep Ring:
    a. Center steel flange for water stoppage on sleeves in exterior or water-bearing walls, 3/16-inch minimum thickness.
    b. Outside Diameter: Unless otherwise shown, 3 inches greater than pipe sleeve outside diameter.
    c. Continuously fillet weld on each side all around.

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B. Modular Mechanical Seal:

1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
2. Fabrication:
    a. Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.
    b. Pressure plates shall be reinforced nylon polymer.
3. Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening and to withstand a hydrostatic head of 40 feet of water.
4. Manufacturer: Thunderline Corp., Link-Seal Division.

2.07 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Ductile Iron Wall Pipe:

1. Diameter, Lining, and Ends: Same as connecting ductile iron pipe.
2. Thickness: Equal to or greater than remainder of pipe in line.
3. Fittings: In accordance with applicable Pipe Data Sheet.
4. Thrust Collars:
    a. Rated for thrust load developed at 250 psi.
    b. Safety Factor: 2, minimum.
    c. Material and Construction: Ductile iron or cast iron, cast integral with wall pipe wherever possible, or thrust rated, welded attachment to wall pipe.
5. Manufacturers:
    a. American Cast Iron Pipe Co.
    b. U.S. Pipe and Foundry Co.

B. Steel or Stainless Steel Wall Pipe:

1. Same material and thickness as connecting pipe, except 1/4-inch minimum thickness.

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2. Lining: Same as connecting pipe.
3. Thrust Collar:
    a. Outside Diameter: Unless otherwise shown, 3 inches greater than outside diameter of wall pipe.
    b. Continuously fillet welded on each side all around.

PART 3 EXECUTION

3.01 GENERAL

A. Provide accessibility to piping specialties for control and maintenance.

3.02 PIPING FLEXIBILITY PROVISIONS

A. General:

1. Thrust restraint shall be provided as specified in Section 40 27 00, Process Piping—General.
2. Install flexible couplings to facilitate piping installation, in accordance with approved shop drawings.

B. Flexible Joints at Concrete Backfill or Encasement: Install within 18 inches or one-half pipe diameter, whichever is less, from the termination of any concrete backfill or concrete encasement.

C. Flexible Joints at Concrete Structures:

1. Install 18 inches or less from face of structures; joint may be flush with face.

3.03 PIPING TRANSITION

A. Applications:

1. Provide complete closure assembly where pipes meet other pipes or structures.
2. Pressure Pipeline Closures: Plain end pieces with double flexible couplings, unless otherwise shown.

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3. Restrained Joint Pipe Closures: Install with thrust tie-rod assemblies as shown.
4. Gravity Pipe Closures: As specified for pressure pipelines, or concrete closures.
5. Concrete Closures: Use to make connections between dissimilar pipe where standard rubber gasketed joints or flexible couplings are impractical, as approved.
6. Elastomer sleeves bonded to pipe ends are not acceptable.

B. Installation:

1. Flexible Transition Couplings: Install in accordance with coupling manufacturer's instructions to connect dissimilar pipe and pipes with a small difference in outside diameter.
2. Concrete Closures:
   a. Locate away from structures so there are at least two flexible joints between closure and pipe entering structure.
   b. Clean pipe surface before placing closure collars.
   c. Wet nonmetallic pipe thoroughly prior to pouring collars.
   d. Prevent concrete from entering pipe.
   e. Extend collar a minimum of 12 inches on each side of joint with minimum thickness of 6 inches around outside diameter of pipe.
   f. Make entire collar in one placement.
   g. After concrete has reached initial set, cure by covering with well-moistened earth.

3.04 PIPING EXPANSION

A. Piping Installation: Allow for thermal expansion due to differences between installation and operating temperatures.

B. Expansion Joints:

1. Grooved Joint and Flanged Piping Systems: Elastomer bellows expansion joint.

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2. Nonmetallic Pipe: Teflon bellows expansion joint.
3. Screwed and Soldered Piping Systems: Copper or galvanized and black steel pipe expansion compensator, as applicable.
4. Air and Water Service above 120 Degrees F: Metal bellows expansion joint.
5. Pipe Run Offset: Flexible metal hose.

C. Weld-End Metal Bellows Installation:

1. Field Weld: Stainless steel bellows beveled ends joined to ALP carbon steel piping in accordance with approved welding procedures.
2. Lining:
   a. System No. 28, in accordance with Section 09 90 00, Painting and Coating.
   b. Field apply lining to protect bellows and piping from rust at welded joint.
   c. Line both ends inside bellows, entire length of extension stub end, and from weld joint to a distance of 1-foot inside length of the carbon steel pipe.
3. Coating:
   a. System No. 28, in accordance with Section 09 90 00, Painting and Coating.
   b. Field apply coating to protect bellows and piping from weather and rust at welded joint.
   c. Coat both ends outside bellows, entire length of extension stub end, and from weld joint to a distance of 1-foot outside length of the carbon steel pipe.

D. Anchors and Anchor Walls: Install as specified in Section 40 05 15, Piping Support Systems, to withstand expansion joint thrust loads and to direct and control thermal expansion.

3.05 COUPLINGS

A. General:

1. Install in accordance with manufacturer’s written instructions.

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2. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.
3. Application:
    a. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
    b. Concrete Encased Couplings: Flexible coupling.

3.06 FLEXIBLE PIPE CONNECTIONS TO EQUIPMENT

A. Install to prevent piping from being supported by equipment, for vibration isolation, and where shown.

B. Product Applications Unless Shown Otherwise:

1. Nonmetallic Piping: Teflon bellows connector.
2. Copper Piping: Flexible metal hose connector.
3. Compressor and Blower Discharge: Metal bellows connector.
4. All Other Piping: Elastomer bellows connector.

C. Limit Bolts and Control Rods: Tighten snug prior to applying pressure to system.

3.07 PIPE SLEEVES

A. Application:

1. As specified in Section 40 27 00, Process Piping—General.
2. Above Grade in Nonsubmerged Areas: Hot-dip galvanized after fabrication.
3. Below Grade or in Submerged or Damp Environments: Shop-lined and coated.
4. Alternatively, Molded Polyethylene Pipe Sleeve as specified may be applied.

B. Installation:

1. Support noninsulating type securely in formwork to prevent contact with reinforcing steel and tie-wires.
2. Caulk joint with specified sealant in non-submerged applications and seal below grade and submerged applications with wall penetration seal.

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3.08 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Applications:

1. Watertight and Below Ground Penetrations:
    a. Wall pipes with thrust collars.
    b. Provide taps for stud bolts in flanges to be set flush with wall face.
2. Nonwatertight Penetrations: Pipe sleeves with seep ring.
3. Existing Walls: Rotary drilled holes.
4. Fire-Rated or Smoke-Rated Walls, Floors or Ceilings: Insulated and encased pipe sleeves.

B. Wall Pipe Installation:

1. Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations.
2. Support wall pipes securely by formwork to prevent contact with reinforcing steel and tie-wires.

END OF SECTION

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SECTION 44 42 24.01
PRIMARY AND SECONDARY SQUARE CIRCULAR CLARIFIER MECHANISMS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Contractor shall furnish all labor, equipment, materials, tools, and incidental items required to install and place into proper operation two Primary Clarifiers and two Secondary Clarifiers (a total of four). All equipment shall be installed as shown on the plans, as recommended by the supplier, and in compliance with all OSHA, local, state, and federal codes and regulations.

B. The clarifier(s) shall be furnished complete with center drive, center column, collector mechanism, skimmer and scum box, scum baffles, effluent troughs, assembly hardware, anchor bolts and controls for operation of the clarifiers(s), and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.

C. Contractor shall be responsible for coordination of all related parts of work. Contractor shall verify all structures, piping, wiring, and components are compatible. Contractor shall be responsible for all structural and other alterations required to accommodate equipment differing in dimensions or other characteristics from these Specifications and Drawings.

D. Contractor is responsible for confirming measurements and surveying of existing mechanisms and layout prior to submittal development.

1.02 DEFINITIONS

A. Continuous Running Torque: The 100 percent AGMA torque to be continuously applied 24 hours a day to the drive system.

B. Momentary Peak Torque: The maximum torque rating of the drive mechanism components. Momentary peak torque shall be two (2.0) times the continuous running torque.

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1.03 QUALITY ASSURANCE

A. Qualifications: Equipment furnished under this section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least ten (10) years and is either ISO9001 certified or has an established and writing quality control program.

B. Regulatory Requirements:

1. All motors, electrical components, and instruments shall be UL listed and have the listing identified on the nameplate. If not UL listed or labeled to the satisfaction of the City of Des Moines electrical inspector, the manufacturer shall arrange and pay for field listing of the motors by a Washington State approved Electrical Testing Laboratory.

2. All primary clarifier drive motors and associated electrical components and instruments shall be rated for operation in a Class 1, Division 1 environment per Article 500 of the National Electrical Code.

C. Unit Responsibility: The manufacturer shall provide unit responsibility to ensure proper operation to provide a single source of supply and single warranty for all equipment provided under this contract. A certificate of unit responsibility shall be provide to include all components provided.

D. Coordination with Other Manufacturers: The manufacturer shall coordinate with suppliers of the FRP launder troughs and weir plates (detailed in Section 44 42 28, Weir and Baffle Plates) to ensure there are no conflicts with the manufacturer's scope of supply specified herein and that items provided by the manufacturer under this specification properly attach, support, connect, and integrate with related items from other suppliers.

E. Field Verification: Drawings are based in part on existing Record Drawings that may not be completely accurate in their representation of the existing installation. While an attempt has been made to check critical dimensions, the Contractor shall be responsible for obtaining field verification of dimensions for development of Submittal Drawings and to confirm necessary dimensions of new equipment prior to fabrication.

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1.04 WARRANTY

A. The manufacturer shall warrant all components of the clarifier mechanism against faulty design, workmanship, and materials for a period of twelve (12) months from date of substantial completion.

1.05 SUBMITTALS

A. Provide shop drawings and product data in accordance with Section 01 33 00, Submittal Procedures, for the equipment being furnished, to include at minimum the following:

1. Certified shop drawings showing the details of construction, dimensions and anchor bolt requirements.
2. Complete wiring diagrams detailing all required field connections.
3. Descriptive literature, brochures, and/or catalogs of submitted equipment.
4. Calculations showing the structural capability of the clarifier mechanism to withstand the momentary peak torque.
5. Calculations showing the structural capability of the walkway to the center column.
6. Seismic anchorage and bracing data sheets and drawings as required by Section 01 73 23, Structural Design and Anchorage Requirements for Non-Structural Components and Non-Building Structures.
7. Complete Bill of Materials for the equipment.
8. List of Manufacturer’s recommended spare parts.
9. Calculations substantiating the continuous torque rating of the main gear set in accordance with standard ANSI / AGMA 2001.
10. Operation and maintenance manuals in accordance with the requirements of Section 01 78 23, Operation and Maintenance Data.
11. Manufacturer’s valid ISO 9001:2015 certificate of registration.
12. Equipment weights and lifting points.
13. Short and long term storage requirements.
14. Manufacturer’s installation instructions.

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15. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 75 00, Testing, Training, and Commissioning.
16. Valid Welder Certifications.
17. Welding Inspector's Report.
18. Test procedures.
19. Test results, reports, and certifications.
20. A copy of Manufacturer's factory warranty.
21. Proof of manufacturer's acceptance of concrete tank tolerances and site conditions.
22. Unit responsibility letter.

1.06 QUALIFICATIONS

A. Welder/Welding Operator: In accordance with AWS D1.1/D1.1M.

B. Welding Inspector: Certified in accordance with AWS QC 1, and having prior experience with welding codes required.

1.07 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Gaskets, O-rings, keys, dowels, and pins	One (1) complete set
Shear pins of each different size	Six (6) per unit
Flexible wipers and seals used in scum collection assemblies	Two (2) of each type and size per unit
Squeegees for sludge rake arm plows	Two (2)
Scum skimming arm blade pivot bearing	Two (2) of each type and size per unit

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Item	Quantity
Drive chain and/or belts (if used)	One (1) of each type and size per unit
Scum trough flushing valve seal assembly	One (1)of each type and size per unit
Springs used in scum collection assemblies	Two (2) of each type and size per unit
Special tools required to maintain or dismantle scum collection assemblies, drive unit except for low speed main bearing, but including that required for removal/insertion of main bearing race balls	One (1) complete set.
Lubricants	As required for one (1) year of continuous operation; locally obtained per manufacturer's listing of approved lubricants

B. Delivery: In accordance with Section 01 66 00, Shipment, Protection, and Storage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. WesTech Engineering.
2. Kusters Water.
3. Approved equal.

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2.02 DESIGN CONDITIONS

A. Meet requirements as shown below.

Design Criteria (per clarifier)	Unit	Value
Influent Flow Rate		
Total Dry Weather Flow	MGD	1.85
Average Dry Weather Flow	MGD	2.10
Average Wet Weather Flow	MGD	3.15
Average Annual Flow	MGD	2.5
Peak Hydraulic Flow	MGD	7.30
Tank Dimensions (square)	ft	Primary: 55 ft x 55 ft Secondary: 65 ft x 65 ft
Side Water Depth (average)	ft	Primary: 9'-11" Secondary: 9'-3"
Total Weir Length (per clarifier)	ft	Primary: 398 Secondary: 478
Design Weir Rates		
Total Dry Weather Flow	gpd/ft	Primary: 4648 Secondary: 3870
Average Dry Weather Flow	gpd/ft	Primary: 5213 Secondary: 4341
Average Wet Weather Flow	gpd/ft	Primary: 7902 Secondary: 6580
Average Annual Flow	gpd/ft	Primary: 6244 Secondary: 5199
Peak Hydraulic Flow	gpd/ft	Primary: 18369 Secondary: 15293
Freeboard	in	Primary: 36" Secondary: 30"

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Design Criteria (per clarifier)	Unit	Value
Bottom Slope	in/ft	Primary: To Be Field Measured Secondary: To Be Field Measured
Influent Column Outside Diameter	in	Primary: To Be Field Measured Secondary: To Be Field Measured
Feedwell		
Feedwell Diameter	ft	Primary: 8' Secondary: To Be Field Measured
Feedwell Depth	ft	Primary: 3'-1" Secondary: 3'-1"
Motor HP	hp	As needed to meet performance requirements
Torque		
Continuous Torque	ft-lbs	As needed to meet performance requirements
Cuttout Torque	ft-lbs	120% of Continuous Torque
Momentary Peak Torque	ft-lbs	200% of Continuous Torque

2.03 SERVICE CONDITIONS

A. Material Handled:

1. Primary Clarifiers: Screened influent wastewater.
2. Secondary Clarifiers: Screened wastewater produced by media biofilters.

B. Influent Liquid Temperature Range: 35 degrees F, minimum to 85 degrees F, maximum.

C. Influent pH Range: 5.5, minimum to eight (8), maximum.

D. Site Conditions:

1. Mechanism and walkway to the center column design shall be in accordance with conditions and requirements stated in

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Section 01 73 23, Structural Design and Anchorage Requirements for Non-Structural Components and Non-Building Structures, and Section 05 50 00, Metal Fabrications.

2. In addition, design shall accommodate the following Site conditions:

   a. Ambient Temperature Range: Minimum ten (10) degrees F to 100 degrees F, maximum.

   b. Ambient Humidity Range: Minimum ten (10) percent to 98 percent relative humidity.

2.04 MANUFACTURED UNITS

A. Provide two primary clarifier unit(s) and two secondary clarifier units, each meeting performance and design requirements as specified below. A total of four will be provided as covered in this Specification.

2.05 CLARIFIER COMPONENTS

A. Center Column:

1. The center column shall Support entire sludge collector mechanism including inboard end of the walkway to the center column; sized and designed by collector manufacturer. Minimum wall thickness of 1/4 inch; mounted at center of basin. Shall be provided and designed to support all required static and dynamic loads. The column shall be designed for two (2) times the continuous operating torque identified in Article Design Conditions.

2. The bottom of the column shall have a bolting flange for anchorage to the concrete tank using stainless steel anchor bolts. The Manufacturer shall provide a steel template/grout shield to accurately locate anchors and allow for grouting beneath the pier after final plumbing.

3. The column shall have gusset plates located at the top and bottom flanges for added strength.

B. Center Drive Cage:

1. The drive cage shall be a steel box truss capable of carrying dead load of rake arms plus its own dead load, as well as design total torque assuming entire design torque is distributed uniformly along each rake

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arm: Bolted to spur gear assembly that rotates center cage; bolted to rake arms and influent well hangers (if used).

2. Structural calculations shall be provided verifying the structural ability of the drive cage. The cage shall be designed for two (2) times the continuous operating torque identified in Article Design Conditions.

C. Feed Well:

1. Welded steel concentric with center column supported by center cage or walkway to the center column; top edges approximately four (4) inches above tank water surface. Size shall be as identified on Drawings.

2. Baffled slots at liquid level to permit removal of floating material in well; twelve (12) inches long; extending below low-water level.

3. The depth of the feed well shall be such as to provide proper detention time and an exit velocity at Average Wet Weather flow that will not scour the settled sludge or cause short circuiting.

4. Connect six (6) inch diameter filter backwash pipe into center column using PVC pipe.

D. Segmented Plow Rake Arms:

1. Designed for two (2) times the continuous torque identified in Article Design Conditions.

2. The mechanism shall include two (2) segmented plow sludge rake arms of steel truss construction with steel scraper blades and adjustable squeegees. Squeegees shall be fastened to the rake blades with stainless steel fasteners. The blades shall be properly sized to ensure complete raking of the bottom twice per revolution. The blades shall rake the heavy sludge to a center sludge hopper. The arms shall be adjustable at the cage to assure an even grout thickness over the tank bottom.

3. Segmented Plow Rake Arms shall be designed such that the corners of the square clarifiers are managed effectively. Rake arms shall be of a design using corner sweeps with pivoting counterweights and tie rods

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to remove sludge from the corners of the tank floor. No pulleys shall be incorporated in the corner sweep design.

4. See Drawings for further information.

E. Walkway to the Center Column:

1. Provide access walkway from side of clarifier to center drive unit.
2. Diagonally cross brace and space beams as necessary to carry loads and produce required clear walkway width. Extend for full length of walkway.
3. Maximum Vertical Deflection: 1/360 of span under uniform fifty (50) pound per square foot of walkway surface live load, plus walkway dead load.
4. Maximum Horizontal Deflection: 1/360 of span under uniform horizontal loading of fifty (50) pounds per linear foot and under torsional loadings from the center drive unit.
5. Walkway Surface Elements: Do not utilize to reduce calculated walkway deflections.
    a. 36 inch width.
6. Guardrails and Toe boards in accordance with OSHA requirements.
7. Material for gratings and structure to follow Section 01 73 23, Structural Design and Anchorage Requirements for Non-Structural Components and Non-Building Structures, Section 06 82 00, Glass-Fiber-Reinforced Plastic, and Section 05 50 00, Metal Fabrications.

F. Skimmer and Scum Removal:

1. A surface skimming system shall be provided and consist of two (2) skimming arms with skimmer heads, and a scum collection box. The skimmer arms shall span from the feed well to the scum box and shall be supported by and rotate with the truss arms. Each skimmer head shall be designed to maintain constant contact with the scum baffle and shall include a wiper.
2. The scum box shall be peripherally located and supported by stainless steel support angles.

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G. Center Drive Mechanism:

1. General: The center clarifier drive mechanism shall consist of an electrical motor, primary reducer, intermediate gear reducer and a main gear set consisting of a spur pinion and internal tooth spur gear.

2. Motor: The clarifier drive shall be driven by an electric motor. The motor shall be UL rated for the operational environment as specified in the Paragraph Regulatory Requirements. The motor shall be rated for 460V, 60 Hz, three-phase operation.

3. Reducer: A primary hydraulic reducer shall transmit torque to the intermediate reducer and provide overload protection. The hydraulic system shall be self-contained and fully enclosed in a Type 304 stainless steel enclosure. The enclosure shall also function as the fluid reservoir and shall provide a minimum eight (8) gallon capacity.

   a. The hydraulic system shall include: A hydraulic motor, a hydraulic pump, an aluminum manifold assembly, a flow directional valve, a pressure relief valve, an oil filter assembly, an oil filter replacement indication gage, a six (6) inch diameter glycerin filled gauge.

4. Intermediate Reducer: The intermediate reducer shall be a planetary type, providing no less than ninety (90) percent gear efficiency. All lubrication of the planetary gearing shall be oil. Grease lubrication is not permitted. The planetary reducer shall be designed for a 200,000 hour. service life at the rpm and torque specified in Article Design Conditions. The output shaft of the intermediate reducer shall be keyed to a heat treated spur pinion.

5. Final Reducer: The main gear shall include an internal tooth spur gear and spur pinion. The main gear material shall be ASTM A536 Ductile iron, 80,000 psi minimum tensile strength. The pinion shall be constructed from AISI 4150 steel, hardened to a minimum 340 Bhn.

6. Turntable Base: Cast Iron, ASTM A48 Class forty (40) minimum 40,000 psi tensile strength; able to be bolted to center column and to provide support for internal spur gear, the entire rotating collector mechanism and one end of the walkway to the center column. Fabricated steel housing are not permitted.

7. Main Bearing: The main bearing shall consist of a full complement of hardened steel chrome ball bearings (one (1) inch minimum), each

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riding on four replaceable hardened steel strip liners. Each liner shall be 3/8 inch by 3/8 inch square, heat treated to a minimum 48-50 Rc. The bearing liners shall be independently replaceable without the need to remove the clarifier drive or walkway to center column. The main bearing diameter shall be as identified in these Specifications.

8. Torque Overload Protection: The clarifier drive shall include a hydraulic torque overload protection system. Mechanical overload devices are not permitted due to their inherent inaccuracy. Two (2) overload switches shall be provide, one for “alarm” set at 100 percent of the continuous torque identified in Article Design Conditions, and one for “motor cut-off” set at 130 percent of the continuous torque identified in Article Design Conditions. Additionally a pressure relieve valve shall be provided set at 150 percent of the continuous torque identified in Article Design Conditions. All switches shall be current rated for 120V ac. Each switch shall be NEMA rated for the specified environment identified in Article Design Conditions. The torque indication gage shall be six (6) inches in diameter, glycerin filled with a scale that displays actual operating torque (ft-lbs or N-m).

2.06 INSTRUMENTATION AND CONTROLS

A. Each clarifier drive motor starter is located in its respective MCC. Each drive will have a local control station and will operate on 120V ac.

B. Operation:

1. The local control system shall be equipped with one ON / OFF position selector switch. In the Off mode the clarifier drive will not run. In the ON mode the clarifier drive shall run continuously. The following items shall be included in each control panel:

a. Reset push button.

b. Start/Stop buttons.

c. Relays and transformers as required.

d. Main power disconnect.

e. Service Receptacle.

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2.07 DISSIMILAR METALS

A. Isolate dissimilar metals or connectors to prevent direct contact and electrical conductivity.

1. Use 1/8-inch thick continuous neoprene gasket to insulate aluminum grating, checker plate, and handrail post bases from access walkway to the center column and other components.

2. Use insulating washer and Teflon sleeves at bolted connections.

2.08 ACCESSORIES

A. Anchor Bolts: Provide Type 316 stainless steel bolts and fasteners, at least 1/2 inch in diameter or as shown, in accordance with Section 05 50 00 Metal Fabrications.

B. Equipment Identification Plates: Sixteen (16) gauge, Type 304 stainless steel, securely mounted on drive unit in readily visible location with 1/4-inch high engraved block type.

2.09 FABRICATION

A. Fabricate walkway beam or stringer sections in continuous unbroken pieces.

B. Shop fabricate and assemble mechanism components in largest sections practicable and permitted by transportation carrier regulations.

C. Welded Construction:

1. Mechanism component interfaces that are not field bolted connections shall be seal welded in shop.

2. Welding: As specified in Section 05 05 23, Welding.

D. Shop/Factory Finishing:

1. Shop prime ferrous metal in accordance with and as specified in Section 09 90 00, Painting and Coating.

2. Finish all non-stainless steel metal surfaces (motors, gear, reducers, submerged, etc.) in accordance with Section 09 90 00, Painting and Coating.

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3. Shop-applied and field-applied coatings shall be by same manufacturer to ensure compatibility.

PART 3 EXECUTION

3.01 INSTALLATION

A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with Drawings. Contractor shall notify Engineer of any significant deviations.

B. Installation of the equipment shall be in strict accordance with the Contract Documents and the Manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the Manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

A. Functional Tests:

1. Conduct on each mechanism.
2. Contractor to provide water for testing.
3. Operate Mechanism: For continuous three (3)-hour period without malfunction.

B. Performance Test:

1. Conduct on each completed assembly in accordance with accepted test procedures.
2. Contractor to provide water for testing.
3. Perform to confirm mechanical and structural compliance with specified torque requirements.
4. Conduct Static Torque Test on Mechanism:
   a. With the clarifier drive shut off, connect a load measurement device to each rake arm at a specific radial distance from the center using nylon straps, and attach the other end of each of the

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two (2) loading assemblies to a temporary anchor installed in either the clarifier wall or floor.

b. Apply a load to the rake arm by tightening both assemblies using a come-along or similar device. Both arms shall be loaded simultaneously.

c. Convert loadings as read on the load measurement devices to torque using the following formula (which assumes both arms are loaded simultaneously):

$T = P_1 * D_1 + P_2 * D_2$

Where:

T	=	torque, ft-lb
P1, P2	=	Load applied at each connection point, lb (should be equal)
D1, D2	=	Radial distances on rake arms to attachment points (should be equal)

d. Set the alarm and cutout torque switches at the corresponding back-calculated loadings and measure the clarifier mechanism deflection against the specified limits.

e. If mechanism deflection exceeds specified limits, structurally modify in the field as necessary to meet limits. Submit modification approach to Engineer for approval prior to implementation. Field weld and repair coatings shall be in accordance with this Specification.

5. Record scale indications and/or mark scale for alarm and cutout torques.

6. Submit test report containing results.

7. Replace shear pins after torque testing is completed.

8. Manufacturer may suggest alternate testing procedure, subject to Engineer's approval.

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3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative present at Site or classroom designated by Owner for minimum person-days listed below, travel time excluded:

1. One (1) person-day for installation assistance and inspection (for each clarifier).
2. Three (3) person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation for each clarifier (primary or secondary).
3. One (1) person-day for prestartup classroom or Site training (for each clarifier).
4. One (1) person-day for facility startup (for each clarifier).
5. One (1) person-day for post-startup training of Owner's personnel for each type of clarifier, primary or secondary. Training shall not commence until accepted detailed lesson plan for each training activity has been reviewed by Owner and Engineer.

B. See Section 01 45 23, Testing and Inspecting Services, and Section 01 75 00, Testing, Training, and Commissioning.

END OF SECTION

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SECTION 44 42 28
WEIR AND BAFFLE PLATES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA): F102, Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets.
2. ASTM International (ASTM):
    a. D256: Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
    b. D570: Standard Test Method for Water Absorption of Plastics.
    c. D638: Standard Test Method for Tensile Properties of Plastics.
    d. D790: Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
    e. D2853: Standard Test Method for Determination of Lead in Paint Layers and Similar Coatings or in Substrates and Homogenous Materials by Energy Dispersive X-Ray Fluorescence Spectrometry Using Multiple Monochromatic Excitation Beams.
    f. American Water Works Association (AWWA) F102: Matched-Die-Molded, Fiberglass-Reinforced Plastic Weir Plates, Scum Baffles, and Mounting Brackets.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
    a. Detailed description of laminate and type of reinforcing to be used.
    b. Manufacturer’s drawings showing dimensions of the items and accessories being provided.

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c. Complete information regarding specific resin to be used.

d. General description of the equipment, including materials and thicknesses used for construction, physical and structural properties, weights, anchor bolt locations, and auxiliary equipment.

e. Calculations using design loads (e.g., buoyancy, gravity, differential water heights, etc.) discussed herein showing that deflections and thermal expansion/contraction do not exceed specified limits and anchorage provided is adequate for the design conditions.

f. Warranty information.

2. Sample: Manufacturer's 6-inch square sample of fiberglass reinforced plastic laminate of same construction, nominal thickness, and color as materials specified.

B. Informational Submittals:

1. Manufacturer's Installation Certification Form, Form 46 05 13-A in Section 01 31 30, Standard Forms, and stating the following:

a. Reinforcing material used will provide suitable chemical resistance.

b. Resin is suitable for the environmental conditions intended and the fabrication technique proposed.

1.03 QUALITY ASSURANCE

A. Qualifications:

1. Equipment furnished under this section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least ten (10) years. Manufacturer for equipment furnished section 44 42 24 has unit responsibility for equipment furnished under this section.

2. Manufacturer shall be ISO9001 certified. Submit copy of manufacturer's ISO certificate with the equipment submittal.

B. Coordination with Other Manufacturers: The Contractor and manufacturer shall coordinate with supplier of the clarifier collector systems (Section 44 42 24.01, Primary Secondary Clarifier Mechanism Circular Plow Type,) to ensure there are no conflicts with the manufacturer's scope of supply specified herein and that

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items provided by the manufacturer under this Specification properly attach, support, connect, and integrate with related items from other suppliers.

C. Field Verification: The design drawings are based in part on existing record drawings that may not be completely accurate in their representation of the existing installation. While an attempt has been made to check existing arrangements and critical dimensions, the Contractor shall be responsible for obtaining field verification of dimensions for development of submittal drawings and to confirm necessary dimensions of new equipment prior to fabrication.

1.04 WARRANTY

A. The manufacturer shall warrant all components of the effluent launder troughs against faulty design, workmanship, and materials for a period of twelve (12) months from date of substantial completion.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site properly packaged for ease of handling and to minimize damage during shipping.

B. Handling and storage of items provided hereunder shall be in strict accordance with manufacturer's printed instructions. Care shall be taken not to damage components and accessories.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization of appearance, operation, maintenance, and manufacturers' services.

2.02 MANUFACTURERS

A. Enduro Composites, www.endurocomposites.com, 16602 Central Green Blvd, Houston, TX 77024, Tel: 800-231-7271.

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B. Equivalent fiberglass troughs by MFG Construction & Water Products Company, www.mfgcwp.com, 55 Fourth Avenue, Union City, PA 16438, Tel: 814-438-3959.

C. Approved equal.

2.03 SYSTEM DESCRIPTION

A. Primary Clarifiers: Two sets of four isophthalic polyester FRP square-bottom effluent trough sections; each trough section has nominal dimensions of 15-inch wide by 18-inch deep (from bottom of V-notch) by 51-foot-0-inch long. Each trough section is supported every 11 feet using stainless steel brackets anchored to the concrete tank walls. Also included is the necessary Type 316 stainless steel fasteners and anchors for a complete installation.

B. Secondary Clarifiers: Two sets of four isophthalic polyester FRP square-bottom effluent trough sections; each trough section has nominal dimensions of 15-inch wide by 18-inch deep (from bottom of V-notch) by 61-foot-0-inch long. Each trough section is supported every 13 feet using stainless steel brackets anchored to the concrete tank walls. Also included is the necessary Type 316 stainless steel fasteners and anchors for a complete installation.

C. Design Conditions (all dimensions to be field verified by Contractor):

1. V-Notch Weir Invert Elevation: 66.00 feet (Primary Clarifiers) 66.5 feet (Secondary Clarifiers).
2. Minimum Side Water Depth: 9.32 feet (Primary Clarifiers) 8 feet (Secondary Clarifiers).
3. Minimum V-Notch Depth: 2.25 inches.
4. V-Notch Spacing: 7 inches.
5. Trough Length: 51 feet (Primary Clarifiers) and 61 feet (Secondary Clarifiers).
6. Trough Width: 15 inches.
7. Trough Invert Elev.: 65.83 feet (Primary Clarifiers) and 66.33 feet (Secondary Clarifiers) (matches invert of openings to effluent channel).

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2.04 EFFLUENT LAUNDER TROUGHS

A. FRP Effluent Launder Trough Design Loads:

1. Gravity Load: Downward vertical loads shall include the weight of the trough and appurtenance attachments, such as weir plates and spreader bars, together with the weight of water based on a full trough.

2. Buoyant Load: The buoyant load shall act vertically upward, its magnitude equal to the weight of displaced water (trough weight neglected) assuming an empty trough. The line of action passes through the centroid of the submerged cross-sectional area.

3. Lateral Load: Loads acting against the trough sidewalls; specifically, those induced by differential water levels on either side of the trough walls. The maximum possible differential, existing when the trough is empty and the tank is full, or when the trough is full and when the tank is empty, shall be used when calculating deflection, fiber stress, etc.

4. Thermal Stresses: The troughs shall be designed to accommodate temperature induced stresses resulting from differences in coefficients of thermal expansion (contraction) between the trough and tank/support materials over temperature range of minus 10 degrees F to 100 degrees F.

5. Torsional Stability: The trough system shall be designed to resist torsional oscillations induced by the flow of water over trough edges. Any or all of the following trough stabilization techniques shall be considered.

a. Trough-to-trough stabilization.

b. Torsional stiffness.

c. Support spacing and rigidity.

d. Internal baffles and/or flow straighteners.

B. FRP Launder Trough Performance Requirements:

1. Maximum vertical deflection under full buoyant or gravity load shall be less than or equal to L/1000, where L is defined as the unsupported trough length in inches. Under no circumstances shall the maximum vertical deflection, measured at mid-point between trough supports, exceed 3/16-inch.

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2. Maximum trough sidewall horizontal deflection under full lateral load shall be less than or equal to D/100, where D is defined as the trough depth in inches. Under no circumstances shall the maximum sidewall deflection exceed 3/16-inch.

3. Trough bottom deflection under full buoyant or gravity load shall be less than or equal to W/100, where W is defined as the trough width, in inches. Under no circumstances shall the maximum bottom deflection exceed 3/16-inch.

4. The troughs shall be designed to accommodate a thermally induced expansion and contraction of 1/8-inch per 20 feet of length over a temperature range of minus 10 degrees F to 100 degrees F, without exceeding the deflection limitations specified above.

C. FRP Trough Laminate Mechanical and Physical Properties (Minimum):

1. Tensile Strength: 14,000 psi (ASTM D638).

2. Flexural Strength: 27,500 psi (ASTM D790).

3. Flexural Modulus: 1,000,000 psi (ASTM D790).

4. Notched Izod: 15.4 ft-lbs/in (ASTM D256).

5. Barcol Hardness: 40 (ASTM 2853).

6. Water Absorption: 0.13 percent maximum (ASTM D570).

D. Resin:

1. FRP trough laminate materials shall include UV stabilized commercial grade isophthalic polyester thermosetting resin.

2. UV stabilizers are required for all trough laminates.

3. The resin shall contain no fillers, although thixotropic agents for viscosity control are acceptable.

E. Metal Reinforcement: When metal reinforcements are used, they shall be free of rust, oil, and any foreign matter. They shall be completely encapsulated with a minimum of 1/8-inch thick laminate. The laminate shall also extend at least 2 inches beyond the reinforcing member.

F. Glass Mat Reinforcement: Glass mat reinforcement shall consist of chemically bonded surfacing mat and chopped strand or chopped strand mat as hereinafter

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described. Surfacing mat shall be 0.020 inches thick reinforced with a surfacing mat of Type C veil, 10 to 20 mils thick, with a silane finish and a styrene-soluble binder compatible with the resin; the glass content of this layer shall not exceed 20 percent by weight. Chopped strands shall be Type E glass, with silane finish and styrene-soluble binder.

G. Woven Roving Reinforcement: If required to meet the design and performance requirements specified herein, the finished laminate may also include one layer of 24 ounce woven roving reinforcement over the entire trough surface.

H. Other Reinforcement: Additional reinforcement in the form of foam or balsa sheet for high stress areas at the sides and bottom of the trough shall be completely encapsulated within the laminate. Care shall be taken to ensure that these areas of the trough laminate are not designated as attachment points or drilled for any purpose.

I. Laminate Construction:

1. Inner trough surface shall be a resin rich layer. A gelcoat interior surface shall be provided.
2. Structural layers shall consist of plies of chopped strand mat with a maximum of 2 ounces per square foot per spray-up pass. Each successive pass of reinforcement shall be thoroughly wetted with resin and shall be well rolled to exclude all air pockets and bubbles prior to the application of additional reinforcement.
3. Outer trough surface shall consist of a resin rich layer not less than 0.020-inch thick. The outer layer resin shall be applied after cure of the structural layer and suitably embed all reinforcing fibers.
4. Finished trough shall be a minimum of 25 percent fiber reinforced with a minimum thickness of not less than 1/4-inch.

J. Trough Manufacturing:

1. The inner surface of the trough shall be smooth and resin rich. The outer surface shall be reasonably smooth, resin rich, and no glass fibers shall be exposed. The size and number of air bubbles shall be held to a minimum. Laminations shall be dense and without voids, dry spots, cracks, or crazes.

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2. The top edges of the trough shall be level and parallel with a tolerance of ±1/8-inch (measured when the trough is not loaded).

3. The length of a trough section shall have a tolerance of ±1/8-inch per 10-foot length.

4. Horizontal stiffening flanges shall be integrally molded along the top edge of each trough side. These flanges shall be 1 inch to 3 inches wide, depending upon the trough configuration and shall face outward.

5. End flanges, where required to bolt trough sections together, and blind ends for securing to a wall, shall be a minimum of 1-1/2 times the nominal thickness of the trough.

6. An integrally molded water stop shall be provided on the trough whenever the trough is grouted into and/or passes through a wall.

7. Horizontal stiffeners shall be provided across the width of the trough to increase the structural rigidity of the trough system.

8. After fabrication, all cut edges, holes and abrasions shall be sanded smooth and sealed with a compatible resin coating to prevent the intrusion of water.

9. Materials used in the manufacture of the FRP troughs shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

K. Trough Supports and Hardware:

1. Manufacturer shall be responsible for the design and fabrication of supports suitable for installation of the troughs specified herein.

2. Trough supports may be Type 316 stainless steel or FRP.

3. All trough mounting hardware shall be Type 316 stainless steel and shall be supplied by the trough manufacturer.

2.05 WEIR PLATES

A. FRP Weir Plates Mechanical and Physical Properties (Minimum):

1. Tensile Strength: 19,400 psi (ASTM D638).

2. Flexural Strength: 28,500 psi (ASTM D790).

3. Flexural Modulus: 1,550,000 psi (ASTM D790).

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4. Barcol Hardness: 50 (ASTM D2853).

5. Water Absorption: 0.2 percent maximum (ASTM D570).

B. Except for bolts and hardware specified herein, the weirs and supports shall be made of UV stabilized polyester resin, reinforced with glass fiber (50 percent minimum by weight). All weir plates, weir washers, and weir splice plates shall be fiberglass reinforced plastic molded to produce uniform smooth surfaces. The surface shall be resin rich, free of voids and porosity, without dry spots, crazes, or unreinforced areas and shall provide for increased corrosion resistance and UV protection. The weirs shall be the same color as the troughs.

C. The weir plates, splice plates, and weir washers shall be 1/4-inch thick FRP and conform to AWWA F102. Weir plates shall not exceed 12 feet in length unless otherwise noted. The specific dimensions of the weirs shall be as follows:

1. Weir plates shall be 6 inches high, unless otherwise required for the installation shown on Drawings.

2. V-notches shall be 2.25 inches deep with a 90 degree angle and spaced 7 inches on center, unless otherwise required for the installation shown on Drawings.

3. Weir splice plates shall be 1/4-inch thick by 9 inches high by 6 inches long, unless otherwise required for the installation shown on Drawings.

4. Weir plate mounting holes shall be oversized for vertical and horizontal alignment of 2 inches (minimum) and shall be 24 inches on center (maximum) and covered with 5-inch diameter FRP weir washers.

D. The weirs shall be mounted to the launders at a minimum of 24 inches on center. Cut ends of non-standard lengths shall be sealed with resin.

E. Nuts, bolts, washers, and other hardware shall be Type 316 stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Field cutting of FRP components shall be avoided whenever possible, but is allowed if necessary. All field cut edges and field drilled holes shall be sealed per the manufacturer's instructions with compatible catalyzed resin.

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B. Ensure that troughs and supports are installed plumb and true, free of warp or twist, within the tolerances specified by the manufacturer, and as shown on Drawings.

C. Weirs shall be carefully aligned and leveled to the elevations shown on Drawings. No variation greater than 1/8-inch shall exist between any two notches of the weir plate in any one tank. In addition, the average deviation from one quadrant of the weir to any other shall not exceed 1/16-inch. The Contractor shall apply a suitable sealant, as recommended by the manufacturer, between the weir and the effluent launder trough to prevent the flow of liquid between the weir plate and launder trough.

D. The Contractor shall send photos of the completed installation to the manufacturer for review and approval. After the manufacturer has approved the installation, and prior to startup, the Contractor shall clean all surfaces in accordance with the manufacturer's instructions.

E. If a representative of the manufacturer must visit the Site to resolve issues with the installation, costs associated with such field services shall be paid by the Contractor. Additionally, adjustments or corrections, as determined by the manufacturer's representative, shall be made by the Contractor at no additional cost to the Owner.

3.02 TESTS AND INSPECTION

A. In accordance with Section 01 75 00, Testing Training and Commissioning.

B. Functional Test: Demonstrate proper installation of weir plate for both water tightness and level, prior to placing unit into service, by filling unit with water to the weir crest elevation. Make adjustments as necessary to meet Specification.

END OF SECTION

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DRAWINGS
(BOUND SEPARATELY)