Technical Specifications

County of San Luis Obispo
Los Osos, California

Technical Specifications for the Construction of

Los Osos Water Recycling Facility

REGISTERED PROFESSIONAL ENGINEER
KARL W. HADLEY
No. 56584
CIVIL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
HAN GIL KANG
No. 62580
CIVIL
STATE OF CALIFORNIA

September 2013

BUY AMERICAN CERTIFICATION

TO: San Luis Obispo County

PROJECT: San Luis Obispo County Los Osos Water Recycling Facility

The plans, specifications, and bidding documents for the subject project have been developed by me or under my supervision. I hereby certify that to the best of my knowledge and belief all iron, steel, and manufactured goods referenced in the documents are either required to be produced in the United States or are the subject of a waiver of the requirements of Section 1605 of the American Recovery and Reinvestment Act as approved by the Secretary of Agriculture. This certification is not intended to be a warranty in any way, but rather the designer's professional opinion that to the best of their knowledge the documents comply.

AFFIX PROFESSIONAL ENGINEER
OR ARCHITECT SEAL BELOW

BY: Karl W. Hadler P.E., PMP

TITLE: Associate Vice President

DATE: 09/16/2013

cc: USDA Rural Development

NOTE: This certification is required to be executed by the Project Engineer and submitted to USDA Rural Development along with the final plans and specifications.

SECTION 01001

INTRODUCTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes general provisions related to implied intent of directives given in Technical Specifications.
   1. These “Technical Specifications” consist of additional requirements imposed upon the CONTRACTOR, including requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto. (The term “Technical Specifications” is synonymous with the term “Specifications” used in Section 00700.)
   2. Any action, requirement or obligation described in these “Technical Specifications” shall be interpreted as an action, requirement and obligation imposed upon the CONTRACTOR unless the language clearly and unambiguously identifies another entity. For every phrase, incomplete sentence or other language that does not identify a subject or actor, it shall be presumed that the subject and/or actor is the CONTRACTOR, unless the language clearly and unambiguously identifies another entity.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Identification and summary description of the Project, the Work, location, OWNER-furnished products, activities by others, coordination, and early occupancy by OWNER.

B. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

C. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.02 THE WORK

A. The Work consists of construction of the Los Osos Water Recycling Facility (LOWRF), including but not limited to:
   1. Administration Building.
   2. Maintenance Building.
   3. Headworks/Septage Receiving.
   4. Odor Control Facility.
   5. Oxidation Ditches.
   6. Secondary Clarifiers.
   7. Scum Pump Station.
   8. Filter Influent Pump Station.
   9. Tertiary Filters.
   10. UV Facility.
   11. Chemical Facility.
   12. Effluent Pump Station.
   13. Sludge Storage Tanks.
   14. Dewatering Building.
   15. Electrical Building.
   16. Groundwater Wells and Pumps.
   17. Water Storage Tank.
   18. Recycled Water Storage Ponds.
   19. Storm Water Retention Pond.
   20. Plant Drain Pump Station.
   21. Storm Water Pump Station.
   22. All associated electrical, instrumentation, and control system work.
   23. All associated yard work, including yard piping, paving, grading, and landscaping.
   24. Plant Entrance Road from Los Osos Valley Road (LOVR) to the LOWRF site (approximately 1,500 linear feet long).
   25. LOVR Improvements.

B. Except as specifically noted otherwise, provide and pay for:
   1. Insurance and bonds.
   2. Labor, materials, and equipment.
   3. Tools, equipment, and machinery required for construction.
   4. Utilities required for construction.
   5. Temporary facilities including sheeting and shoring.
   6. Traffic control and dust control measures.
   7. Other facilities and services necessary for proper execution and completion of the Work.

C. Secure and pay for all permits including OSHA excavation permits, Department of Transportation permits, government fees, and licenses.

D. Comply with codes, ordinances, regulations, orders, and other legal requirements of public authorities having bearing on the performance of the Work.

1.03 LOCATION OF PROJECT

A. The Work is primarily located north of the intersection of LOVR and Clark Valley Road in the community of Los Osos, San Luis Obispo County, California. This Site is situated north of the Los Osos Mortuary and Memorial Park and does not currently have a postal address. The Los Osos Mortuary and Memorial Park is at 2260 Los Osos Valley Road, Los Osos, California, 93402.

B. Other Work is located at the Mid-Town Standby Power Building and other collection system facilities, which are listed on Sheet 00N08. All of these facilities are located in Los Osos. The Work at these locations pertains to the SCADA system for the collection system. The Los Osos collection system is currently under construction by others.

1.04 OWNER-FURNISHED EQUIPMENT

A. Owner will furnish the following products:
   1. None.

1.05 ACTIVITIES BY OTHERS

A. OWNER, utilities, and others may perform activities within Site while the Work is in progress.
   1. Schedule the Work with OWNER, utilities, and others to minimize mutual interference.

B. Activities by others which may affect performance of work include:
   1. Los Osos Collection System Project, which consists of multiple construction contracts currently in progress in the community of Los Osos to provide wastewater collection and recycled water distribution to and from the LOWRF, will construct buried influent force main and recycled water piping, fiber-optic conduits and wiring, and associated manholes, up to the intersection of LOVR and the plant entrance road.
   2. Southern California Gas Company will furnish and install a natural gas pipeline on the Plant Entrance Road, terminating it within the LOWRF in the vicinity of the Main Entrance with a gas meter and a pressure regulator. The

CONTRACTOR shall coordinate with the utility company and provide the trenching and backfill for the gas pipe on the Plant Entrance Road**.**

3. AT&T will provide a land telephone service for the LOWRF. Similarly, PG&E will provide a new electric service.
4. The CONTRACTOR shall coordinate with the utility companies and provide the necessary materials and labor as specified in Section 16210 - Utility Coordination.

C. Cooperate with others to minimize interference and delays.
   1. When cooperation fails, submit recommendations and perform Work in coordination with work of others.

D. When the Work depends on proper execution or results upon work performed by others, inspect and promptly report apparent discrepancies or defects in work performed by others.
   1. Assume responsibility for work performed by others, except for defects reported as specified in this paragraph and defects, which may become apparent in work performed by others after execution of the Work.

1.06 COORDINATION OF WORK

A. Maintain overall coordination of the Work.

B. Obtain construction schedules from each subcontractor, and require each subcontractor to maintain schedules and coordinate modifications.

1.07 WORK MILESTONES

A. Refer to Section 00500 for intermediate milestone(s) required for the Project.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01046

CONTROL OF WORK

PART 1 GENERAL

1.01 PRIVATE LAND

A. Do not enter or occupy private land outside of easements, except by permission of the land owner.

1.02 PIPE LOCATIONS

A. Locate pipelines substantially as indicated on the Drawings. The ENGINEER reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures, existing overhead or buried utilities, or for other reasons. Where fittings are noted on the Drawings, such notation is for the CONTRACTOR's convenience and does not relieve him from laying and jointing different or additional items where required.

1.03 OPEN EXCAVATIONS

A. Adequately safeguard all open excavations by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. Provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Remove bridges provided for access during construction when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the ENGINEER. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the ENGINEER may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street and requiring that the trench shall not remain open overnight.

B. Take precautions to prevent injury to the public due to open trenches. Provide adequate light at all trenches, excavated material, equipment, or other obstacles which could be dangerous to the public at night.

1.04 POTHOLING

A. Excavate potholes to locate underground pipelines or structures in advance of the construction. Backfill potholes immediately after their purpose has been satisfied, and restore and maintain the surface in a manner satisfactory to the ENGINEER.

1.05 MAINTENANCE OF TRAFFIC

A. Unless permission to close a street is received in writing from the proper authority, place all excavated material so that vehicular and pedestrian traffic may be maintained at all times. If the construction operations cause traffic hazards, repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety in accordance with Section 01571 – Traffic Control.

B. Detours around construction will be subject to the approval of the ENGINEER. Where detours are permitted, provide all necessary barricades and signs as required to divert the flow of traffic. Expedite construction operations while traffic is detoured. Periods when traffic is being detoured will be strictly controlled by the OWNER.

C. Take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist. The CONTRACTOR shall be fully responsible for damage or injuries.

1.06 CARE AND PROTECTION OF PROPERTY

A. CONTRACTOR shall be responsible for the preservation of all public and private property and use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the CONTRACTOR, restore such property to a condition similar or equal to that existing before the damage was done, or make good the damage in other manner acceptable to the ENGINEER.

1.07 WATER FOR CONSTRUCTION PURPOSES

A. Refer to Section 01500.

1.08 MAINTENANCE OF FLOW

A. Provide for the flow of drains and water courses interrupted during the progress of the work, and immediately remove all materials affecting facilities and dispose of in a legal manner. Notify the ENGINEER in writing at least one week in advance of the interruption of any flow.

1.09 COOPERATION WITHIN THIS CONTRACT

A. All firms or persons authorized to perform any work under this Contract shall cooperate with CONTRACTOR and Subcontractors or trades and assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated herein or directed by the ENGINEER.

1.10 CLEANUP AND DISPOSAL OF EXCESS MATERIAL

A. During the course of the work, keep the site of operations as clean and neat as possible. Dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.

B. In order to prevent environmental pollution arising from the construction activities related to the performance of this Contract, comply with all applicable Federal, State

and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and in other related sections.

C. Disposal of excess excavated material in wetlands, stream corridors and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the CONTRACTOR or any person employed by him will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The CONTRACTOR will be required to remove the fill and restore the area impacted at no increase in the Contract Price.

D. If CONTRACTOR elects to dispose of materials at locations other than those where arrangements have been made by OWNER, or, if material is to be disposed of and OWNER has not made arrangements for disposal of the material, the CONTRACTOR shall make arrangements for disposing of the materials outside the right of way and shall pay all costs involved. Arrangements shall include, but not be limited to, entering into agreements with property owners and obtaining necessary permits, licenses, and environmental clearances. Before disposing of any material outside the right of way, CONTRACTOR shall furnish to ENGINEER satisfactory evidence that CONTRACTOR has entered into agreements with the property owners of the site involved and has obtained the permits, licenses, and clearances.

E. When any material is to be disposed of outside the right of way, and the OWNER has not made arrangements for disposal of the material, CONTRACTOR shall first obtain written authorization from the property owner on whose property the disposal is to be made and CONTRACTOR shall file with ENGINEER the authorization or a certified copy thereof together with a written release from the property owner absolving the OWNER from any and all responsibility in connection with the disposal of material on the property. Before any material is disposed of on the property, CONTRACTOR shall obtain written permission from ENGINEER to dispose of the material at the location designated in the authorization.

F. When material is disposed of as above provided and the disposal location is visible from a highway, the CONTRACTOR shall dispose of the material in a neat and uniform manner to the satisfaction of the ENGINEER.

G. Where the OWNER has made arrangements with owners of land in the vicinity of the Project for the disposal of materials on an owner's property, the arrangements are made solely for the purpose of providing all Bidders an equal opportunity to dispose of the materials on the property. Bidders or CONTRACTORs may, upon written request, inspect the documents evidencing the arrangements between property owners and the OWNER. The CONTRACTOR may, if the CONTRACTOR so elects, exercise any rights that have been obtained, which may be exercised by a CONTRACTOR under the arrangements, subject to and upon the conditions hereinafter set forth.

H. Such arrangements are not a part of the Contract and it is expressly understood and agreed that the OWNER assumes no responsibility to the Bidder or CONTRACTOR whatsoever in respect to the arrangements made with the property owner to dispose of materials thereon and that the Contractor shall assume all risks in connection with the use of the property, the terms upon which the use shall be

made, and there is no warranty or guaranty, either express or implied, as to the quantity or types of materials that can be disposed of on the property.

I. The Bidder or CONTRACTOR is cautioned to make such independent investigation and examination as the CONTRACTOR deems necessary to be satisfied as to the quantity and types of materials which may be disposed of on the property and the rights, duties and obligations acquired or undertaken under the arrangement with the property owner.

J. Notwithstanding that the CONTRACTOR may elect to dispose of materials on any such property owner's property, no material may be disposed of on that property unless the CONTRACTOR has first either:
   1. Executed a document that will guarantee to hold the owner harmless from all claims for injury to persons or damage to property resulting from the CONTRACTOR's operations on the property owner's premises and also agree to conform to all other provisions set forth in the arrangement made between the OWNER and the property owner. The document will be prepared by the ENGINEER for execution by the CONTRACTOR, or
   2. Entered into an agreement with the owner of the disposal site on any terms mutually agreeable to the owner and the CONTRACTOR; provided that the CONTRACTOR shall furnish to the ENGINEER a release, in a form satisfactory to the ENGINEER, executed by the owner, relieving the OWNER of any and all obligations under the OWNER's arrangement with the owner.

K. If the CONTRACTOR elects to dispose of material under (1), the use of the site shall be subject to the terms, conditions and limitations of the arrangement made between the property owner and the OWNER and the CONTRACTOR shall pay those charges that are provided for in the arrangement made by the OWNER with the property owner, and deductions will be made from any moneys due or that may become due the CONTRACTOR under the Contract sufficient to cover the charges for the material disposed of.

L. If the CONTRACTOR elects to dispose of material under (2), the CONTRACTOR shall pay those charges that are provided for in the agreement between the owner and the CONTRACTOR and deductions will not be made from any moneys due or that may become due the CONTRACTOR under the Contract to cover the charges.

M. Before acceptance of the Contract, the ENGINEER may require the CONTRACTOR to submit written evidence that the owner of the disposal site is satisfied that the CONTRACTOR has satisfactorily complied with the provisions of either - (1), the arrangement between the OWNER and the owner, or (2), the agreement between the owner and the CONTRACTOR, as the case may be.

N. Full compensation for all costs involved in disposing of materials as specified in this paragraph, including all costs of hauling, shall be considered as included in the price paid for the contract item of work involving the materials and no additional compensation will be allowed therefor.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01060

REGULATORY AGENCY AND UTILITY REQUIREMENTS

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall apply for, obtain, and comply with terms, conditions and requirements attached to all permits, bonds and licenses required by any local, regional, state, or federal agencies to perform work, construct, erect, test, and start up the Work. The CONTRACTOR shall also obtain written agreements from any private property owners with whom it arranges to use their land and/or facilities during construction and coordinate with OWNER to secure permits, as necessary.

B. The OWNER has obtained certain permits during the project design phase. These are appended to these Specifications and described in Paragraph 1.02 below. The CONTRACTOR is required to abide by the requirements of these permits and shall also obtain construction phase permits and abide by their requirements.

C. While not covered by permits or agreements, the CONTRACTOR shall also plan and execute its work in coordination with utility agencies. This shall include, but not be limited to, working adjacent to and protecting in place existing water, gas, fiber optic and other underground utilities and arranging for utility connections to the new water recycling facility. Utility contacts are listed in the General drawings of the Contract Drawings. Also, see Paragraph 1.03, below.

1.02 PERMITS AND AGREEMENTS

A. The CONTRACTOR shall abide by the conditions of all permits and agreements and shall obtain written proof of satisfaction of conditions from issuers of permits and agreements prior to acceptance of the Work by the OWNER.

B. Conditions and requirements affecting the CONTRACTOR are found in the following permits and agreements. Note, however, that this list may not be all inclusive:

1. County of San Luis Obispo Project Encroachment Permit. The OWNER has obtained an encroachment permit for constructing the project within County right of way and has incorporated the applicable provisions into the Contract Documents. The CONTRACTOR shall abide by all requirements pertaining to it. No encroachment permit related fees or trench cut fees are required to be paid by the CONTRACTOR.
2. County of San Luis Obispo, Department of Planning and Building, Approved Development Plan/Coastal Development Plan A-3-SLO-09-055/069. See “Conditions of Approval” construction phase requirements pertaining to the CONTRACTOR as presented in Paragraph 1.04, below.
3. Central Coast Regional Water Quality Control Board (RWQCB) Low Threat Discharge General Permit CAG993001, Order No. R3-2011-0223. The subject permit applies for disposal of dewatering water by the CONTRACTOR. The CONTRACTOR shall abide by the requirements of said permit including dewatering water desilting prior to disposal.

4. Central Coast Regional Water Quality Control Board Storm Water General Permit. The OWNER has submitted to the RWQCB its intent to comply with the requirements of the Storm Water General Permit. CONTRACTOR shall modify the permit to become the listed QSP. CONTRACTOR may also modify the permit as required. The CONTRACTOR shall abide by all of said permit requirements including preparing and submitting its Stormwater Pollution Prevention Plan (SWPPP) to the RWQCB. Also, see Section 01570 Stormwater Pollution Prevention Plan and the erosion control methods shown in the Contract Drawings.
5. County of San Luis Obispo Fill and Grading Permits. The CONTRACTOR shall obtain a fill and grading permit for each property used for disposal of excavation spoils.
6. Private Property Use Agreements. Should the CONTRACTOR wish to arrange for and negotiate agreements with private property owners for use of their property for project-related activities, it shall coordinate with OWNER prior to agreement execution as all staging agreements between CONTRACTOR and private property owners are subject to approval from the Coastal Commission. CONTRACTOR shall provide a copy of unexecuted agreements to the OWNER.
7. San Luis Obispo Air Pollution Control District Authority to Construct/ Permit to Operate (ATC/PTO) a Standby Engine Permit. The OWNER will prepare and apply for an ATC/PTO for a standby generator engine permit. The CONTRACTOR shall support the OWNER's efforts and furnish equipment information as requested by the OWNER.
8. California Department of Water Resources Well Construction Report. The CONTRACTOR shall file a well construction report to the California Department of Water Resources in accordance with the provisions of Sections 13750 through 13755 (Division 7, Chapter 10, Article 3) of the California Water Code. The CONTRACTOR shall provide a copy of the filed report to the ENGINEER.

1.03 UTILITY CONNECTIONS

A. The CONTRACTOR will include all costs in its bid to contact utilities and make arrangements for and provide all utilities required for the project facilities. The foregoing shall include costs for any utility engineering, construction work that must be performed by utility forces including their facility extension costs, metering and other appurtenances, utility inspection and other fees and other costs associated with providing the utility service to the project facilities.

B. CONTRACTOR shall contact the Utilities listed on the General Drawings of the Contract Drawings to obtain service needed for the project facilities.

1.04 CONDITIONS OF COSTAL DEVELOPMENT APPROVAL PERTAINING TO CONTRACTOR

A. The CONTRACTOR shall conform to the conditions of the Coastal Development Permit (CDP) and provide measures required.

B. Condition 11. Fire Safety: Prior to occupancy or final inspection, whichever comes first, the CONTRACTOR shall assist the OWNER in obtaining final inspection approval of all required fire/life safety measures.

C. Condition 12. Portable Engines: Prior to initiating grading activities, if it is determined that portable engines and portable equipment will be used, the CONTRACTOR shall contact the SLOAPCD and obtain a permit to operate portable engines or portable equipment, and such engines or equipment shall be registered in the statewide portable equipment registration program. The SLOAPCD Compliance Division shall be contacted to determine the implementation requirements of this mitigation measure.

D. Condition 13. Encroachment Permit: see Paragraph 1.02B.1 of this Specification.

E. Condition 19. Erosion Control: Prior to commencement of grading activities, erosion control measures shall be incorporated into the grading plans to minimize the potential for erosion or loss of top soil during grading to the satisfaction of the Planning Director. Any erosion and sedimentation control netting or other erosion and sedimentation control devises used for temporary or permanent erosion and sedimentation control, shall be limited to biodegradable mesh or other biodegradable products

F. Condition 20. Erosion Control: Prior to commencement of grading activities, fiber roll and silt fence shall be provided on the top of graded cut and at the base of fill slopes to reduce the long-term potential for soil erosion or loss of topsoil to the satisfaction of the ENGINEER.

G. Condition 21. Erosion Control: Prior to commencement of grading activities, the CONTRACTOR shall provide for the control of surface water to prevent erosion or discharge of pollutants into storm drain systems or watercourses.

H. Condition 28. Cultural Resources: The CONTRACTOR is directed to Specification 01561 – Biological and Cultural Resource Environmental Controls.

I. Condition 32. Traffic Management Plan: The CONTRACTOR is directed to Specification Sections 01571 – Traffic Control.

J. Condition 35. Construction Activity Management Plan: Prior to commencement of grading activities, the OWNER will submit a Construction Activities Management Plan for the review and approval of the SLOAPCD. The CONTRACTOR shall assist the OWNER in preparation of this Plan. This plan shall include but not be limited to the following Best Available Control Technologies for construction equipment:
   1. Minimize the number of large pieces of construction equipment operating during any given period.
   2. Schedule construction related truck/equipment trips during non-peak hours to reduce peak-hour emissions and overall daily and quarterly emissions.
   3. Properly maintain and tune all construction equipment according to manufacturer’s specifications.
   4. Fuel all off-road and portable diesel powered equipment including but not limited to: bulldozers, graders, cranes, loaders, scrapers, backhoes, generators, compressors, auxiliary power units, with ARB certified motor vehicle diesel fuel.

5. All diesel construction equipment shall meet ARB's Tier 3 standard for off-road heavy-duty diesel engines.
6. All on-road heavy-duty trucks shall meet the ARB's 2007 or newer certification standard for on-road heavy-duty diesel engines.
7. All on and off-road diesel equipment shall not be allowed to idle for more than 5 minutes. Signs shall be posted in the designated queuing areas and or job sites to remind drivers and operators of the 5-minute idling limit.
8. Electrify portable equipment where possible throughout the Site.
9. All diesel powered portable equipment used shall have tier 2 or tier 3 engines and retrofitted with an ARB level 3 verified diesel emissions control strategy (VEDEC).
10. Locate construction staging areas at least 1000 feet from sensitive receptors.

K. Condition 36. Construction Activity Management Plan: The Construction Activity Management Plan (CAMP) should include but not be limited to the following elements:
   1. Schedule construction truck trips during non-peak hours to reduce peak hour emissions.
   2. Limit the length of the construction workday period, if necessary.
   3. Phase construction activities to minimize overlapping emissions.
   4. Construction Equipment composition and schedule including:
      a. Equipment Type
      b. Equipment Model
      c. Equipment Year
      d. Engine Type
      e. Engine Model
      f. Engine Year
      g. Engine Horsepower
      h. Schedule of use

L. CONTRACTOR to provide OWNER with quarterly equipment usage logs/worker travel trips to be used in calculating project emissions.

M. Condition 48. CAL-OSHA Standards: All CONTRACTORs shall comply with relevant provisions of CAL-OSHA CAC Title 8 regarding the provision of safety and rescue equipment, to the satisfaction of the County Department of Public Works in consultation with the Planning Director.

N. Not Used.

O. Not Used.

P. Not Used.

Q. Not Used.

R. Not Used.

S. Condition 68. Worker Education Program: The CONTRACTOR is directed to Specification 01561 – Biological and Cultural Resource Environmental Controls.

T. Condition 69. Nesting Bird Survey: The CONTRACTOR is directed to Specification 01561 – Biological and Cultural Resource Environmental Controls.

U. Condition 70. Nesting Raptor Survey: The CONTRACTOR is directed to Specification 01561 – Biological and Cultural Resource Environmental Controls.

V. Condition 73. Discovery of Human Remains: The CONTRACTOR is directed to Specification 01561 – Biological and Cultural Resource Environmental Controls.

W. Condition 74. Paleontological Resources: Although unlikely, should any vertebrate fossils or potentially significant finds (e.g., numerous well-preserved invertebrate or plant fossils) be encountered by anyone working on the site, all activities in the immediate vicinity of the find are to cease until a qualified paleontologist evaluates the find for its scientific value. If deemed significant, the paleontological resource(s) shall be salvaged and deposited in an accredited and permanent scientific institution where they will be properly curated and preserved for the benefit of current and future generations.

X. Not Used.

Y. Condition 76. Dust Control: The CONTRACTOR shall comply with Section 01562 – Dust Control.

Z. Condition 78. Noise Abatement Requirements: The CONTRACTOR shall adhere to the following noise attenuation requirements:
   1. A construction noise control plan shall be developed for the project that identifies the nature and timing of operations designed to minimize noise exposure to noise sensitive receptors including natural resource areas.
   2. Generally, construction activities shall be limited to between the hours of 7 a.m. to 9 p.m. on any day except Saturday or Sunday or between the hours of 8 a.m. to 5 p.m. on Saturday or Sunday.
   3. Not Used.
   4. All construction equipment shall use noise-reduction features (e.g., mufflers and engine shrouds) that are no less effective than those originally installed by the manufacturer.
   5. The noise produced by construction activities shall be monitored to insure that the noise produced by construction equipment is compliant with the emission standards listed in the project EIR (page 5.10-4 and in source document, FHWA Construction Noise Model, page 3).
   6. Measures to minimize back-up alarm issues shall be established including such techniques as:
      a. Use of self-adjusting ambient sensitive backup alarms.
      b. Manual adjustable alarms on lower settings.
      c. Use of observers.
      d. Scheduling of activities so that alarm noise is minimized.
      e. Construction site access designed such that deliveries and trucks move through the site in a forward manner without the need to back up.
   7. Construction staging and heavy equipment maintenance activities shall be performed a minimum distance of 300 feet from the nearest residence, unless safety or technical factors take precedence.
   8. Stationary combustion equipment such as pumps or generators operating near any noise sensitive receptor shall, if necessary, be shielded with a noise protection barrier. Leq values at the property line of receiver locations shall not exceed 65 dB.

AA. Not Used.

BB. Condition 81, Invasive Plants: The CONTRACTOR is directed to Specification 01561 – Biological and Cultural Resource Environmental Controls.

CC. Not Used.

DD. Not Used.

EE. Coastal Condition 1l. Approved Development – Construction: All areas within which construction staging are to take place shall be minimized to the maximum extent feasible in order to minimize impacts on resources (e.g., terrestrial habitat, wetlands, creeks, riparian areas, or other sensitive resource areas, etc.). All measures to be taken to minimize impacts associated with construction staging and related areas shall be identified, including but not limited to screening, fencing (see Part 2 of this Specification), landscaping, signage, and designation of various activity and storage areas on the site. If additional construction staging and related areas are needed following award of the Work, such areas shall be identified in a plan and submitted for Executive Director review and approval. Copies of the signed Coastal Development Permit (CDP) shall be maintained in a conspicuous location at the construction staging area at all times, and that such copies be available for public review on request. All persons involved with the construction shall be briefed on the content and meaning of the CDP, and the public review requirements applicable to them, prior to commencement of construction. A primary construction coordinator shall be designated by the CONTRACTOR for public inquiries regarding the construction, and that their contact information (i.e., address, phone numbers, etc.) including, at a minimum, a telephone number available 24 hours a day for the duration of construction, be conspicuously posted at the construction staging area and at individual construction sites where such contact information is readily visible from public viewing areas, along with indication that the construction coordinator should be contacted in the case of questions regarding the construction (in case of both regular inquiries and emergencies). The construction coordinator shall record the name, phone number, and nature of all complaints received regarding the construction, and shall investigate complaints and take remedial action, if necessary, within 24 hours of receipt of the complaint or inquiry.

1.05 SURFACE MINE AND RECLAMATION ACT

A. Imported borrow or aggregate material must come from a surface mine permitted under the Surface Mining and Reclamation Act of 1975 (SMARA), Pub Res Code § 2710, et seq., or from an exempt site.

B. The Department of Conservation, Office of Mine Reclamation maintains a list of permitted mine sites. For the list of permitted sites, go to:

http://www.conservation.ca.gov/omr/ab_3098_list

C. If CONTRACTOR uses import borrow or aggregate material from a surface mine not on this list, CONTRACTOR shall submit proof the mine is exempt from SMARA to Engineer.

1.06 SOLID WASTE DISPOSAL AND RECYCLING

A. For the purpose of complying with San Luis Obispo County Code, Title 8, Health and Sanitation, Chapter 8.12, “Solid Waste Management,” CONTRACTOR shall recycle at least 50% of the construction and demolition waste generated by the Project.

B. The following is a list of IWMA-Certified Recycling Facilities:
   1. C&D Recycling Facility at Cold Canyon Landfill 805-549-8332
   2. C&D Recycling Facility at Chicago Grade Landfill 805-466-2985
   3. North SLO County Recycling 805-434-0043
   4. API (roll-off/debris box company) 805-928-8689
   5. R&R (a roll-off/debris box company) 805-929-8000
   6. Recycling Facility at the Paso Robles Landfill 805-238-2028
   7. Santa Maria Transfer Station 805-922-9255
   8. Bedford Enterprises/SMART 805-922-4977

C. CONTRACTOR shall complete and sign the “RECYCLING PLAN” form in conformance with the provisions in Paragraph 2.05 of the General Conditions. This form must be submitted and approved by the ENGINEER prior to receiving the Notice to Proceed.

D. This form must show how at least 50 percent of the Project construction and demolition waste will be recycled. CONTRACTOR shall maintain receipts or other documentation for any facility or site that received waste from the Project.

E. CONTRACTOR shall submit a complete and accurate “DISPOSAL REPORT” form with original receipts and supporting documentation. This form must be submitted and approved prior to receiving the Notice of Completion.

F. If CONTRACTOR fails to submit the required information showing the 50-percent recycling goal was met, the OWNER could impose a penalty equal to 2 percent of the total Contract Price.

G. Full compensation for complying with these requirements shall be considered as included in the prices paid for the various items of work generating such construction and demolition waste and no additional compensation will be allowed therefor.

H. The copies of the “RECYCLING PLAN” and “DISPOSAL REPORT” forms are included at the end of this Specification Section.

PART 2 PRODUCTS

2.01 PROTECTIVE FENCING

A. Protective fencing is referred to as ESA fencing on the Drawings.

B. Protective fencing shall be 4 feet tall international orange high-density polyethylene resin, with 1-inch by 3-3/4-inch mesh openings to withstand a temperature service rating of -40 to 200 degrees Fahrenheit (e.g., Visi Barrier or equivalent). Protective fencing shall be at locations as indicated on the Drawings. Metal T-posts should be

placed at maximum of 20 feet on center and fencing should be secured to the posts for the entire construction period, according to the manufacturer's specifications.

PART 3 EXECUTION

Not Used

END OF SECTION

RECYCLING PLAN FOR COUNTY PROJECTS

SECTION 1. PROJECT INFORMATION

Contract Title	Contractor Name	
	Contractor Phone	Contractor Fax
Contract Number	Street Address	
Total Contract Amount	City, State, Zip	
Print Name and Title	Signature	Date

SECTION 2. RECYCLING PLAN

	Before Construction (estimated tons)				
	Landfill	Recycling Facility		Reuse	
Materials	(Tons)	(Tons)	Location	(Tons)	Location
Cleared Vegetation					
Asphalt Concrete					
Concrete					
Metals (including spent equipment)					
Lumber					
Drywall					
Mixed Recyclables					
Trash					
Totals					
% Diversion					

Official Use Only

Recycling Plan Approved ☐	Recycling Plan Denied ☐
Information Required:	
Print Name and Title	Signature / Date

DISPOSAL REPORT FOR COUNTY PROJECTS

SECTION 1. PROJECT INFORMATION		
Contract Title	Contractor Name	
	Contractor Phone	Contractor Fax
Contract Number	Street Address	
Total Contract Amount	City, State, Zip	

Contractor Certification: I certify under penalty of perjury that the information provided in this form is complete and accurate.

Print Name and Title	Signature	Date

SECTION 2. DISPOSAL REPORT

	After Construction (actual tons)				
	Landfill	Recycling Facility		Reuse	
Materials	(Tons)	(Tons)	Location	(Tons)	Location
Cleared Vegetation					
Asphalt Concrete					
Concrete					
Metals (including spent equipment)					
Lumber					
Drywall					
Mixed Recyclables					
Trash					
Totals					
% Diversion					

I have reviewed and approved the information submitted in this report for completeness

Resident Engineer's Name:	Signature:	Date:

Official Use Only

Disposal Report Approved ☐	Disposal Report Denied ☐

Information Required

Print Name and Title	Signature	Date

SECTION 01101

SAFETY, HEALTH AND EMERGENCY RESPONSE

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Site specific health and safety procedures including a detailed accident prevention plan are required. These procedures shall be described in a Safety, Health, and Emergency Response Plan (SHERP) prepared by the CONTRACTOR. The SHERP shall be submitted to the ENGINEER and be reviewed and approved by the ENGINEER and OWNER before any WORK at the site can be initiated. Implement, maintain, and enforce the SHERP procedures at the appropriate time prior to and during all phases of the WORK.

B. Utilize the services of a health and safety professional designated the Health and Safety Manager (HSM) to develop and implement the SHERP, conduct initial site-specific training and provide support for all health and safety activities as needed, including the upgrading or downgrading of the level of personnel protection.
   1. In addition, a Site Safety and Health Officer (SSHO) shall assist and represent the HSM in the continued implementation and enforcement of the SHERP. The SSHO shall be assigned to the site on a full time basis and shall be either the CONTRACTOR's employee or a subcontractor who reports to the CONTRACTOR and the HSM in matters pertaining to site safety and health.

C. The following definitions shall be used throughout this Safety, Health, and Emergency Response Plan.
   1. Health and Safety Manager (HSM): The CONTRACTOR's employee assigned to develop the SHERP and assume full responsibility for the CONTRACTOR's health and safety program.
   2. Site Safety and Health Officer (SSHO): The CONTRACTOR's employee assigned to the site on a full-time basis for the duration of the project with functional responsibility for implementation of the SHERP.
   3. Site: For the purpose of the SHERP, the site shall be the area within the limits of work as shown on the Drawings.
   4. Physician: A licensed physician provided by the CONTRACTOR with experience in the practice of occupational medicine.

1.02 REGULATORY REQUIREMENTS AND APPLICABLE PUBLICATIONS

A. The site specific SHERP shall be consistent with the requirements of:
   1. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in Title 29, Code of Federal Regulations, Parts 1910 and 1926 (29 CFR 1910 and 1926). Revised July 1, 2009.
   2. United States Environmental Protection Agency (USEPA) Standard Operating Procedures. Revised November, 2007.
   3. Corps of Engineers Accident Prevention and Safety and Health Requirements Manual, EM 385-1-1. Revised July, 2011.
   4. Cal-OSHA Title 8, Subchapter 4 Requirements for Trench Shoring Systems. Dated July, 2001.

B. The SHERP shall include but not necessarily be limited to, the following components as required by OSHA 29 CFR 1910.120(i)(2):
   1. Names of key personnel and alternates responsible for site safety and health (responsibilities and chain of command).
   2. Safety and health hazard assessment and risk analysis for each site task and operation (Accident Prevention Plan).
   3. Site Description and Evaluation.
   4. Education and Training.
   5. Personnel Protective Equipment.
   6. Medical Surveillance.
   7. Air Monitoring.
   8. Standard Operating Procedures, Engineering Controls, and Work Practices.
   9. Site Control Measures (Work Zones, Communications, and Security).
   10. Personnel Hygiene and Decontamination.
   11. Equipment Decontamination and Record Keeping.
   12. Emergency Equipment and First Aid Requirements.
   13. Emergency Response Plan and Contingency Procedures.
   14. Heat/Cold Stress Monitoring.
   15. Logs, Reports, and Record Keeping.

C. Six copies of the site specific SHERP shall be submitted to the ENGINEER within 7 days following the Notice to Proceed and must be approved prior to commencement of any on-site work.

D. Determination of the appropriate level of worker safety equipment and procedures shall be made by the CONTRACTOR as a result of initial site survey review of existing data and a continued safety and health-monitoring program performed by the SSHO and approved by the ENGINEER, in accordance with the requirements specified herein. Existing data indicate that all work can be performed in Level D with contingency procedures to move to Level C protection.

E. Standards delineated in this Section are in addition to or an amplification of procedures and requirements of the above referenced regulations and documents.

F. Should any unforeseen or site specific safety related factor, hazard, or condition become evident during the performance of work at this site, it shall be the CONTRACTOR's responsibility to bring such to the attention of the ENGINEER both verbally and in writing as quickly as possible, for resolution. In the interim, the CONTRACTOR shall take prudent action to establish and maintain safe working conditions and to safeguard employees, the public and the environment.

G. Should the CONTRACTOR seek relief from, or substitution for, any portion or provision of the SHERP, such relief or substitution shall be requested of the ENGINEER in writing and if approved, be authorized in writing.

1.03 SITE CONTROL

A. Communications:
   1. Provide portable two-way radio or portable vehicle telephone communication at the site and emergency numbers, including police, fire, ambulance, hospital, and OWNER, shall be prominently posted near the radio or telephone.

1.04 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

A. Develop contingency plans including evacuation procedures and routes to places of refuge or safe distances from the danger area, for the following potential emergencies: chemical exposure, personal injury, potential or actual fire or explosion, or environmental accident (spill or release).

B. Emergency medical care services shall be prearranged at a nearby medical facility with established emergency routes. The staff at the facility shall be advised of the potential medical emergencies that might result.

C. Establish emergency communications with health and emergency services. The name of this facility, name of contact, emergency routes, and emergency communications arrangements shall be provided in the SHERP. In addition, the CONTRACTOR shall provide the following equipment:
   1. At least one first aid kit shall be provided and maintained fully stocked at a first aid station that is in close proximity to the work, but not inside a hazardous work area. First aid kit locations shall be specially marked and provided with adequate water and other supplies necessary to cleanse and decontaminate burns, wounds, or lesions.
   2. Have at least one certified First Aid Technician on the site at any time there is work being performed. This person may perform other duties, but must be immediately available to render first aid when needed. Certification shall be by the American Red Cross or other approved agency and shall be submitted to the ENGINEER.
   3. 2A-10 B:C type dry chemical fire extinguishers shall be provided at the CONTRACTOR's field office(s).

1.05 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

A. Develop an emergency response and contingency plan for on-site and off-site emergencies, as specified in OSHA 29 CFR 1910.120(l), which shall address at a minimum:
   1. Pre-emergency planning.
   2. Personnel roles, lines of authority, training, and communication.
   3. Emergency recognition and prevention.
   4. Safe distances and places of refuge.
   5. Site security and control.
   6. Evacuation routes and procedures.
   7. Decontamination.
   8. Emergency medical treatment and first aid.
   9. Emergency alerting and response procedures.
   10. Critique of response and follow-up.
   11. Personal Protection Equipment (PPE) and emergency equipment.

B. In the event of any emergency associated with Response Action, without delay: take diligent action to remove or otherwise minimize the cause of the emergency; alert the ENGINEER and institute whatever measures might be necessary to prevent any repetition of the conditions or actions leading to, or resulting in, the emergency.

C. Emergency medical care services shall be prearranged at a nearby medical facility with established emergency routes.

D. Establish emergency communications with health and emergency services. The name of this facility, name of contact, emergency routes, and emergency communications arrangements shall be posted at the site. The posted list shall include the following minimum points:
   1. CONTRACTOR physician name, address and telephone number.
   2. Ambulance service and fire department telephone numbers.

E. In the event that an accident for some other safety related incident occurs during the course of the project, the OWNER shall be telephoned immediately and receive a written notification within 24 hours. The report shall include the following items:
   1. Name, organization, telephone number, and location of the CONTRACTOR.
   2. Name and title of the person(s) reporting.
   3. Date and time of accident/incident.
   4. Location of accident/incident, including site location and facility name.
   5. Brief summary of accident/incident giving pertinent details including type of operation ongoing at time of accident.
   6. Cause of accident/incident, if known.
   7. Casualties (fatalities, disabling injuries).
   8. Details of any existing chemical hazard or contamination.
   9. Estimated property damage, if applicable.
   10. Nature of damage; effect on contract schedule.
   11. Action taken by CONTRACTOR to ensure safety and security.
   12. Other damage or injuries sustained (public or private).

1.06 PERSONAL PROTECTIVE EQUIPMENT

A. Provide all on-site personnel with appropriate personal safety equipment and protective clothing, and ensure that all safety equipment and protective clothing is kept clean and well maintained. The CONTRACTOR's HSM shall establish upgrade/downgrade "action levels" from the specified minimum levels of protection based upon air monitoring results and direct contact potential. Protocols formally changing the level of protection and the communication network for doing so shall be described in the SHERP. Any changes to the minimum level of protection shall be approved by the SSHO and the ENGINEER. At a minimum, the following items shall be provided:
   1. Protective clothing shall be furnished for on-site personnel, consisting of:
      a. Level D: use as appropriate.
         1) Coveralls*
         2) Gloves*
         3) Safety vest.
         4) Boots/shoes, chemical-resistant steel toe and shank
         5) Boots, outer, chemical-resistant (disposable)*
         6) Safety glasses or chemical splash goggles*
         7) Hard hat
         8) Escape mask*
         9) Face shield*

         *Optional as applicable.
   2. Footwear used on site shall be steel-toed, steel shank safety shoes or boots, with chemical resistant soles.
   3. All on-site personnel shall wear a hard hat.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01110

DISPUTES REVIEW BOARD

PART 1 GENERAL

1.01 SUMMARY

A. A Disputes Review Board (DRB) shall be established to assist in the resolution of disputes, claims, and other controversies in connection with, or arising out of performance of the Work of this Contract.

B. This Section describes the purpose, procedure, function, and key features of the DRB. Appended to this specification is a Three Party Agreement to be used for formalizing the creation of the DRB.

C. The DRB will assist in and facilitate the timely and equitable resolution of disputes between the OWNER and the CONTRACTOR, in an effort to avoid construction delay and litigation.

D. It is not intended for the OWNER or the CONTRACTOR to default on their normal responsibility to amicably and fairly settle their differences by indiscriminately referring them to the DRB. It is intended that the DRB encourage the OWNER and CONTRACTOR to resolve potential disputes without resorting to this review procedure.

E. The DRB process described in this Section does not relieve the CONTRACTOR's obligations for the timely adherence to the requirements of Article 10 of the General Conditions for the filing of Claims. This DRB process is established to assist in the resolution of dispute before or during a Claim process.

F. Either the OWNER or the CONTRACTOR may refer a dispute to the DRB. Referral to the DRB should be initiated as soon as it is apparent that the dispute resolution efforts of the General Conditions are not succeeding and prior to initiating other dispute resolution procedures or filing of litigation by either party. If a dispute is submitted for an ENGINEER’s Final Determination and also to the DRB, the ENGINEER’s decision on the matter shall not be rendered until the DRB’s written recommendation has been submitted.

G. The DRB shall impartially and promptly consider disputes referred to it, and shall provide written recommendations to the OWNER and the CONTRACTOR, to assist in the resolution of these disputes.

H. Although the recommendations of the DRB should carry great weight for both the OWNER and the CONTRACTOR, the recommendations are not binding on either party.

1.02 CONTINUANCE OF WORK DURING DISPUTES

A. At all times during the course of the dispute resolution process, diligently continue with the Work as directed, without delay, conforming to the OWNER's decision or order, and all applicable provisions of the Contract.

1.03 MEMBERSHIP

A. General: The DRB will consist of one member selected by the OWNER and approved by the CONTRACTOR, one member selected by the CONTRACTOR and approved by the OWNER, and a third member selected by the first two members and approved by both the OWNER and the CONTRACTOR. The third member shall act as Chairman.

B. Experience: It is desirable that all Board members be experienced with wastewater plant construction, interpretation of Contract Documents, and resolution of construction disputes. The goal in selecting the third member is to complement the experience of the first two and to provide leadership for the DRB's activities.

C. Neutral and Impartial: DRB members shall be neutral, act impartially, and not have any conflict of interest.

D. Criteria for Membership: For purposes of this Section, the term "member" also includes the member's current primary or full-time employer, and "involved" means having a contractual relationship with the OWNER or CONTRACTOR at any tier. The criteria and limitations for membership are:
   1. No member shall have an Ownership interest in any Party involved in the Construction Contract, or a financial interest in the Contract, except for payment for services on the DRB.
   2. Except for fee-based consulting services on other projects, no member shall have been previously employed by, or have had financial ties to, any Party involved in the Construction Contract within a period of 30 years prior to award of the Contract.
   3. No member shall have had a close professional or personal relationship with any key member of any party involved in the Construction Contract that, in the judgment of either party, could suggest partiality.
   4. No member shall have had prior involvement in the project, of a nature that could compromise his ability to participate impartially in the DRB's activities.
   5. During his tenure on the DRB, no member shall be employed, including fee-based consulting services, by any party involved in the Construction Contract except with the express approval of both parties.
   6. During his tenure on the DRB, no member shall engage in a discussion or make an agreement with any party involved in the Construction Contract regarding employment after the Contract is completed.
   7. All members shall be fluent in English, and be able to prepare their recommendations in English.

E. Availability: Prompt resolution of disputes is a priority. DRB members shall be able to complete their review of information, deliberations, and preparation of recommendations within the timeframes indicated herein. DRB members shall be prepared to comply with these requirements as a condition of their assignment to the DRB.

F. Disclosure Statement: Before their appointments are final, the first two prospective members shall submit complete disclosure statements for the approval of both the OWNER and the CONTRACTOR. Each statement shall include a resume of experience, together with a declaration describing all past, present and anticipated or planned future relationships, including indirect relationships through the prospective member's primary or full-time employer, to this project and with all parties involved in the Construction Contract. Disclosure of close professional or personal relationships with all key members of all parties to the Contract shall be included. The third DRB member shall supply such a statement to the first two DRB members and to the OWNER and CONTRACTOR before his or her appointment is final.

G. Nomination and Approval of First Two Members: The OWNER and the CONTRACTOR shall each nominate a proposed DRB member and convey the nominee's name and reference information to the other party within three weeks after Award of the Contract. If the nominee is not rejected within two weeks after receipt of the name and information, he shall be deemed approved.

H. Nomination and Approval of Third Member:
   1. Immediately after approval, the OWNER and CONTRACTOR will notify their members to begin selection of the third member. The first two members shall ensure that the third member meets all of the criteria listed above. The third member shall be selected within three weeks after the first two members are notified to proceed with his selection.
   2. In the event of an impasse in selection of the third member, that member shall be selected by mutual agreement of the OWNER and the CONTRACTOR. In so doing, they may, but are not required to, consider nominees offered by the first two members.

I. Execution of the Three Party Agreement: The OWNER, the CONTRACTOR, and all three members of the DRB shall execute the Three Party Agreement within four weeks after the selection and approval of the third member.

1.04 OPERATION

A. General:
   1. The DRB shall formulate its own operating procedures. It is not desirable to adopt hard and fast rules for the functioning of the DRB. The entire procedure shall be kept flexible to adapt to changing situations. The DRB shall initiate, with the OWNER's and CONTRACTOR's concurrence, new procedures or modifications to old ones, whenever this is deemed appropriate.
   2. Neither party shall solicit any DRB member's advice or consultation on matters concerning the conduct of the work.

B. Reports to DRB: The members will be kept informed of construction activity and other developments by means of regular weekly progress reports, minutes of progress meetings, and other relevant information prepared by the OWNER and the CONTRACTOR.

C. Regular Visits by DRB: The DRB shall visit the project site and meet with representatives of the OWNER and the CONTRACTOR at regular intervals not exceeding once every three months, and maximum of 3 site visits. The first site visit will be during the mass grading required for the REW pond excavation. The second

site visit will be approximately at the midpoint of the overall construction. The third site visit will be at the beginning of the LOWRF start-up. The first site visit will be scheduled as agreed among the OWNER, the CONTRACTOR, and the DRB. Subsequent visits will be scheduled only if the OWNER and the CONTRACTOR mutually agree on the need for subsequent visits and then will be scheduled as agreed among the OWNER, the CONTRACTOR, and the DRB.

D. Regular Meetings with DRB: The regular meetings shall be held at the job site in conjunction with the regular visits. Each meeting shall consist of an informal round table discussion followed by field observation of the Work. The field observations shall cover all active segments of the tunnel Work. The DRB shall be accompanied by representatives of both the OWNER and CONTRACTOR. The round table discussion shall be attended by selected personnel from the OWNER and the CONTRACTOR. The regular meeting agenda shall generally include the following:
   1. Meeting convened by the DRB Chairman.
   2. Opening remarks by the OWNER's representative.
   3. A description by the CONTRACTOR of:
      a. Work accomplished since the last meeting;
      b. Current status of the work schedule;
      c. Schedule for future work;
      d. Potential or anticipated problems and proposed solutions; and
      e. Current and potential disputes, claims, and other controversies.
   4. Discussion by the OWNER's representative of:
      a. The work schedule as he views it;
      b. Potential disputes, claims and other controversies; and
      c. Status of past disputes, claims and other controversies.
   5. Such other items as the parties may wish to discuss with the DRB.
   6. Set tentative date for next meeting(s).

1.05 PROCEDURE AND SCHEDULE FOR DISPUTE RESOLUTION

A. Disputes shall be considered as quickly as possible, taking into consideration the particular circumstances and the time required to prepare appropriate documentation. Steps may be omitted, as agreed by both parties, and the time periods stated below may be shortened in order to hasten resolution.
   1. By written request for review, either the OWNER or CONTRACTOR may request that the DRB review any disputes, claims and other controversies in connection with, or arising out of performance of the Work, which the parties have considered, but have been unable to resolve.
   2. Simultaneous with submittal to the DRB, a copy of the request for review shall be provided to the other party. The request for review shall state clearly and in full detail the specific issues of the dispute to be considered by the DRB.
   3. When a dispute is submitted to the DRB, it may be heard at the next regular DRB meeting or at a special meeting, as agreed by both Parties. For an urgent matter, the DRB shall meet within two weeks of notification.
   4. During the hearing, the CONTRACTOR and the OWNER shall each have ample opportunity to be heard and to offer evidence. Detailed procedures are given in Paragraph 1.06. The DRB's recommendations for resolution of the dispute will be given in writing, to both the OWNER and the CONTRACTOR, within 2 weeks of completion of the hearings. In difficult or complex cases, and in consideration of the DRB's schedule, this time may be extended by mutual agreement of all parties.

5. If requested by either party, the DRB shall provide oral or written clarification of its recommendation.
6. Within two weeks of receiving the DRB's recommendations, or such other time specified by the DRB, both the OWNER and the CONTRACTOR shall respond to the other and to the DRB in writing, signifying either acceptance or rejection of the DRB's recommendations. The failure of either party to respond within the specified period shall be deemed an acceptance of the DRB's recommendations. If, with the aid of the DRB's recommendations, the OWNER and the CONTRACTOR are able to resolve their dispute, the OWNER will promptly process any required Contract changes.
7. Should the dispute remain unresolved, either party may request that the DRB clarify its recommendation or, if new evidence has become available, reconsider its recommendation.

B. Although both the OWNER and the CONTRACTOR should place great weight on the DRB's recommendations, they are not binding. If the DRB's recommendations do not resolve the dispute, the written recommendations, including any minority report, will be admissible as evidence in any subsequent dispute resolution proceeding.

1.06 CONDUCT OF HEARING

A. Prehearing Submittals: Written position statements shall be submitted to each DRB member before the hearing begins. The DRB may also request a presentation of factual documentation, prepared jointly by the parties.

B. Location: Normally the hearing will be conducted at the job site. However, any location that would be more convenient and still provide all required facilities and access to necessary documentation is satisfactory. Private sessions of the DRB may be held at any convenient location.

C. Proceedings: The third member of the DRB will act as Chairman of the hearing, or he may appoint one of the other members. A formal transcript will not be prepared. In special cases, when requested by either party, the DRB may allow preparation of a transcript by a Court Reporter. Audio or video recordings will not be permitted.

D. Participants:
1. The OWNER and the CONTRACTOR shall have representatives at all hearings. The Party requesting DRB review will first present its position, followed by the other party. Each party will then be allowed successive rebuttals until all aspects are fully covered. The DRB members may ask questions, request clarification, or ask for additional data. In difficult or complex cases, additional hearings may be necessary in order to consider and fully understand all the evidence presented by both parties. Both the OWNER and CONTRACTOR shall be provided full and adequate opportunity to present all of their evidence, documentation, and testimony regarding all issues before the DRB.
2. Attendance by, or participation of, lawyers is prohibited.
3. During the hearing, no DRB member shall express any opinion concerning the merit of any facet of the case.

E. DRB Deliberations:

1. After the hearing is concluded, the DRB shall meet to formulate its recommendations. All DRB deliberations shall be conducted in private, with all individual views kept strictly confidential. The DRB's recommendations, together with explanations of its reasoning, shall be submitted as a written report to both parties. The recommendations shall be based on the pertinent provisions of the Contract, applicable laws and regulations, and the facts and circumstances involved in the dispute. It is important for the DRB to clearly and completely express the logic and reasoning leading to the recommendations, so that both parties fully understand it.
2. The DRB shall be permitted to consult with independent legal counsel when deliberating and drafting their decision.
3. The DRB shall make every effort to reach a unanimous recommendation. If this proves impossible, the dissenting member may prepare a minority report.

1.07 COMPENSATION AND LOGISTIC SUPPORT

A. Fees and expenses of all three members of the DRB shall be shared equally by the OWNER and the CONTRACTOR. The OWNER will mail progress reports, will provide administrative services, such as conference facilities and secretarial services, and will bear the cost of these services. If the DRB desires special services, such as legal or other consultation, accounting, data research, and the like, both parties must agree, and the costs will be shared by them as mutually agreed.

B. The CONTRACTOR shall pay the invoices of all DRB members after approval by both parties. The CONTRACTOR will then bill the OWNER for 50 percent of such invoices.

END OF SECTION

DISPUTE REVIEW BOARD THREE PARTY AGREEMENT
(To Be Executed After the Award of the Construction Contract)

THIS THREE PARTY AGREEMENT (Agreement), made and entered into this_____ day of _____ 20_____, between:(OWNER) _____, hereinafter called the "OWNER," acting through the ENGINEER, and (CONTRACTOR) _____,hereinafter called the "CONTRACTOR", and the Dispute Review Board, hereinafter called the "Board", and consisting of three members,_____,_____ ____,

_____.

WITNESSETH, that

WHEREAS, the OWNER is now engaged in the construction of the Los Osos Water Recycling Facility; and

WHEREAS, the Los Osos Water Recycling Facility Project Contract (CONTRACT) provides for the establishment and operation of a Board to assist in resolving disputes, claims and other controversies relating to the Work; and

WHEREAS, the Board is composed of three members, one selected by the OWNER, one selected by the CONTRACTOR, and the third member selected by these two;

NOW THEREFORE, in consideration of the terms, conditions, covenants, and agreements contained herein, or attached and incorporated and made a part hereof, the parties hereto agree as follows:

DESCRIPTION OF WORK

In order to assist in the resolution of disputes, claims and other controversies between the OWNER and the CONTRACTOR, the OWNER has provided, in the Contract, for the establishment of a Dispute Review Board. The intent of the Board is to fairly and impartially consider the disputes referred to it, and to provide written recommendations to the OWNER and CONTRACTOR for resolution of these disputes. The members of this Board shall perform the services necessary to participate on this Board in accordance with the Scope of Work.

The Board is organized to recommend resolution of disputes, claims and all other controversies between the OWNER and the CONTRACTOR, arising from or related to the Construction Contract.

SCOPE OF WORK

The Scope of Work of the Board includes, but is not limited to, the following:

A. Project Site Visits:

The Board members shall visit the project site to keep abreast of construction activities and to become familiar with the Work in progress. The frequency, time, and duration of these visits shall be mutually agreed upon among the Board, the OWNER and the CONTRACTOR. In case of failure to agree, the Board shall schedule the visits.

In the case of an actual or potential dispute involving an alleged differing site condition or specific construction problem, it may be advantageous for the Board to personally view any relevant conditions. If viewing by the Board would cause delay to the project, videos, photographs, and descriptions of these conditions, collected by either or both parties will be utilized.

B. Establish Procedures

During its first meeting at the project site, the Board shall, with the agreement of all parties, establish procedures for the conduct of its routine site visits and its hearings of disputes. The conduct of its business shall, in general, be based on the specification provisions.

C. Recommend Resolution of Disputes

Upon receipt by the Board of a written Request for Review of a dispute, either from the OWNER or the CONTRACTOR, the Board shall convene a hearing to review and consider the dispute.

It is expressly understood that all Board members are to act impartially and independently in the consideration of facts and conditions surrounding any dispute, and that the recommendations concerning any such dispute are advisory and not binding, unless agreed otherwise by the OWNER and the CONTRACTOR.

The Board recommendations shall be based on the applicable provisions of the Contract Documents, and the facts and circumstances involved in the dispute as conveyed by the testimony and evidence presented by the parties. The recommendations shall be furnished in writing to the OWNER and the CONTRACTOR.

D. Member Replacement

Should the need arise to appoint a replacement Board member, the replacement member shall be appointed in the same manner as the original member was appointed. The selection of a replacement Board member shall begin promptly upon notification of the necessity for a replacement and shall be completed within 4 weeks. This Agreement will be amended to indicate changes in Board membership.

BOARD RESPONSIBILITIES

The Board members shall become familiar with the Contract Documents, review periodic reports, and maintain a current file.

Prior to receiving a request for review, the Board will encourage the resolution of differences at the job level.

Except for providing the services required in the Agreement, the Board and its individual members shall refrain from giving any advice to either party concerning conduct of the Work or the resolution of problems, which might compromise the Board's integrity.

CONTRACTOR RESPONSIBILITIES

Except for its participation in the Board's activities as provided in the Contract Documents and in this Agreement, the CONTRACTOR shall not solicit advice or consultation from the Board or its members on matters dealing with the conduct of the Work or resolution of problems, which might compromise the Board's integrity.

The CONTRACTOR shall furnish to each Board member one copy of all documents it has, other than those furnished by the OWNER, which are pertinent to the performance of the Board.

OWNER RESPONSIBILITIES

Except for its participation in the Board's activities as provided in the Contract Documents and in this Agreement, the OWNER shall not solicit advice or consultation from the Board or its members on matters dealing with the conduct of the Work or resolution of problems, which might compromise the Board's integrity.

The OWNER shall furnish the following:

Contract Related Documents

The OWNER shall furnish each Board member one copy of all Contract Documents, including, but not limited to, the Specifications, Drawings, Geotechnical Report, addenda, progress schedule and updates, weekly progress reports, minutes of progress meetings, change orders, and other documents pertinent to the performance of the Contract, and necessary to the Board's work.

Coordination

The OWNER will, in cooperation with the CONTRACTOR, coordinate the operations of the Board.

Services

The OWNER will arrange for or provide conference facilities at or near the site, and provide secretarial and copying services.

TIME FOR BEGINNING AND COMPLETION

The Board shall be active throughout the duration of the Construction Contract. It shall begin operation upon written authorization of the OWNER following execution of this Agreement, and shall terminate its activities on completion or termination of the Construction Contract.

Except for choosing a third member by the first two members, the Board members shall not begin any work under the terms of this Agreement until authorized in writing by the OWNER.

PAYMENT

Invoices of the Board members shall be paid by the CONTRACTOR. Payments shall constitute full compensation for work performed and services rendered, and for all materials, supplies, and incidentals necessary to serve on the Board.

Payment for Services and Expenses

Payment for services of the OWNER-appointed and CONTRACTOR-appointed members of the Board will be at the rates agreed to between the OWNER and the CONTRACTOR and their respective appointed Board members. Changes in the billing rates are subject to agreement between the OWNER and the CONTRACTOR and their respective appointed members.

Payment for services rendered by the third member of the Board will be paid at the rate agreed to between the OWNER, the CONTRACTOR, and the third member. Changes in the billing rate are subject to agreement between the OWNER, the CONTRACTOR, and the third member.

The first two members will be reimbursed for the time and expense associated with choosing the third member.

Direct, non-salary expenses will be reimbursed at the actual cost to the Board member. These expenses may include, but are not limited to, automobile mileage, parking, travel expenses from the Board member's point-of-departure to the initial point-of-arrival, automobile rental, food and lodging, printing, long distance telephone, postage, and courier delivery. Air travel will be reimbursed for Coach class. Billing for these expenses shall include an itemized listing supported by copies of the original bills, invoices, and expense accounts.

Payments

Each Board member may submit invoices for payment for work completed not more often than once per month during the progress of Work. Such invoices shall be in a format approved by the OWNER and CONTRACTOR, and accompanied by a general description of activities performed during that period. The value of work accomplished for

payment shall be established from the billing rate and hours expended by the Board member together with direct, non-salary expenses. Satisfactorily submitted invoices shall be paid within 30 days.

The CONTRACTOR shall pay the invoices of all Board members after approval of both Parties. The CONTRACTOR will then bill the OWNER for 50 percent of such invoices.

Inspection of Cost Records

The cost records and accounts pertaining to this Agreement shall be kept available for inspection by representatives of the OWNER or CONTRACTOR for 3 years after final payment.

ASSIGNMENT

Board members shall not assign any of the Work of this Agreement.

TERMINATION OF AGREEMENT

This Agreement may be terminated by mutual agreement of the OWNER and the CONTRACTOR at any time upon not less than four weeks written notice to the other parties.

Board members may withdraw from the Board by providing four weeks written notice. Board members may be terminated for or without cause only by their original appointer; the OWNER may only terminate the OWNER-appointed member, the CONTRACTOR may only terminate the CONTRACTOR-appointed member, and the first two members or the OWNER and CONTRACTOR must agree to terminate the third member.

LEGAL RELATIONS

The parties hereto mutually understand and agree that each Board member, in the performance of his duties on the Board, is acting in the capacity of an independent agent and not as an employee of either the OWNER or the CONTRACTOR.

The OWNER and CONTRACTOR expressly acknowledge that each Board member is acting in a capacity intended to facilitate resolution of disputes. Accordingly, it is agreed and acknowledged that to the fullest extent permitted by law each Board member shall be accorded quasi-judicial immunity for any actions or decisions associated with the consideration, hearing, and recommendation of resolution for disputes rightfully referred to the Board.

Each Board member shall be held harmless for any personal or professional liability arising from or related to Board activities. To the fullest extent permitted by law, the OWNER and CONTRACTOR shall indemnify all Board members for claims, losses, demands, costs, and damages (including reasonable attorney fees) for bodily injury, property damage, or economic loss arising out of or related to Board members carrying out Board functions. The foregoing indemnity is a joint and several obligation.

DISPUTES REGARDING THIS THREE PARTY AGREEMENT

Any dispute among the parties hereto, arising out of the Work or other items of this Agreement, which cannot be resolved by negotiation and mutual concurrence between the parties, shall be referred to the _____ Court of the (jurisdiction) _____.

VENUE, APPLICABLE LAW, AND PERSONAL JURISDICTION

In the event that any party deems it necessary to institute legal action or proceedings to enforce any right or obligation under this Agreement, the parties hereto agree that any such action shall be initiated in the _____ Court of the (jurisdiction) _____. The parties hereby agree that all questions shall be resolved by application of (jurisdiction) _____ law and that the parties to such action shall have the right to appeal from such decisions of the _____ Court in accordance with the laws of the (jurisdiction) _____. The Board member hereby consents to the personal jurisdiction of the _____ Court of the (jurisdiction) _____.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first above written.

Board MEMBER Board MEMBER Board MEMBER

CONTRACTOR OWNER

By: _____ By: _____

Title: _____Title: _____

SECTION 01115

ESCROW BID DOCUMENTS

PART 1 GENERAL

1.01 GENERAL

A. The three low bidders shall submit, within two business days of the opening of bids, one copy of all documentary information generated in preparation of bid prices for this Contract. This material is hereinafter referred to as Escrow Bid Documents (EBDs). The Escrow Bid Documents of the successful bidder will be held in escrow for the duration of the Contract.

B. The successful bidder agrees, as a condition of award of the Contract, that the Escrow Bid Documents constitute all of the information used in preparation of his bid. No other bid preparation information shall be considered in resolving any disputes or claims.

C. Nothing in the Escrow Bid documents shall change or modify the terms or conditions of the Contract.

1.02 OWNERSHIP

A. The EBDs are and shall always remain the property of the CONTRACTOR subject only to joint review by OWNER and the CONTRACTOR, except as provided for herein.

B. OWNER stipulates and expressly acknowledges that the EBDs, as defined herein, constitute trade secrets. This acknowledgment is based on the OWNER's express understanding that the information contained in the EBDs is not known outside the CONTRACTOR's business, is known only to a limited extent and only by a limited number of employees of the CONTRACTOR, is safeguarded while in the CONTRACTOR's possession, and is extremely valuable to competitors by virtue of it reflecting the CONTRACTOR's contemplated techniques of construction.

C. OWNER acknowledges that EBDs and the information contained therein are made available to OWNER only because such action is an express prerequisite to award of the Contract. OWNER acknowledges that the EBDs include a compilation of information used in the CONTRACTOR's business, intended to give the CONTRACTOR an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation. OWNER agrees to safeguard the EBDs and all information contained therein to the fullest extent permitted by law.

1.03 PURPOSE

A. EBDs will be used to assist in the negotiation of price adjustments and variations and in the settlement of disputes, Claims and other controversies. They will not be used for pre-award evaluation of the CONTRACTOR's anticipated methods of construction or to assess the CONTRACTOR's qualifications for performing the Work.

1.04 FORMAT AND CONTENTS

A. No standard format is required for EBDs, but the submitted documentary information must be legible and complete. Documentary information shall be submitted in the format the information was generated in the preparation of Bid prices for the Project. It is not intended that extra work is required in preparing the bid but to ensure that the EBDs will be adequate to enable complete and proper understanding and proper interpretation for their intended use. The EBDs shall be in the English language only.

B. The EBDs shall clearly itemize the estimated costs of performing the work of each item contained in the Bid Schedule. Items should be separated into sub-items as required to present a complete and detailed cost estimate and allow a detailed cost review. The EBDs shall include all quantity take-offs, crews, equipment, calculations of rates of production and progress, copies of quotations from sub-Contractors and suppliers, and memoranda, narratives, consultants reports, add/deduct sheets and all other information used by the CONTRACTOR to arrive at the prices contained in the bid. Estimated costs shall be broken down into the CONTRACTOR's usual estimate categories such as direct labor, repair labor, equipment operation, equipment Ownership, expendable materials, permanent material and subcontract costs as appropriate. Plant and equipment and indirect costs should be detailed in the CONTRACTOR's usual format. The CONTRACTOR's allocation of plan and equipment, indirect costs, contingencies, mark-up and other items to each bid item shall be clearly indicated.

C. The EBDs shall clearly show in calculations, text, or both, the relationship between baseline indications presented in the contract Documents and assumptions that form the basis for the CONTRACTOR's means, methods, equipment selection, rates of production, and costs.

D. All costs shall be identified. For bid items where the extended amount is less than $10,000 estimated unit costs are acceptable without a detailed cost estimate, providing that labor, equipment, materials and subcontracts, as applicable, are included and provided that indirect costs, contingencies, and mark-up, as applicable, are allocated.

E. Bid Documents provided by OWNER should not be included in the EBDs unless needed to comply with the above requirements.

1.05 SUBMITTAL

A. The EBDs shall be submitted by the three lowest bidders in a sealed container within two business days of the bid opening. The container shall be clearly marked on the outside with the Bidder's name, date of submittal, project name, Contract No., and the words "Escrow Bid Documents".

B. The EBDs shall be accompanied by the following "Escrow Bid Documentation Certification", signed by an individual authorized by the bidder to execute the bid, stating that the material in the Escrow Bid Documentation constitutes all the documentary information used in the preparation of the bid and that he or she has personally examined the contents of the EBDs container and has found that the documents in the container are complete.

"ESCROW BID DOCUMENT CERTIFICATION"

THE UNDERSIGNED HEREBY CERTIFIES THAT THE BID DOCUMENTATION CONTAINED HEREIN CONSTITUTES ALL THE INFORMATION USED IN PREPARATION OF THE BID AND THAT I HAVE PERSONALLY EXAMINED THESE CONTENTS AND HAVE FOUND THAT THIS BID DOCUMENTATION IS COMPLETE.

*SIGNATURE:*_____

*NAME:*_____
(Print)

*TITLE:*_____

*FIRM:*_____

*DATE:*_____

C. Timely submission of the complete EBDs is an essential element of the bidder's responsibility and a prerequisite to contract award. Failure to provide the necessary EBDs within the specified time frame will be sufficient cause for OWNER to reject the bid.

D. If the bidder's proposal is based on subcontracting any part of the Work, each subcontractor whose total subcontract price exceeds five percent of the total contract price proposed by the bidder, shall provide separate EBDs to be included with those of the bidder. These documents will be opened and examined in the same manner and at the same time as the examination described above for the apparent successful bidder.

E. If the CONTRACTOR wishes to subcontract any portion of the Work after award, OWNER retains the right to require the CONTRACTOR to submit EBDs from the subcontractor before the subcontract is approved.

1.06 INITIAL EXAMINATION

A. Once received by OWNER, the EBDs of the apparent lowest Bidder will be promptly examined, organized, and inventoried by representatives of the OWNER and members of the Bidder’s staff who are knowledgeable of how the Bid was prepared. Such members of Bidder’s staff shall attend said initial examination upon being provided with 48-hour advance written notice (email and facsimile included) by the OWNER of the date and time of such examination.

B. This examination is to ensure that the EBDs are authentic, legible, and complete. It will not include review of and will not constitute approval of proposed construction methods, estimating assumptions, or interpretations of Contract Documents. Examination will not alter any condition or term of the Contract.

C. Should the examination and inventory by the OWNER's designated review representatives indicate that data is incomplete or missing data, the OWNER will give notice of such to the CONTRACTOR who shall supply it within twenty four (24) hours.

D. If all the itemized cost breakdowns and allocations required previously mentioned herein have not been made, due to last minute bid revisions, the detailed breakdown of estimated costs shall be reconciled and revised by agreement between the CONTRACTOR and the OWNER before making the award.

1.07 EBDs OF OTHER BIDDERS

A. If the OWNER has reason to believe that the Contract may not be awarded to the apparent lowest Bidder, the OWNER may process the EBDs of the next apparent lowest Bidder as described above.

B. If the OWNER has reason to believe that the Contract may not be awarded to the apparent lowest Bidder, the OWNER may request the apparent fourth lowest Bidder to submit its EBDs within two business days.

C. EBDs submitted by unsuccessful Bidders will be returned unopened, unless opened as provided for above, following award of the Contract.

1.08 STORAGE

A. The EBDs shall be placed in escrow prior to award of the contract, for the life of the Contract, in a mutually agreeable institution. The cost of storage will be borne by OWNER.

1.09 EXAMINATION

A. The EBDs shall be examined by both OWNER and the CONTRACTOR, at any time deemed necessary by either OWNER or the CONTRACTOR, to assist in the negotiation of price adjustments and change orders, or the settlement of disputes.

B. Examination of the EBDs is subject to the following conditions:
   1. As trade secrets, the EBDs are proprietary and confidential as described above.
   2. OWNER and the CONTRACTOR shall each designate, in writing to the other party a minimum of ten days prior to examination, representatives who are authorized to examine the EBDs. No other person shall have access to the EBDs.
   3. Access to the EBDs will take place only in the presence of duly designated representatives of both OWNER and the CONTRACTOR.
   4. Members of the Disputes Review Board (DRB) may examine the EBDs in the presence of representatives of OWNER and CONTRACTOR if such examination would assist the DRB's review of a Claim that the parties have submitted to the DRB for review. Any mediator used by the Owner and Contractor to mediate a Claim may examine the EBDs in the presence of representatives of OWNER and CONTRACTOR if such examination would assist the mediator's review of a Claim for purposes of mediation. The EBDs may also constitute discoverable evidence in any litigation relating to the Project, to the extent allowed under applicable law.

1.10 FINAL DISPOSITION

A. The EBDs will be returned to the CONTRACTOR at such time as the Contract has been completed and final settlement has been achieved.

1.11 CONDITIONS FOR RETURN TO CONTRACTOR

A. Upon completion of the Contract, issuance of Final Payment by the OWNER, verification that all Claims have been settled, litigation has been completed, and verification that future litigation does not exist, the EBDs will be sealed and promptly returned to the CONTRACTOR by the escrow entity in charge of the EBDs.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01116

CONTRACT DOCUMENT LANGUAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Explanation of arrangement, language, reference standards and format.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 00700 - Standard General Conditions.
      b. Section 01600 - Product Requirements.

1.02 REFERENCES

A. Construction Specifications Institute (CSI):
   1. MasterFormat™.
   2. SectionFormat™.
   3. PageFormat™.

1.03 PROJECT MANUAL ARRANGEMENT

A. Document and Section numbers used in Project Manual, and Project Manual arrangement are in accordance with CSI MasterFormat™, except where departures have been deemed necessary.

B. Sections are written in CSI SectionFormat™, Three-Part Section Format, except where departures have been deemed necessary.

C. Page format for Sections in the Project Manual is in PageFormat™, except where departures have been deemed necessary.

1.04 CONTRACT DOCUMENT LANGUAGE

A. Specification Section Paragraphs entitled "Section Includes" summarize briefly what is generally included in the section.
   1. Requirements of Contract Documents are not limited by "Section Includes" paragraphs.

B. Specifications have been partially streamlined by intentionally omitting words and phrases, such as "the Contractor shall," "in conformity therewith," "shall be" following "as indicated," "a," "an," "the" and "all."
   1. Assume missing portions by inference.

C. Phrase "by ENGINEER" modifies words such as "accepted," "directed," "selected," "inspected," and "permitted," when they are unmodified.

D. Phrase "to ENGINEER" modifies words such as "submit," "report," and "satisfactory," when they are unmodified.

E. Colons (:) are used to introduce a list of particulars, an appositive, an amplification, or an illustrative quotation:
   1. When used as an appositive after designation of product, colons are used in place of words "shall be."

F. Words "CONTRACTOR shall" are implied when direction is stated in imperative mood.

G. Term "products" includes materials and equipment as specified in Section 01600.

H. Refer to Section 00700 for additional terminologies used in the project manual.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01120

PROJECT PARTNERING

PART 1 GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall participate in “project partnering” along with the ENGINEER and the OWNER for this Project. Partnering will be effective only if all parties willingly enter into this cooperative arrangement with the support of each entity at the highest level in their organizations. The OWNER and ENGINEER consider partnering important to the overall success of this project. It is desired that the CONTRACTOR will be equally concerned with cooperation, effective communication, quality, performance, budget, and schedule and will endorse and adopt partnering as an effective tool for achieving these objectives.

B. It must be recognized that the OWNER, CONTRACTOR, and ENGINEER all hold in common the goal of successful completion of this Project. Success necessarily must include the following requirements.
   1. Construction of a facility that meets the project performance standards as defined in the Drawings and Technical Specifications.
   2. Completion of the project on schedule.
   3. Conformance to budgetary requirements and limitations.
   4. Cooperation and effective communication.

   In addition, it is recognized that safety, profit, liability limitation, avoidance of litigation, reputation, good will, and other factors are of significant importance to all parties involved in the Project. These goals can be achieved most readily if the CONTRACTOR, OWNER, and ENGINEER join together in a mutually beneficial alliance that recognizes the issues that each considers of greatest importance and work to accomplish them.

C. Through partnering, the three parties will agree among themselves regarding the primary goals for the Project and the methods that will be used to accomplish them. This will require development of a trust relationship, not an adversarial one, among these parties who will be working closely and cooperatively for the duration of the project. Commitment, communication, and conflict resolution must be of highest importance for this relationship to succeed.

D. The CONTRACTOR should include its major subcontractors and suppliers in partnering so these participants may “buy-in” to the concept and work cooperatively with other parties on the project.

E. Partnering will include an initial 1-day workshop in which the basic requirements for the partnering relationship will be established, an issue resolution ladder developed, and a Partnering Charter prepared. The workshop will be held within 30 days of issuance of the Notice-to-Proceed at a time and date agreed upon by all parties at a neutral location away from each entities’ home office and field facilities. Attendees at the workshop will include:
   1. CONTRACTOR representatives:
      a. Principal-in-Charge.

b. Project Manager.
c. Superintendent.
d. General Foreman.
e. Major Subcontractors.

2. OWNER REPRESENTATIVES:
   a. Public Works Director.
   b. Deputy Public Works Director.
   c. Project Manager.
   d. Environmental Programs Manager.
3. ENGINEER REPRESENTATIVES:
   a. Principal-in-Charge.
   b. Construction Manager.
   c. Resident Project Representatives.
   d. Public Information Liaison.
   e. Inspectors.

F. Semi-annual half-day partnering sessions also may be held during the Project to confirm the relationship and assure the partnering effort continues to be successful. In this manner, it can best be assured that the CONTRACTOR, OWNER, and ENGINEER all will work cooperatively to ensure a successful Project.

G. A partnering facilitator will be employed by the OWNER who will help establish and monitor the partnering relationship. The OWNER will pay all costs associated with employing the partnering facilitator and will pay all costs for facilities and food services at the initial workshop. The CONTRACTOR shall pay all costs associated with its own and its subcontractor's participation in partnering.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01140

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility and work restrictions.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 00700 - General Conditions.
      b. Section 01010 - Summary of Work.
      c. Section 01210 - Allowances.
      d. Section 01324A - Progress Schedules and Reports.
      e. Section 01500 - Temporary Facilities and Controls.
      f. Section 01571 - Traffic Control.
      g. Section 01660 - Testing, Training, and Commissioning.

1.02 SUBMITTALS

A. Baseline Schedule with MOP tasks.

B. Method of Procedure (MOP) Form.

C. Method of Procedure (MOP) Log.

D. Progress Schedule with MOP tasks.

1.03 DEFINITIONS

A. Refer to Section 01660 for the definitions of the following terminologies.
   1. Testing Phase.
   2. Completion Date for Testing Phase.
   3. Start-Up Phase.
   4. Interim Measures.
   5. Commissioning Phase.

1.04 GENERAL CONSTRAINTS ON SEQUENCE AND SCHEDULING OF WORK

A. The Los Osos Water Recycling Facility (LOWRF) will be the County of San Luis Obispo's only means of treating domestic and industrial wastewater prior to discharging treated wastewater to leach fields or distributing it to recycled water customers. Impairing the operational capabilities of this treatment plant following Testing Phase will result in serious environmental damage and monetary fines.
   1. Conduct work in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
   2. During the Commissioning Phase, status of the treatment plant shall be defined as "operational" when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in discharge permit.

B. Work sequence and constraints:
   1. Utilize description of critical events in work sequence in this Section as a guideline for scheduling and undertaking the Work.
   2. Work sequence and constraints presented do not include all items affecting completion of the Work, but are intended to describe critical events necessary to ensure compliance with National Pollutant Discharge Elimination System permit requirements.
   3. Following Contract execution, the following general Work Sequence is expected:
      a. Site preparation including:
         1) Clearing, grubbing, and removal of soils.
         2) Los Osos Valley Road improvements.
         3) Plant entrance road improvements.
         4) Extension of utilities from Los Osos Valley Road to the treatment facility site.
         5) Excavation of recycled water storage ponds and stormwater retention pond.
         6) Mass grading of treatment facility process area.
         7) Installation of groundwater wells.
      b. Construct foundation of Effluent Pump Station and install piping to recycled water storage ponds.
      c. Construct foundation and base slab for oxidation ditches and secondary clarifiers.
      d. Construct Scum Pump Station, Filter Influent Pump Station, Plant Drain Pump Station, and Stormwater Pump Station.
      e. Install yard piping and electrical ductwork.
      f. Construct structures for remaining at/above grade facilities.
      g. Install mechanical equipment.
      h. Complete electrical work.
      i. Complete site paving and fencing.
      j. Complete installation of instrumentation and controls.
      k. Field-testing.
      l. Complete landscaping.
      m. Complete testing of facility.
      n. Warranty period.
      o. Support during Start-Up Phase.
      p. Support of commissioning.

1.05 CONSTRUCTION CONSTRAINTS

A. Specific work restrictions and constraints:
   1. Refer to Section 01010 for any areas requiring early completion/occupancy.
   2. Northern Portion of Project Site
      a. Project site contains a large area in the north end that is bounded by an environmentally sensitive habitat area (ESHA) to the east and the Giacomazzi property on the west (identified on Drawing 00G09). Permissible construction activities in this bounded area shall be limited to stockpiling of spoils resulting from site excavation.
   3. Work on Los Osos Valley Road including but not limited to making tie-ins for influent force main, recycled water transmission line, natural gas line, fiber-optic cables and wires, and for a new electrical service:
      a. Schedule and conduct work in accordance with construction limits specified in Section 01571.
   4. Plant Entrance Road:
      a. Throughout construction, CONTRACTOR shall allow vehicular access to the Los Osos Mortuary and Memorial Park via its existing entrance at the intersection of Los Osos Valley Road and Clark Valley Road. That entrance is the only means of vehicular access into the Park.
      b. Install buried utilities, complete subsurface preparation, and construct first asphalt pavement lift on Plant Entrance Road before hauling any native soils offsite or any imported soils onsite to the plant site.
      c. Following completion of major construction activities and before the completion date for the Testing Phase, construct the remaining asphalt pavement lifts on Plant Entrance. Treat and polarize existing asphalt as part of final overlay.
   5. Temporary Fire Protection System:
      a. Install, test, and make fully operational a temporary water storage tank and appurtenances, prior to start of construction or material arriving on site, including temporary offices or construction trailers as specified in Section 01500.
   6. General Site Work:
      a. Install temporary fences and protective fences where indicated on the Drawings and elsewhere where required, before starting construction activities.
   7. Odor Control Facility:
      a. Place Odor Control Facility into service as soon as influent wastewater is being conveyed to LOWRF. Maintain its operation from that point forward.
   8. Oxidation Ditches:
      a. Work during Testing Phase:
         1) Complete testing, training, and other required activities as specified in Section 01660.
         2) During the Testing Phase, coordinate with OWNER and the Los Osos Collection System Project for start of Start-Up Phase, and schedule initiating influent wastewater flows into plant by OWNER. Make a written request for OWNER's approval 6 months and 4 weeks in advance. Provide a written confirmation 1 week in advance.
      b. Work during Start-Up Phase:
         1) CONTRACTOR's work under this phase is being covered with a bid allowance. Refer to Sections 00700 and 01210.

2) Provide assistance in accordance with OWNER's specific request and as specified in Section 01660.
   a) Depending on actual influent flow rates, cost, and other factors, OWNER will select the appropriate Interim Measures to be implemented by CONTRACTOR.
   b) Depending on Interim Measures selected for implementation, the Oxidation Ditches may or may not be in service during the Start-Up Phase. If they are used, one ditch would be in service at a time.

c. Work during Commissioning Phase:
   1) If oxidation ditches are not used during the Start-Up Phase, follow the following sequence during the Commissioning Phase:
      a) CONTRACTOR shall truck in wastewater activated sludge from a nearby plant (located approximately 25 miles away and to be designated by OWNER) to the LOWRF in order to seed the first oxidation ditch during its commissioning.
      b) Operate the first oxidation ditch and one secondary clarifier for 3 weeks allowing the biological process to stabilize.
      c) Once the first oxidation ditch stabilizes, perform Final Acceptance Testing specified in Section 01660 for the ditch and the secondary clarifier in service.
      d) Upon completion of Final Acceptance Testing of the ditch and secondary clarifier in service, bring on-line the second oxidation ditch and the second secondary clarifier.
         (1) Provide temporary pumps, piping, and other appurtenances to transfer the content from the ditch to be removed from service to the ditch to be placed in service.
         (2) Perform a similar transfer from the clarifier to be removed from service to the clarifier to be placed in service.
         (3) Wash down, fully dewater, and clean the basins that have been removed from service.
      e) Following transfer, operate oxidation ditch and secondary clarifier for 3 days for restabilization. Then, perform Final Acceptance Testing of ditch and secondary clarifier in service.

9. Plant Water/Utility Water System
   a. It is anticipated that LOWRF will not produce Title 22-compliant recycled water during the Testing Phase, Start-Up Phase, and possibly Commissioning Phase. During such periods, treated wastewater stored in the REW ponds would not be suitable for use as plant water. As such, CONTRACTOR shall provide an additional, reliable water source, at no additional cost, as needed to support plant operation, testing, and other activities. At CONTRACTOR's discretion, infrastructure for the W2 water system may be used for these purposes. However, CONTRACTOR shall provide all other necessary piping, valving, and other appurtenances to achieve a reliable distribution system. Examples of needs include seal water for mechanical equipment and humidification water for the Odor Control System.

10. Electrical System Studies:
    a. Complete electrical system studies and implement studies results prior to commencing 10-day operational testing specified in Section 01660.

11. Emergency Generator:
    a. Install, test, and make fully operational the Emergency Generator prior to commencing 10-day operational testing and prior to fire pump commissioning.
12. SCADA System:
    a. Install, test, and make fully operational from the LOWRF, the SCADA system for the Collection System, prior to commencing the Start-Up Phase.
13. Landscaping:
    a. The majority of the plants specified on the landscaping drawings require contract growing at a nursery for duration of approximately six months to one year prior to planting. Coordinate schedule with nursery accordingly.
    b. Refer to the landscaping drawings for additional requirements.
    c. Complete all landscaping work prior to the completion date of the Testing Phase, specified in Section 01660.
    d. Be responsible for irrigating and maintenance of landscaping from date of planting until completion date of the Testing Phase. Before, during, and following the Testing Phase, it is anticipated that plant water (PW) would not be available for irrigation purposes. During such periods, potable water (W1) shall be used until the LOWRF produces Title 22-compliant recycled water and PW becomes available. However, only one water source shall be physically connected to the irrigation system at any given time, in order to prevent potential cross contamination. Hence, prior to connecting PW for irrigation, CONTRACTOR shall physically sever the W1 connection. In addition, CONTRACTOR shall provide a proper backflow prevention device on W1 piping while it is being used for irrigation.

1.06 PROCESS SHUTDOWN CONSTRAINTS

A. General shutdown constraints:
    1. During Start-Up Phase and Commissioning Phase, activities that disrupt plant operations or operation of any temporary equipment treating or handling wastewater are prohibited unless otherwise approved in writing by ENGINEER.
    2. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
    3. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
    4. Final determination of the permitting of shutdowns will be the sole judgment of OWNER.
    5. OWNER maintains the ability to abort a scheduled shutdown at any time.

B. Shutdown activities during the Start-Up Phase and the Commissioning Phase that interrupt operating treatment processes:
    1. Scheduling:
        a. Perform between the hours of 2:00 a.m. and 6:00 a.m. or as directed by ENGINEER or OWNER.
    2. Unplanned shutdowns due to emergencies are not indicated in this Section.

1.07 METHOD OF PROCEDURE (MOP)

A. MOP Instructions: See Appendix A.

B. Prepare MOP for the following conditions:
   1. Process start up activities.
   2. Power interruption and tie-ins.
   3. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
   4. Process constraints requiring interruption of operating processes or utilities.

C. Other Work not specifically listed may require MOPs as determined necessary by the CONTRACTOR, OWNER, or ENGINEER.

D. Submit Baseline Schedule, as specified in Section 01324A, with proposed MOPs.

E. Submit MOP Log at construction progress meetings.

F. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the OWNER and ENGINEER to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.

G. Where required to minimize treatment process interruptions while complying with specified sequencing constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.08 COMPLIANCE WITH WASTE DISCHARGE/RECYCLED WATER REQUIREMENTS

A. The facility will operate under the terms of Waste Discharge/Recycled Water Requirements (WDR) (Order No. R3-2011-0001) issued by the California RWQCB. This permit specifies the water quality limits that the plant must meet prior to discharge of effluent. A copy of the existing permit is on file for review at the County of San Luis Obispo.

B. Bear the cost of penalties imposed on the OWNER for discharge violations caused by actions of the CONTRACTOR.

1.09 UTILITIES

A. Provide advance notice to and utilize services of Underground Services Alert (U.S.A.) for location and marking of underground utilities operated by utility agencies other than the OWNER.

B. Provide temporary electrical, telephone, water, gas, sanitary facilities, and other utilities as necessary for construction.

C. New yard utilities were designed using existing piping drawings.
   1. Field verification of utilities locations was not performed during design.
   2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
   3. Pipe alignments as indicated on Drawings.

1.10 COORDINATION OF WORK

A. Maintain overall coordination of the Work.

B. Obtain construction schedules from subcontractors and suppliers, and assume responsibility for correctness.

C. Incorporate schedules from subcontractors and suppliers into Progress Schedule to plan for and comply with sequencing constraints.

1.11 WORK BY OTHERS

A. Where proper execution of the Work depends upon work by others, inspect and promptly report discrepancies and defects.

1.12 TEMPORARY SERVICES, MATERIALS, AND EQUIPMENT

A. As specified in Section 01500.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A
"Method of Procedure" (MOP)
Instructions and Forms

Definition and Purpose

"Method of Procedure" (MOP) is a detailed document submitted by the CONTRACTOR to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the OWNER and ENGINEER that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The OWNER should use the information within the MOP to define operational procedures and methods to safely and successfully assist the CONTRACTOR.

MOP Process Summary

Who	Step	Timing
CONTRACTOR	1. Identify MOPs needed on MOP Log and Baseline Schedule.	7 days prior to Preconstruction Scheduling Meeting
CONTRACTOR, OWNER, ENGINEER	2. Pre-MOP Meeting.	More than 28 days prior to work
CONTRACTOR	3. Submits MOP.	No later than 28 days prior to work
OWNER	4. Reviews MOP.	
OWNER	5. MOP finalized.	7 days prior to work
CONTRACTOR	6. Complete Readiness Checklist.	5 days prior to work
CONTRACTOR	7. Complete Safety Checklist.	Just prior to commencing work
CONTRACTOR	8. Complete Work.	
CONTRACTOR	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identify MOPs needed on MOP Log and Baseline Schedule.
CONTRACTOR submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Schedule MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.
CONTRACTOR requests a Pre-MOP Meeting with the OWNER and ENGINEER to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the OWNER or ENGINEER if the work is deemed to be minor.

STEP 3. Submit MOP.
CONTRACTOR completes the MOP Form and submits 3 copies for approval to the OWNER's Project Manager (OPM).

STEP 4. Review MOP.
OPM distributes MOP Form for review by the OWNER's Construction Coordinator, O&M Representative, and ENGINEER's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in contract documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP Finalized.
Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the OWNER, ENGINEER, and CONTRACTOR.

STEP 6. Complete Readiness Checklist.
CONTRACTOR verifies everything is ready for the work.

STEP 7. Complete Safety Checklist.
CONTRACTOR ensures safety.

STEP 8. Complete work.
CONTRACTOR completes work.

STEP 9. Update MOP Log and Progress Schedules.
CONTRACTOR updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.

METHOD OF PROCEDURE (MOP) FORM

Owner:		Date:	
Contractor:		Carollo Project No.:	
Project Name:		Submittal No.:	
Submittal Title:		Spec/Dwg. Reference:	

MOP #	Task Title *(Provide <10 word title)*:	Submittal Date: *(No later than 28 days prior to work)*

SCHEDULE OF WORK ACTIVITY START: *(Date/Time)* END: (Date/Time)

REQUESTOR:

PRIMARY POINT OF CONTACT:	PHONE/PAGER:
SECONDARY POINT OF CONTACT:	PHONE/PAGER:
NOTIFY ☐ Control Room, Phone	☐ Security, Phone
BUILDING:	LOCATION OF WORK FLOOR/LEVEL:

DESCRIPTION OF WORK: *(Provide sufficient details on process isolation, work sequencing, and safety (i.e., control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.)*

Task Summary:

Processes Affected:

Trades Affected:

WORK PLAN:

Work Sequencing:

Process Isolation:

Spill Prevention Plan:

Contingency Plans:

CRITICAL EQUIPMENT/TOOLS: *(pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.)*

☐ Acoustic Ceiling/or Walls Access	☐ Excavation Permit	☐ Lock Out/Tag Out
☐ Chemical Use Approval	☐ Fire Sprinkler Impairment	☐ Life Safety Systems
☐ Confined Space Permit	☐ Flammable Materials	☐ Roof Protocol
☐ Critical Lift Plan	☐ Flush / Discharge	☐ Work After Dark
☐ Energized Electrical Work	☐ High Pressure Test	☐
☐ Elect. Panel Schedules	☐ Hot Work/Open Flame	☐

EXISTING SERVICE(S) AT RISK:

☐ Breathing Air	☐ Elect Normal	☐ Process Access	☐ Telephones
☐ Chemical Distribution	☐ Fire Protection	☐ Safety Showers	☐ UPS
☐ City Water	☐ HVAC	☐ SCADA	☐ VAX/DATA
☐ Communication	☐ Inert Gas	☐ Security	☐
☐ Domestic Drain	☐ Instrument - Air	☐ Solvent Drain	☐
☐ Elect-Bus Duct	☐ Life Safety System	☐ Specialty Gases	☐
☐ Elect Emergency	☐ Natural Gas	☐ Storm Drain	☐

REVIEWER'S INSTRUCTIONS / COMMENTS:

☐ PREJOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:

	Full Name (printed)	Signature	Phone	Date
Submitted By				
System Owner				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				

READINESS CHECKLIST
(5 days prior to work)

Checklist provided as a guide but is not all-inclusive.

1. Confirm all parts and materials are on site: _____

_____

2. Review work plan: _____

_____

3. Review contingency plan: _____

_____

SAFETY CHECKLIST
(Just prior to commencing work)

Checklist provided as a guide but is not all-inclusive.

1. Location awareness:
   a. Emergency exits: _____
   b. Emergency shower and eyewash: _____
   c. Telephones and phone numbers: _____
   d. Shut-off valve: _____
   e. Electrical disconnects: _____
2. Inspect work area:
   a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. MSDS (Material Safety Data Sheets)
   a. Understand the chemicals and substances in the area you are working in by reading the MSDS.
4. Lockout/Tagout Procedure:
   a. Lockout/Tagout energy sources before beginning work.
   b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
   c. Make sure the lines are depressurized.
5. Overhead work:
   a. Use appropriate personal protective equipment; i.e. safety harness, lifeline, etc.
   b. Select appropriate tie-off points; i.e. structurally adequate, not a pipe or conduit, etc.
   c. Spotter assigned and in position.
   d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves, or electrical switches identified and protected.
6. Safety equipment:
   a. Shepherd's hook
   b. ARC flash protection
   c. Fire extinguisher
   d. Other _____
7. Accidents:
   a. Should accidents occur do not shut-off and do not attempt to correct the situation, unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
8. Review testing and start-up documents:
   a. In the event the system is shutdown, the Control Center should have a working knowledge of the testing and start-up procedures in order to deal effectively with unforeseen events.
9. Evacuation procedures:
   a. Do not obstruct evacuation routes.
   b. Take time to survey the area for evacuation routes.

Method of Procedure (MOP) Log
Sample

MOP Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (yes/no)
001					
002					
003					

SECTION 01201

PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Procedures for submitting applications for payment and means used as a basis for Progress Payments, including:
   1. Cost Summaries.
   2. Payment for Mobilization.
   3. Commissioning, Training, and Demobilization.

1.02 REFERENCES

A. Occupational Safety and Health Administration (OSHA).

1.03 BASIS FOR PROGRESS PAYMENTS

A. Base Application for Payment on the breakdown of costs for each scheduled activity in the Progress Schedule and the Percentage of Completion for each activity. Generate Application for Payment by downloading cost data from the Progress Schedule to a spreadsheet type format. Identify each activity on the Progress Schedule that has a cost associated with it, the cost of each activity, the estimated Percent Complete for each activity, and the Value of Work Completed for both the payment period and job to date.

1.04 PAYMENT REQUESTS

A. Refer to Section 00700, Article 14.02.

1.05 COST SUMMARIES

A. Prepare Summary of Cost Information for each Major Item of Work listed in the Schedule of Values. Identify the Value of Work Completed for both the payment period and job to date.

B. Cash flow summary: Prepare cash flow summary, indicating total dollar amount of work planned for each month of the project. Equate sum of monthly amounts to Lump Sum contract price.

1.06 PAYMENT FOR MOBILIZATION

A. Limit amounts included under mobilization to the following items:
   1. Moving on the site any equipment required for first month operations.
   2. Installing temporary construction power, wiring, and lighting facilities.
   3. Establishing fire protection plan and safety program.
   4. Developing construction water supply.
   5. Providing field office trailers for the CONTRACTOR, complete with all specified furnishings and utility services including telephones.

6. Providing on-site sanitary facilities and potable water facilities as specified.
7. Arranging for and erection of CONTRACTOR's work and storage yard, employee parking facilities, and entrance road.
8. Submit all required insurance certificates and bonds.
9. Obtaining all required permits, licenses, and fees.
10. Developing construction schedule.
11. Submit preliminary schedule of values of the Work.
12. Provide and erect the project sign.
13. Post all OSHA, Department of Labor, and all other required notices.
14. Location and flagging of construction and clearing.
15. Have CONTRACTOR's project manager and/or general superintendent on job site full-time.

B. Furnish data and documentation to substantiate the amounts claimed under mobilization.

C. Limit price for mobilization to no more than 2 percent of Contract Price.

D. No payment for mobilization, or any part thereof, will be recommended until all mobilization items listed above have been completed.

1.07 PAYMENT FOR DEMOBILIZATION, COMMISSIONING, AND TRAINING

A. Total Price for demobilization, commissioning, and training shall not be less than 2 percent of Contract Price.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01210

ALLOWANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Listing of allowance items:
      a. Related responsibilities of ENGINEER and CONTRACTOR, and procedures.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01660 - Testing, Training, and Commissioning.

1.02 ALLOWANCE AMOUNTS

A. Include following amounts in Contract Price:
   1. $1,000,000 for providing assistance to the OWNER during the Start-Up Phase at the specific direction of the OWNER.
      a. Refer to Section 01660 for a description of CONTRACTOR's assistance that is anticipated during the Start-Up Phase.

1.03 COSTS INCLUDED AND EXCLUDED IN ALLOWANCES

A. Costs included in allowances for furnishing and installing products:
   1. Net cost of product.
   2. Delivery and unloading at site.
   3. Applicable taxes.
   4. Handling at site, including uncrating and storage.
   5. Protection from elements and from damage.
   6. Labor, installation, testing, and finishing.
   7. Other expenses required to complete installation.
   8. Other expenses required to remove installation following completed usage if installation is temporary.

1.04 DUTIES OF CONTRACTOR IN PROVIDING PRODUCTS BY ALLOWANCE

A. Advise ENGINEER at least 60 days in advance of purchase or other procurement date necessary to avoid impacts to Progress Schedule.

B. Obtain proposals from suppliers, including:
   1. Quantity.
   2. Complete description of product and services provided under allowance, including data substantiating compliance with requirements.
   3. Unit cost.
   4. Total amount of purchase.
   5. Taxes and delivery charges.

C. On notification of selection, enter into purchase agreement with designated supplier.

D. Arrange for delivery and unloading.

E. Install products in accordance with Contract Documents or as directed by the ENGINEER.

1.05 ADJUSTMENT OF COSTS

A. The OWNER is not obligated to use the total dollar amount assigned to each allowance item.

B. The CONTRACTOR shall not be entitled to payment for allowance unless specifically authorized in writing.

C. When actual cost is more or less than amount of allowance, Contract Price will be adjusted by Change Order.

D. The OWNER reserves the right to delete any portion of or the entire amount of the allowance from the Contract. The CONTRACTOR agrees to make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and expenses actually incurred and the total allowance amount.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01292

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for preparation, format, and submittal of Schedule of Values.

B. Related section:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01324A - Progress Schedules and Reports.
      b. Section 01660 - Testing, Training, and Commissioning.
      c. Section 16050 - Common Work Results for Electrical.

1.02 PREPARATION

A. Print out Schedule of Values from accepted Preliminary or Baseline Schedule submitted and accepted under Section 01324A.

B. Schedule of Values shall be a listing of all cost loaded, on- site construction activities from the progress schedule, listed in numerical order, showing that the sum total of all cost loaded activities equals the value of Contract.

C. When the schedule is changed or revised to include added or deleted work, the Schedule of Values shall also be revised such that the sum total of all cost loaded activities continuously equals the current Contract value.

D. Refer to Section 01660 for Contractor's activities during Start-Up Phase and Commissioning Phase.

1.03 SUBMITTALS

A. Submit Schedule of Values for the Preliminary Schedule in accordance with the requirements in Article "Preliminary Schedule," Section 01324A.

B. Submit Schedule of Values for the Baseline Schedule in accordance with the requirements in Article "Baseline Schedule," Section 01324A.

C. Submittal of the Schedule of Values is a condition precedent to the issuance of any payment under this Contract.

1.04 SAMPLE SCHEDULE OF VALUES

A. Following is an acceptable form for Schedule of Values:

(SAMPLE ONLY) SCHEDULE OF VALUES		
No.	**Description of Item**	**Lump Sum Cost**
1.	Mobilization.	
2.	General earthwork and grading.	
3.	List Major Items of Work identified in Paragraph 1.02 B and number consecutively.	
4.	Electrical work schedule of values as specified in Section 16050.	
5.	General instrumentation work not included on Major Items of Work.	
6.	Testing and demobilization	
7.	Additional guard posts as indicated on DWG 01C01.	
8.	Allowance: Assistance during Start-Up Phase	
9.	Commissioning and Training	
10.	Miscellaneous work items and other prices not included in previous items and necessary to complete the Work.	
	TOTAL LUMP SUM BID	

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01312

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
   1. Qualifications of Meeting Participants.
   2. Preconstruction Conference.
   3. Progress Meetings.
   4. Pre-Installation Meetings.
   5. Meetings During Testing, Start-Up, and Commissioning.
   6. Post Construction Meeting.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01660 - Testing, Training, and Commissioning.
      b. Section 16050 - Common Work Results for Electrical.
      c. Section 16305 - Electrical System Studies.
      d. Section 17050 Common Work Results for Process Control and Instrumentation Systems.
      e. Section 17762 - Control Systems - SCADA Software.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 PRECONSTRUCTION CONFERENCE

A. Upon issuance of Notice to Proceed, or earlier when mutually agreeable, Engineer will arrange preconstruction conference in convenient place for most persons invited, in accordance with the General Conditions.

B. Attending Preconstruction Conference: Contractor's superintendent, Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.

C. Engineer will preside at conference.

D. Purpose of conference: To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.

E. Agenda will include:
   1. Adequacy of distribution of Contract Documents.
   2. Distribution and discussion of list of major subcontractors and suppliers.
   3. Proposed progress schedules and critical construction sequencing.
   4. Major equipment deliveries and priorities.
   5. Project coordination.
   6. Designation of responsible personnel.
   7. Procedures and processing of:
      a. Field decisions.
      b. Proposal requests.
      c. Submittals.
      d. Change Orders.
      e. Applications for Payment.
      f. Record Documents.
   8. Use of premises:
      a. Office, construction, and storage areas.
      b. Owner's requirements.
   9. Construction facilities, controls, and construction aids.
   10. Shoring requirements and submittal of Contractor’s geotechnical report.
   11. Temporary utilities.
   12. Safety and first aid procedures.
   13. Security procedures.
   14. Housekeeping procedures.

F. Engineer will record minutes of meeting and distribute copies of minutes within 7 days of meeting to participants and interested parties.

1.04 PROGRESS MEETINGS

A. Conduct progress meetings weekly in Contractor's field office, Engineer's field office, or other mutually agreed upon place.

B. Distribute to each anticipated participant written notice and agenda of each meeting at least 4 days before meeting.

C. Require attendance of Contractor's superintendent and subcontractors who are or are proximate to be actively involved in the Work, or who are necessary to agenda.

D. Invite Owner, Engineer, utility companies when the Work affects their interests, and others necessary to agenda.

E. Complete and bring Application for Payment and Progress Schedule to progress meeting.

F. Prepare and distribute agenda.

G. Preside at meetings.

H. Purpose of progress meetings: To expedite work of subcontractors or other organizations that are not meeting scheduled progress, resolve conflicts, and coordinate and expedite execution of the Work.

I. Review progress of the Work, Progress Schedule, narrative report, Application for Payment, record documents, and additional items of current interest that are pertinent to execution of the Work.

J. Verify:
   1. Actual start and finish dates of completed activities since last progress meeting.
   2. Durations and progress of activities not completed.
   3. Reason, time, and cost data for Change Order Work that will be incorporated into Progress Schedule and application for payment.
   4. Percentage completion of items on Application for Payment.
   5. Reasons for required revisions to Progress Schedule and their effect on Contract Time and Contract Price.

K. Discuss potential problems which may impede scheduled progress and corrective measures.

L. Engineer will record minutes of meeting and distribute copies of minutes within 7 days of meeting to participants and interested parties.

1.05 PRE-INSTALLATION MEETINGS

A. General: Meet with manufacturers and installers of major units of construction which require coordination between subcontractors. Major units of construction which require pre-installation meetings include:
   1. Dewatering Building, dewatering screw presses, and shaftless screw conveyors.
   2. UV Equipment.
   3. Emergency Generator.

B. Distribute to each anticipated participant written notice and agenda of each meeting at least 4 days before meeting.

C. Schedule meeting at least 7 days in advance of installation.

D. Conduct meetings in Contractor's field office or other mutually agreed upon place.

E. Require attendance of Superintendent, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.

F. Invite Owner and Engineer.

G. Preside at meetings.

H. Record minutes of meeting and distribute copies of minutes within 3 days of meeting to participants and interested parties.

1.06 MEETINGS FOR TESTING, START-UP, AND COMMISSIONING PHASES

A. Refer to Section 01660 for testing, training, and other activities required during each phase.

B. Pre-testing coordination meetings as specified in Section 01660.

C. General: Meet with Owner and Engineer for coordination and to report on status, progress, and results.
   1. Meeting Frequency:
      a. Not less than once a week in general.
      b. During 10-day continuous Operational Testing, meet daily.
      c. During Final Acceptance Testing, meet daily.

D. Distribute to each anticipated participant written notice and agenda of each meeting at least 4 days before meeting.

E. Conduct meetings in Contractor's field office or other mutually agreed upon place.

F. Require attendance of Test Engineer, appropriate manufacturer’s representatives, and affected subcontractors.

G. Preside at meetings.

H. Record minutes of meeting and distribute copies of minutes within 3 days of meeting to participants and interested parties

1.07 POST CONSTRUCTION MEETING

A. Meet with and inspect the Work 11 months after date of Substantial Completion with Owner and Engineer.

B. Arrange meeting at least 7 days before meeting.

C. Meet in Owner’s office or other mutually agreed upon place.

D. Inspect the Work and draft list of items to be completed or corrected.

E. Review service and maintenance contracts, and take appropriate corrective action when necessary.

F. Complete or correct defective work and extend correction period accordingly.

G. Require attendance of Superintendent, appropriate manufacturers and installers of major units of constructions, and affected subcontractors.

1.08 ELECTRICAL AND INSTRUMENTATION COORDINATION MEETINGS

A. Electrical Meetings:
   1. Pre-submittal review meeting as specified in Section 16050.
   2. Electrical System Study Meetings (3 separate meetings) as specified in Section 16305.
   3. Other meetings as required and as otherwise specified.

B. Instrumentation and Control Meetings:
   1. Pre-Submittal Conference as specified in Section 17050.
   2. System Configuration Meetings (3 separate meetings) as specified in Section 17050.
   3. Graphics Meetings (2 separate meetings) as specified in Section 17762.
   4. Report Meetings (2 separate meetings) as specified in Section 17762.
   5. Other meetings as required and as otherwise specified.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01322

WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT (EADOC)

PART 1 GENERAL

1.01 DESCRIPTION

A. The CONTRACTOR, ENGINEER and DESIGNER shall use EADOC LLC's EADOC system for electronic submittal of all data and documents throughout the duration of the Contract. EADOC is a web-based electronic media site that is hosted by EADOC LLC using their EADOC web solution. The EADOC system will be paid for by the OWNER and will be made available to all CONTRACTOR project personnel, subcontractor personnel, and suppliers. The joint use of this system is to facilitate electronic exchange of information, automation of key processes, and overall management of the Contract. EADOC shall be the primary means of project information submission and management. Paper or hard copy documents will also be required as specified or as directed by the ENGINEER. In the event of discrepancy between the electronic version and paper documents, the paper documents will govern. EADOC is a registered trademark of EADOC LLC.

1.02 USER ACCESS LIMITATIONS

A. The ENGINEER will control the CONTRACTOR's access to EADOC by allowing access and assigning user profiles to accepted CONTRACTOR personnel. User profiles will define levels of access into the system; determine assigned function-based authorizations (determines what can be seen) and user privileges (determines what they can do). Sub-contractors and suppliers will be given access to EADOC through the CONTRACTOR. Entry of information exchanged and transferred between the CONTRACTOR and its sub-contractors and suppliers on EADOC shall be the responsibility of the CONTRACTOR.

B. Joint Ownership of Data - Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the EADOC system) by the ENGINEER and the CONTRACTOR will be jointly owned.

1.03 AUTOMATED SYSTEM NOTIFICATION AND AUDIT LOG TRACKING

A. Review comments made (or lack thereof) by the ENGINEER on CONTRACTOR submitted documentation shall not relieve the CONTRACTOR from compliance with requirements of the Contract Documents. The CONTRACTOR is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents. ENGINEER’s acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the CONTRACTOR's submitted information.

1.04 SUBMITTALS

A. See Section 01330 - Submittal Procedures.

B. Preconstruction Submittals:
   1. List of CONTRACTOR's key EADOC personnel, include descriptions of key personnel's roles and responsibilities for this project. CONTRACTOR should also identify their organization’s administrator on the list.

1.05 COMPUTER REQUIREMENTS

A. The CONTRACTOR shall use computer hardware and software that meets the requirements of the EADOC system as recommended by EADOC LLC to access and use EADOC. As recommendations are modified by EADOC, the CONTRACTOR will upgrade their system(s) to meet the recommendations or better. Upgrading of the CONTRACTOR's computer systems will not be justification for a cost or time modification to the Contract. The contractor will ensure that connectivity to the EADOC system (whether at the home office or job site) is accomplished through DSL, cable, T-1, or wireless communications systems. The minimum bandwidth requirement for using the system is 128 kb/s. It is recommended a faster connection be used when uploading pictures and files into the system.

B. EADOC currently supports Mozilla's Firefox v3.0-3.6, Apple's Safari V3.0-5.0, and Microsoft's Internet Explorer v7.0-8.0 web browsers for accessing the application.

1.06 CONTRACTOR RESPONSIBILITY

A. The CONTRACTOR shall be responsible for the validity of their information placed in EADOC and for the abilities of their personnel. Accepted users shall be knowledgeable in the use of computers including Internet Browsers, e-mail programs, CAD drawing applications, and Adobe Portable Document Format (PDF) document distribution program. The CONTRACTOR shall use the existing forms in EADOC to the maximum extent possible. If a form does not exist in EADOC, the CONTRACTOR must include a form of their own or one provided by the ENGINEER as an attachment to a submittal. Adobe PDF documents will be created through electronic conversion rather than optically scanned whenever possible. The CONTRACTOR is responsible for the training of their personnel in the use of EADOC (outside what is provided by the ENGINEER) and the other programs indicated above as needed.

B. User Access Administration - Provide a list of CONTRACTOR's key EADOC personnel for the ENGINEER's acceptance. CONTRACTOR is responsible for adding and removing users from the system. The ENGINEER reserves the right to perform a security check on all potential users. The CONTRACTOR will be allowed to add additional personnel and sub contractors to EADOC.

1.07 CONNECTIVITY PROBLEMS

A. EADOC is a web-based environment and therefore subject to the inherent speed and connectivity problems of the Internet. The CONTRACTOR is responsible for its own connectivity to the Internet. EADOC response time is dependent on the CONTRACTOR's equipment, including processor speed, Internet access speed,

etc. and current traffic on the Internet. The OWNER will not be liable for any delays associated from the usage of EADOC including, but not limited to: slow response time, down time periods, connectivity problems, or loss of information.

B. The CONTRACTOR will ensure that connectivity to the EADOC system (whether at the home office or job site) is accomplished through DSL, cable, T-1, or wireless communications systems. The minimum bandwidth requirement for using the system is 128kb/s. It is recommended a faster connection be used when uploading pictures and files into the system. Under no circumstances shall the usage of the EADOC system be grounds for a time extension or cost adjustment to the Contract.

PART 2 PRODUCTS

2.01 DESCRIPTION

A. EADOC project management application (no equal). Provided by EADOC LLC www.EADOCsoftware.com

PART 3 EXECUTION

3.01 EADOC UTILIZATION

A. EADOC shall be used in connection with submittal preparation and information management required by the Contract. Requirements of this Section are in addition to requirements of all other Sections of the Contract.

B. Design Document Submittals:
   1. All design drawings and specifications shall be submitted as CAD ".dwg" files or PDF attachments to the EADOC submittal workflow process and form.

C. Shop Drawings:
   1. Shop drawing and design data documents shall be submitted as CAD ".dwg" files or PDF attachments to the EADOC submittal workflow process and form.

D. Product Data:
   1. Product catalog data and manufacturer's instructions shall be submitted as PDF attachments to the EADOC submittal workflow process and form.

E. Samples:
   1. Sample submittals shall be physically submitted as specified in Section 01330. CONTRACTOR shall enter submittal data information into EADOC with a copy of the submittal form(s) attached to the sample.

F. Administrative Submittals:
   1. All correspondence and pre-construction submittals shall be submitted using EADOC.

G. Compliance Submittals:
   1. Test reports, certificates, and manufacture field report submittals shall be submitted on EADOC as PDF attachments.

H. Record and Closeout Submittals:
   1. Operation and maintenance data and closeout submittals shall be submitted on EADOC as PDF documents during the approval and review stage as specified, with actual set of documents submitted for final.

I. Financial Submittals:
   1. Schedule of Values, Pay Estimates, and Change Request Proposals shall be submitted on EADOC. Supporting material for Pay Estimates and Change Requests shall be submitted on EADOC as PDF attachments.

END OF SECTION

SECTION 01324A

PROGRESS SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preparation, submittal, and maintenance of computerized progress schedule and reports, Contract Time adjustments, and payment requests, including the following:
   1. Preliminary Schedule.
   2. Baseline Schedule.
   3. Summary Schedule.
   4. Weekly Schedule.
   5. Schedule Updates.
   6. Schedule Revisions.
   7. Time Impact Analyses.
   8. Final Schedule Submittal.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 00500 - Agreement.
      b. Section 00700 - General Conditions.
      c. Section 01292 - Schedule of Values.
      d. Section 01294 - Applications for Payment.
      e. Section 01312 - Project Meetings.

1.02 RESPONSIBLE PERSON

A. Designate, in writing and within 5 calendar days after Notice of Award, person responsible for preparation, maintenance, updating, and revision of all schedules.

B. Qualifications of responsible person:
   1. Authority to act on behalf of Contractor.
   2. 5 years verifiable experience in preparation of complex construction schedules for projects of similar value, size, and complexity.
   3. Knowledge of critical path method (CPM) scheduling utilizing the specified Oracle Primavera software.

C. References: Submit written reference of 3 project Owners who have personal experience with this scheduler on previous projects. Identify name, address, telephone number, project name, and cost.

D. Scheduler: Dedicated full time to this project, located on-site. All scheduling software and hardware located on-site. Scheduler will attend all project meetings called for as specified in Section 01312.

E. Engineer reserves the right to disapprove scheduler when submitted by Contractor if not qualified. Engineer reserves the right to remove scheduler from the project if found to be incompetent.

1.03 SCHEDULING FORMAT AND SOFTWARE

A. Schedule format: Utilize (CPM) format.

B. Prepare computerized schedule utilizing Oracle Primavera P6 Professional release 7 or greater.

1.04 PRECONSTRUCTION SCHEDULING MEETING

A. Engineer will conduct Preconstruction Scheduling Meeting with Contractor's Project Manager, General Superintendent, and scheduler within 7 calendar days after Notice To Proceed. This meeting is separate from the Preconstruction Conference Meeting and is intended to cover schedule issues exclusively.

B. At the meeting, review scheduling requirements. These include schedule preparation, reporting requirements, labor and equipment loading, updates, revisions, and schedule delay analysis. Present schedule methodology, planned sequence of operations, resource loading methodology, and proposed activity coding structure.

C. Coding structure:
   1. Submit proposed coding structure, identifying the code fields and the associated code values it intends to use in the project schedule.
   2. A minimum, include code fields for Project Segment or Phase, Area of Work, Type of Work, Submittal/Procurement/Construction and Responsibility/Subcontractor. Refer to NETWORK DETAILS AND GRAPHICAL OUTPUT for listing of activity categories to be included in the schedule.

1.05 PREPARATION

A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints. Failure to conform to requirement may result in termination for cause as defined in Section 00700, under Suspension of Work and Termination.

B. Contractor's bid covers all costs associated with the execution of the Work in accordance with the Progress Schedule.

C. During preparation of the preliminary Progress Schedule, Engineer will facilitate Contractor's efforts by being available to answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

D. Prepare schedule utilizing Precedence Diagramming Method (PDM).

E. Prepare schedule utilizing activity durations in terms of working days. Do not exceed 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work. Coordinate holidays to be observed with the Owner and incorporate them into the schedule as non-working days.

F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Agreement. Contract requirements are not waived by failure of Contractor to include required schedule constraints, sequences, or milestones in schedule. Contract requirements are not waived by Owner's acceptance of the schedule. In event of conflict between accepted schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the Owner.

G. Reference schedule to working days with beginning of Contract Time as Day "1."

H. Baseline Schedule and Project Completion: Should Contractor submit a Baseline Schedule showing project completion more than 20 working days prior to Contract completion date, Owner may issue Change Order, at no cost to Owner, revising time of performance of Work and Contract completion date to match Contractor's schedule completion date. Adjust accordingly any Contract milestone dates.

I. Contract float is for the mutual benefit of both Owner and Contractor. Changes to the project that can be accomplished within this available period of float may be made by Owner without extending the Contract Time, by utilizing float. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date. Likewise, Contractor may utilize float to offset delays other than delays caused by Owner. Mutual use of float can continue until all available float shown by schedule has been utilized by either Owner or Contractor, or both. At that time, extensions of the Contract Time will be granted by Owner for valid Owner-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.

J. Resource loading and leveling: Input labor and equipment data on each construction activity. Manpower data consist of the man-hours estimated to perform each task, categorized by trade. Equipment data consist of equipment hours estimated to perform each task, categorized by piece of equipment. Optimize and level manpower and equipment requirements. Resource leveling reflect a reasonable plan for accomplishing Work. Individual activities may be sequenced within limits of available float. Keep to a minimum critical or near critical paths resulting from use of labor or equipment restraints. Near critical path identified as path with 15 or less working days of float.

K. Schedule logic: Assembled to show order in which Contractor proposes to carry out Work, indicate restrictions of access, availability of Work areas, and availability and use of manpower, materials, and equipment. Form basis for assembly of schedule logic on the following criteria:
   1. Which activities must be completed before subsequent activities can be started?

2. Which activities can be performed concurrently?
3. Which activities must be started immediately following completed activities?
4. What major facility, equipment or manpower restrictions are required for sequencing these activities?

L. Non-sequestering of float: Pursuant to float sharing requirements of Contract, schedule submittals can be rejected for, use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations or imposed dates.

M. Major subcontractor, parallel prime contractor sign off: Provide written confirmation of concurrence from all major subcontractors and independent prime contractors on site with all schedule submittals. Term “major subcontractor” as used in this Section means any subcontractor, at any tier, with a subcontract worth 5 percent or more of the total cost of the Work.

N. Imposed dates, hidden logic prohibited: Do not use imposed dates or hidden logic in preparation of schedule.

O. Interim milestone dates, operational constraints: In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on schedule. Do not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.

P. Schedule windows for Owner-furnished, Contractor-installed equipment or materials: Immediately after Award of Contract, obtain from Engineer anticipated delivery dates of Owner furnished equipment or materials. Show these dates in the schedule in same manner indicated by Engineer.

Q. Cost loading: All schedules:
1. Only on-site construction activities.
2. The sum total of all cost loaded activities equal to the current value of the Contract, including change orders, at all times.
3. Payment for mobilization or payment for materials or equipment delivered to the site, not yet incorporated into the Work.
4. Owner acceptance of the Baseline Schedule creates the Schedule of Values required as specified in Section 01292.
5. Provide updated Schedule of Values as the monthly Payment Application as specified in Section 01294.
6. Payments will not be made until updated Schedule of Values is accepted.

1.06 SUBMITTAL OF PROGRESS SCHEDULES

A. Submit preliminary and baseline schedule.

B. Submit, on a monthly basis, updated schedules as specified. Submit final schedule update as specified.

C. Submit revised schedules and time impact analyses as specified.

D. Submit schedules in the media and number of copies as follows:
   1. 3 sets of the CPM network and/or barchart (as specified by the Owner) on D-size sheets. Color-coding to be specified by the Owner.
   2. 3 sets of Tabular reports listing all activities sorted numerically identifying duration, early start, late start, early finish, late finish, total float, and all predecessor/successor information.
   3. 2 sets of CPM Schedule data electronic files stored on CD/DVD.

1.07 PRELIMINARY SCHEDULE

A. Submit Preliminary Schedule within 10 calendar days after Notice to Proceed. Include a detailed plan of operations for first 90 calendar days of Work after receipt of Notice to Proceed.

B. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule to review and make necessary adjustments. Submit revised preliminary schedule within 5 calendar days after meeting.

C. Submit schedule of manpower and costs for all activities with revised Preliminary Schedule. Provide realistic and level manpower and costs so as not to have unusual manpower requirements.

D. Schedule of costs:
   1. Schedule of Values as specified in Section 01292 for first 90 calendar days of Work.
   2. Submittal and acceptance of Preliminary Schedule is condition precedent to making of progress payments as specified in Section 01294 and payments for mobilization costs otherwise provided for in the Contract.
   3. Proceed with pay item Work after Preliminary Schedule and schedule of costs have been accepted by Owner.

E. Incorporate unchanged, the accepted Preliminary Schedule as first 90 calendar days of activity in Contractor's Baseline Schedule.

F. Update Preliminary Schedule monthly during first 90 calendar days after Notice to Proceed. Use Preliminary Schedule as the payment application as specified in Section 01294.

1.08 BASELINE SCHEDULE

A. No more than 45 calendar days after Notice of Award, submit the Baseline Schedule for all Work of the project. Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.

B. Acceptance of the Baseline Schedule by the Owner is a condition precedent to making payments as specified in Section 01294 after the first 90 calendar days after Notice to Proceed.

1.09 NETWORK DETAILS AND GRAPHICAL OUTPUT

A. Produce a clear, legible, and accurate calendar based, time scaled, graphical network diagram. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.

B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.

C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.

D. Indicate the critical path for the project.

E. Delineate the specified contract duration and identify the planned completion of the Work as a milestone. Show the time period between the planned and Contract completion dates, if any, as an activity identified as project float unless a Change Order is issued to officially change the Contract completion date.

F. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion date as milestones.

G. Include, in addition to construction activities:
   1. Submission dates and review periods for major equipment submittals, shoring submittals, and indicator pile program:
      a. Shoring reviews: Allow 4-week review period for each shoring submittal.
      b. Pile indicator program: Allow 3-week review period for analysis of program.
   2. Any activity by the Owner or the Engineer that may affect progress or required completion dates.
   3. Equipment and long-lead material deliveries over 8 weeks.
   4. Approvals required by regulatory agencies or other third parties.

H. Produce network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.

I. Identify the execution of the following:
   1. Mobilization.
      a. All required submittals and submittal review times showing 30 calendar day duration for such activities and equal amount of time for re-submittal reviews.
      b. Equipment and materials procurement/fabrication/delivery.
   2. Excavation.
      a. Shoring design and submission of detailed shoring submittals. Identify submission as a milestone.
      b. Shoring review, shoring materials procurement, shoring installation, and shoring removal.
      c. Backfill and compaction.
   3. Dewatering.
      a. Grading, subbase, base, paving, and curb and gutters.

b. Fencing and landscaping.
c. Concrete, including installation of forms and reinforcement, placement of concrete, curing, stripping, finishing, and patching.
d. Tests for leakage of concrete structures intended to hold water.

4. Masonry.
5. Metal fastenings, framing, structures, and fabrications.
6. Wood structures, finish carpentry, architectural woodwork, and plastic fabrications.
7. Waterproofing and dampproofing, insulation, roofing and flashing, and sealants.
8. Doors and windows, including hardware and glazing.
9. Finishes including coating and painting, flooring, ceiling, and wall covering.
10. Building specialties including furnishings, laboratory equipment, and toilet and bath accessories.
11. Process equipment, including identification of ordering lead-time, factory testing, installation, and witnessed operational testing.
12. Pumps and drives, including identification of ordering lead time, factory testing, and installation.
13. Conveying equipment including hoists and cranes, conveyor systems, and materials handling equipment, including identification of ordering lead-time and installation.
14. Other mechanical equipment including fans and heating, ventilating, and air conditioning equipment.
15. Trenching, pipe laying, and trench backfill and compaction.
16. Piping, fittings and appurtenances, including identification of ordering and fabrication lead time, layout, installation and testing.
17. Valves, gates, and operators, including identification of order lead-time, installation, and testing.
18. Plumbing specialties.
19. Electric transmission, service, and distribution equipment, including identification of ordering lead-time, factory testing, and witnessed operational testing.
20. Other electrical work including lighting, heating and cooling, and special systems, including identification of ordering lead-time.
21. Instrumentation and controls, including identification of ordering lead-time and witnessed operational testing.
22. Preliminary and witnessed operational testing of equipment, instrumentation, and controls.
23. Testing Phase including ten-day operational test.
24. Operation and maintenance training.
25. Start-Up Phase.
26. Commissioning Phase.
27. Substantial completion.
28. Punch list work.
29. Demobilization.

1.10 SUMMARY SCHEDULE

A. Provide Summary Schedule, which consolidates groups of activities associated with Major Items of Work shown on Baseline Schedule. Summary Schedule is intended to give an overall indication of the project schedule without a large amount of detail.

B. Updated and submitted monthly and after each Schedule Update or Schedule Revision.

1.11 SCHEDULE OF SHOP DRAWING AND SAMPLE SUBMITTALS

A. After Preliminary Schedule has been submitted and accepted by Owner, submit a list of all shop drawings and sample submittals anticipated in first 90 calendar days after Notice to Proceed using early start dates.

B. Progress payments during the first 90 calendar days after Notice to Proceed will not be made until preliminary list of all shop drawings and sample submittals is provided.

C. After Baseline Schedule has been submitted and accepted by Owner, print out and submit list of all shop drawings and sample submittals for all Work using early start dates. This listing will contain all submittals required for the entire Work including those listed above.

D. Submittal of final list: Condition precedent to making of progress payments after the first 90 calendar days after Notice to Proceed.

1.12 MANPOWER SCHEDULES

A. After Baseline Schedule has been submitted and accepted by Owner, submit a schedule histogram depicting total craft manpower and craft manpower for Contractor's own labor forces and those of each subcontractor. Submit this manpower schedule electronically on a computer disk in Excel format, with 1 paper copy.

B. Progress payments during the first 90 calendar days after Notice to Proceed will not be made until manpower schedule is provided.

1.13 EQUIPMENT SCHEDULE

A. After Baseline Schedule has been submitted and accepted by Owner, submit a tabular report listing each major piece of construction equipment to be used in performing the Work. This report will list major equipment for Contractor and each subcontractor. Submit this tabular report of equipment electronically on a computer disk in Excel format with 1 paper copy.

B. Progress payments during the first 90 calendar days after Notice to Proceed will not be made until equipment schedule is provided.

1.14 WEATHER DAY ALLOWANCE

A. Include as a separate identifiable activity on the critical path, an activity labeled "Weather Days Allowance." Insert this activity at the end of the schedule.
   1. The duration of the Weather Days Allowance shall be 50 days. Weather Days are defined as those days (as approved by the ENGINEER) in which the CONTRACTOR is unable to work on critical path activities due to the effects of inclement weather. Time extensions will be granted for approved Weather Days in excess of 50 days. The 50 days are included in the contract duration for Intermediate Milestone No. 2, which is specified in Section 00500. The Weather Day allowance shall also apply to Intermediate Milestone No. 1 in a pro-rated fashion.

B. Insert an activity in critical path to reflect weather day occurrences when weather days are experienced and accepted by Engineer. Identify this activity as a weather delay.

C. Reduce duration of Weather Days Allowance activity as weather delays are experienced and inserted into the Schedule. Remaining weather days in Weather Day Allowance at completion of project is considered float.

1.15 REVIEW AND ACCEPTANCE OF SCHEDULES

A. Engineer will review Baseline Schedules, Schedule Updates, Schedule Revisions and Time Impact Analyses to ascertain compliance with specified project constraints, compliance with milestone dates, reasonableness of durations and sequence, accurate inter-relationships, and completeness.

B. Engineer and Owner will issue written comments following completion of review of Baseline Schedule within 21 calendar days after receipt. Written comments on review of Schedule Updates and Schedule Revisions and Time Impact Analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.

C. Revise and resubmit schedule in accordance with Engineer’s comments within 7 calendar days after receipt of such comments, or request joint meeting to resolve objections. If a meeting is requested the Contractor and all major subcontractors must participate in the meeting with Engineer. Revise and resubmit schedule within 7 calendar days after meeting.

D. When schedule reflects Owner's and Contractor's agreement of project approach and sequence, schedule will be accepted by Owner. Use accepted schedule for planning, organizing, and directing the work and for reporting progress.

1.16 UPDATING THE SCHEDULE

A. Update the schedule prior to monthly progress meeting. Submit a written report of significant changes in progress meeting. Submit at the monthly progress meeting a detailed written list of all changes to the previous schedule submittal contained in the Schedule Update.

B. Submit updated schedule and materials specified under Submittal of Progress Schedules, 5 calendar days before the progress meeting.

C. Since monthly Schedule Update is the application for progress payment required as specified in Section 01294, submittal and acceptance of the monthly Schedule Update is a condition precedent to the making of any progress payments.

D. Prepare update using most recent accepted version of schedule. Include:
   1. Actual start dates of activities that have been started.
   2. Actual finish dates of activities that have been completed.
   3. Percentage of completion of activities that have been started but not finished.
   4. Actual dates on which milestones were achieved.
   5. Update activities by inputting percent complete figures with actual dates.
   6. Use retained logic in preparing Schedule Updates.
   7. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
   8. Revisions to the schedule may be included that have been previously approved in under Revisions to Schedule.

E. Submit written narrative report in conjunction with each Schedule Update. Describe:
   1. Activities added to or deleted from schedule. Identify added activities in manner distinctly different from original activity designations.
   2. Changes in sequence or estimated duration of activities.
   3. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
   4. Assumptions made and activities affected by incorporating change order work into the schedule.
   5. Activities added to or deleted from the schedule are to adhere to cost and other resource loading requirements.

F. Identify overall progress of each Major Item of Work in the Summary Schedule.

G. Should monthly Schedule Update show project completion earlier than current Contract completion date show early completion time as schedule activity, identified as “Project Float.”

H. Should monthly Schedule Update show project completion later than current Contract completion date prepare and submit a Schedule Revision in accordance with the Revisions to Schedule.

1.17 REVISIONS TO SCHEDULE

A. Submit Revised Schedule within 5 days:
   1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
   2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
   3. When the schedule does not represent the actual progress of activities.
   4. When any change to the sequence of activities, the completion date for major portions of the work, or when changes occur which affect the critical path.
   5. When Contract modification necessitates schedule revision, submit schedule analysis of change order work with cost proposal.

B. Submit revised schedule and materials as specified under Submittals of Progress Schedules.

C. Make revisions on most recently accepted version of schedule.

D. Create a separate submittal for Schedule Revisions. The Schedule Revisions shall not be submitted with Schedule Updates.

E. Schedule revisions will not be reflected in the schedule until after the revision is accepted by the Owner. This includes Schedule Revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.18 PAYMENT REQUESTS AND CASH FLOW

A. After Baseline Schedule has been submitted and accepted by the Owner, submit on a monthly basis a tabular report showing anticipated earnings each month of the Contract period. This tabulation will be based on the summation of the cost-loaded activities each month. Submit an updated payment schedule each month showing actual earned amounts and anticipated remaining earnings.

B. Utilize cost loaded monthly Schedule Updates as the applications for payment specified in Section 01294. List payment application in Excel format of all schedule activities showing cost and percentage completion during the current month for which payment is sought. Progress payments will not be made until monthly Schedule Update is provided.

1.19 WEEKLY SCHEDULE

A. Submit to Engineer, on the last working day of every week, a progress schedule showing the activities completed during the previous week and the schedule of activities for the following 2 weeks.

B. Use the logic and conform to the status of the current progress schedule when producing a Weekly Schedule in CPM schedule or a bar chart format. In the event that the Weekly Schedule no longer conforms to the current schedule, Contractor may be required to revise the schedule.

C. The activity designations used in the Weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.

D. Contractor and Engineer must agree on the format of the Weekly Schedule.

1.20 SCHEDULE OF VALUES

A. Requirements for Schedule of Values are specified in Section 01292.

B. Submit, in conjunction with the Progress Schedule, a Schedule of Values identifying costs of all on-site construction activities as generated by the cost loaded schedule. Equate the aggregate of these costs to the Lump Sum Contract Price.

1.21 ADJUSTMENT OF CONTRACT TIMES

A. Contract Time will be adjusted only for causes specified in Contract Documents.
   1. Non-excusable delay: Non-excusable delays include actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility (including actions or inactions of subcontractors, suppliers, or

material manufacturers at any tier) that would independently delay the completion of the Work beyond the current Contract completion date). No time extensions will be granted for non-excusable delays.

2. Excusable delay: Events which are unforeseeable, outside the control of, and without the fault or negligence of either the Owner or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date. The Contractor is entitled to a time extension only. No other damages will be approved.
3. Compensable delay: Actions or inactions of the Owner, or events for which the Owner has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date. The Contractor is entitled to a time extension and delay damages.
4. Concurrent delay: Concurrent delay is any combination of the above 3 types of delay occurring on the same calendar date.
    a. Exception to concurrent delay: Cases where the combination consists of 2 or more instances of the same type of delay occurring on the same calendar date. When one cause of delay is Owner-caused or caused by an event which is beyond the control and without the fault or negligence of either the Owner or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.

B. If the Contractor believes that the Owner has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time.

C. Time Impact Analysis:
1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). Represent the delay event in the schedule by:
    a. Inserting new activities associated with the delay event into the schedule.
    b. Revising activity logic.
    c. Revising activity durations.
2. If the project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
3. The Time Impact Analysis submittal must include the following information:
    a. A fragment of the portion of the schedule affected by the delay event.
    b. A narrative explanation of the delay issue and how it impacted the schedule.
    c. A CD containing the schedule file used to perform the Time Impact Analysis.

D. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor may be entitled to a time extension and no compensation for extended overhead. The OWNER may seek compensation for extended overhead.

E. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date. Utilize the

latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.

F. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.

G. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.

H. If completion of the project occurs within the specified Contract Time, the Contractor is not entitled to job-site or home office overhead beyond the Contractor's originally planned occupancy of the site.

I. Notify Engineer of a request for Contract Time adjustment. Submit request as specified with Contract Documents. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

J. The Engineer will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing.
   1. Include the new Progress Schedule data, if accepted by the Owner, in the next monthly Schedule Update.
   2. When the Owner has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of time adjustment in the Progress Schedule as the Engineer may accept as appropriate for such interim purpose. It is understood and agreed that any such interim acceptance by the Engineer shall not be binding and shall be made only for the purpose of continuing to schedule the Work, until such time as a final determination as to any adjustment of the Contract Time acceptable to the Engineer has been made. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

K. Refer to Section 00700, Article 12 for additional requirements.

1.22 FINAL SCHEDULE SUBMITTAL

A. The final Schedule Update becomes the As-Built Schedule.
   1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.
   2. Contractor’s Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.

B. Retainage will not be released until final Schedule Update is provided.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements and procedures for submittals.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01292 - Schedule of Values.
      b. Section 01294 - Applications for Payment.
      c. Section 01322 - Web Based Construction Document Management.
      d. Section 01324A - Progress Schedules and Reports.
      e. Section 01600 - Product Requirements.
      f. Section 01770 - Closeout Procedures.
      g. Section 03200 - Concrete Reinforcing.

1.02 DEFINITIONS

A. Certificates: Describe certificates that document affirmations by the Contractor or other entity that the work is in accordance with the Contract Documents.

B. Extra stock materials: Describe extra stock materials to be provided for the Owner's use in facility operation and maintenance.

C. Maintenance material submittals: Use this article to categorize maintenance materials submittals requiring no A/E action other than confirmation of receipt under an explanatory heading.

D. Manufacturer's instructions: Instructions, stipulations, directions, and recommendations issued in printed form by the manufacturer of a product addressing handling, installation, erection, and application of the product; manufacturer's instructions are not prepared especially for the Work.

E. Product data: Product data usually consists of manufacturers' printed data sheets or catalog pages illustrating the products to be incorporated into the project.

F. Samples: Samples are full-size actual products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.

G. Spare parts: Describe spare parts necessary for the Owner's use in facility operation and maintenance; identify the type and quantity here, but include the actual characteristics of the spare parts in Product as part of the specification of the product.

H. Shop drawings: Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown in the contract documents. Shop drawings could include graphic line-type drawings, single-line diagrams, or schedules and lists of products and their application.

I. Submittals: Submittals are samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform with the Contract Documents.

J. Tools: Tools are generally defined as items such as special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit.

1.03 GENERAL INSTRUCTIONS

A. Provide submittals that are specified or reasonably required for construction, operation, and maintenance of the Work.

B. Edit all submittals so that the submittal specifically applies to only the equipment furnished. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.

C. Prepare submittals in the English language. Do not include information in other languages.

D. Present measurements in customary American units (feet, inches, pounds, etc).

E. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

F. Where multiple submittals are required, provide a separate submittal for each specification section.
   1. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
   2. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section.
      a. For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.

G. Hardcopy submittals must be clear and legible, and of sufficient size for presentation of information.
   1. Minimum page size will be 8-1/2 inches by 11 inches.
   2. Maximum page size will be 11 inches by 17 inches.

H. Submittals in electronic media format:
   1. General: Provide all information in PC compatible format using Windows XP operating system.
   2. Text: Provide text documents and manufacturer's literature using current version of Adobe Acrobat (i.e., PDF extension).
   3. Graphics: Provide all graphic submittals (drawings, diagrams) utilizing current version of Adobe Acrobat (i.e., PDF extension).
   4. Contractor using other software shall be required to provide to the Engineer conclusive evidence of 100 percent data transfer compatibility.

1.04 SUBMITTAL CONTENTS

A. Submittal Transmittal Form is provided in Appendix A of this Section.
   1. Substitute forms require Engineer approval based on forms providing the same information, statements, and certifications.
   2. Required submittal numbering format: Section number-sequential number-resubmittal number:
      a. Example: 03200-002-1:
         1) "03200" indicates the affected specification is Section 03200.
         2) "002" indicates the second submittal under this Section.
         3) "1" indicates the first resubmittal of the Submittal 03200-002.
      b. Contractor may add a separate numbering scheme for Contractor's internal use. However, all correspondence with Engineer must include the required submittal numbering.
   3. Specification section: Include with each submittal a copy of the relevant specification section, including relevant addendum updates.
      a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
   4. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates.
      a. Indicate either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
      c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.
   5. Other information or materials as needed.

1.05 SUBMITTAL FORMAT

A. Fully indexed with a tabbed divider for every component.

B. Sequentially number pages within the tabbed sections:
   1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

C. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

D. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.

E. Consolidate electronic format submittals with multiples pages into a single file.

1.06 SUBMITTAL PROCEDURE

A. Contractor: Prepare submittal information in sufficient detail to show compliance with specified requirements.
   1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
   2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
   3. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.

B. Contractor: stamp, sign and date submittals indicating review and approval:
   1. Signature indicates Contractor has satisfied submittal review responsibilities and constitutes Contractor's written approval of submittal.
   2. Submittals without Contractor's signature will be returned to the Contractor unreviewed. Subsequent submittal of this information will be counted as the first resubmittal.

C. Contractor: Send submittal to Engineer.
   1. Provide specified number of copies of submittal.
   2. Delivery: Deliver submittals to Engineer using web based construction document management system described in Section 01322.
   3. Timeliness: Schedule and make submissions in accordance with the requirements of the individual specification sections and in such a sequence as to cause no delay in Work.
   4. Contractor assumes risk of expense and delays when proceeding with work related to required submittals without review and acceptance.

D. Engineer: Review submittal and provide response.
   1. Review description:
      a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular submittal whether or not a stamp or seal is required by Contract Documents or Laws and Regulations.
      b. Engineer's review of submittals shall not release Contractor from Contractor's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release Contractor from fulfilling purpose of installation nor from Contractor's liability to replace defective work.
      c. Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents.
      d. Engineer's review does not extend to:
         1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by Contractor.

2) Contractor's means, methods, techniques, sequences, or procedures except when specified, indicated on the Drawings, or required by Contract Documents.
3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.

e. Engineer can accept or reject any exception at their sole discretion.

2. Review timeframe:
   a. Except as may be provided in technical specifications, a submittal will be returned within 30 calendar days.
   b. When a submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned.
   c. Engineer's acceptance of progress schedule containing submittal review times less than those specified or agreed to in writing by Engineer will not constitute Engineer's acceptance of review times.
   d. Critical submittals:
      1) Contractor will notify Engineer in writing that timely review of a submittal is critical to the progress of Work.
   e. Engineer will provide decision on request.
      1) Written acceptance of request.
         a) Written agreement by Engineer to reduce submittal review time will be made only for unusual situations.
      2) Written rejection of request.
3. Schedule delays:
   a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of submittals, unless all of the following criteria are met:
      1) Engineer has failed to review and return first submission within the agreed upon time frame.
      2) Contractor demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return submittal within time indicated and accepted by Engineer.
4. Review responses: 1 copy of submittal will be returned to Contractor with one of the following reviewer's response and stamp.
   a. Reviewed - No Corrections Noted:
      1) Contractor may proceed with the work described in the submittal.
   b. Resubmittal not required - make corrections noted/see comments:
      1) Contractor shall incorporate all review comments into the work, but resubmittal of an amended submittal package is not required.
      2) Resubmit only the portion of package necessary to respond to Engineer's comments.
   c. Correct and resubmit - make corrections noted/see comments:
      1) Contractor shall incorporate the review comments into a complete revised package, and resubmit it for review.
   d. Rejected- see comments:
      1) Contractor shall develop a new submittal package with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.
   e. Submittal not reviewed, filed for record:
      1) Contractor has no further action required.
   f. Submittal not reviewed:
      1) Submittals not required by these Contract Documents will be returned to the Contractor without review.

E. Contractor: Prepare resubmittal, if applicable.
   1. Clearly identify each correction or change made.
   2. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented throughout the submittal.
      a. Acceptable responses to Engineer's comments are listed below:
         1) "Incorporated" Engineer's comment or change is accepted and appropriate changes are made.
         2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.
      b. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.
   3. Review costs:
      a. Costs incurred by Owner as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by Contractor.
      b. Reimbursement to Owner will be made by deducting such costs from Contractor's subsequent progress payments.

1.07 SUBMITTALS

A. Shop Drawings:
   1. Certificate or letter signed by office of company stating conformance with the ARRA requirements specified in Section 01600.
   2. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in prior to the preparation of shop drawings.
   3. Details:
      a. Fabrication drawings: drawn to scale and dimensioned.
      b. Front, side, and, rear elevations, and top and bottom views, showing all dimensions.
      c. Locations of conduit entrances and access plates.
      d. Component layout and identification.
      e. Weight.
      f. Finish.
      g. Temperature limitations, as applicable.
      h. Nameplate information.

B. Product Information:
   1. Product Data:
      a. Details:
         1) Supplier name and address.
         2) Subcontractor name and address.
      b. Include:
         1) Catalog cuts.
         2) Bulletins.
         3) Brochures.

4) Manufacturer's Certificate of Compliance: signed by product manufacturer along with supporting reference data, affidavits, and tests, as appropriate.
5) Manufacturer's printed recommendations for installation of equipment.
6) Quality photocopies of applicable pages from manufacturer's documents.

2. Completely fill out a Motor Data Sheet, as specified in Section 16222, for every motor furnished:
   a. Submit one copy of the Motor Data Sheet to the Engineer for review as part of the associated equipment submittal.
3. Samples:
   a. Number of samples: 3 minimum.
      1) Owner: 1 copy.
      2) Engineer: 2 copies.
      3) Contractor: None.
   b. Details:
      1) Submit labeled samples.
      2) Samples will not be returned.
      3) Provide samples from manufacturer's standard colors, materials, products, or equipment lines.
         a) Clearly label samples to indicate any that represent non-standard colors, materials, products, or equipment lines and that if selected, will require an increase in Contract Time or Contract Price.
4. Minor or incidental products and equipment schedules:
   a. Details:
      1) Shop Drawings of minor or incidental fabricated products will not be required, unless requested.
      2) Submit tabulated lists of minor or incidental products showing the names of the manufacturers and catalog numbers, with Product Data and Samples as required to determine acceptability.

C. Design calculations:
   1. Details:
      a. Defined in technical sections.
      b. Calculations must bear the original seal and signature of a Professional Engineer or Structural Engineer licensed in the state where the project is located and who provided responsible charge for the design.

D. Qualifications Statements:
   1. Details:
      a. Defined in technical sections.
      b. Licensing documentation.
      c. Certification documentation.
      d. Education documentation.

E. Quality assurance/control submittals:
   1. Mill test reports:
      a. Details:
         1) Submit certified copies of factory and mill test reports.

2) Do not incorporate Products in the Work which have not passed testing and inspection satisfactorily.
3) Pay for mill and factory tests.

2. Test reports:
   a. Details:
      1) Include the following information:
         a) A description of the test.
         b) List of equipment used.
         c) Name of the person conducting the test.
         d) Date and time the test was conducted.
         e) Ambient temperature and weather conditions.
         f) All raw data collected.
         g) Calculated results.
         h) Clear statement if the test passed or failed the requirements stated in Contract Documents.
         i) Signature of the person responsible for the test.
3. Factory Acceptance Test:
   a. Details: Include complete test procedure and all forms to be used during test.
4. Certificates:
   a. Details: Defined in technical sections.
5. Manufacturers' field reports:
   a. Details: Certificate of proper installation.
6. Field Samples:
   a. Details: Defined in technical sections.
7. Test Plans:
   a. Details: Defined in technical sections.

F. Project management submittals:
   1. Applications for payment:
      a. Details:
         1) As specified in Section 01294.
   2. Schedules:
      a. Details:
         1) Progress schedules: As specified in Section 01324A.
         2) Schedule of values: As specified in Section 01292.
         3) Schedule of submittals: As specified in Section 01324A.
   3. Progress reports and quantity charts:
      a. Details: As specified in Section 01324A.

1.08 CLOSEOUT SUBMITTALS

A. Provide closeout submittals as specified in Section 01770.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

CONTRACTOR SUBMITTAL

TRANSMITTAL

Owner:		**Submittal Number:**	
Contractor:		**Package Number:**	
Date:		**Project Number:**	

TO: **CAROLLO ENGINEERS (Field Address)** Enter Address Here	
From: Enter Name & Address Here	
SPECIFICATION NO.	**SUBJECT OF SUBMITTAL / EQUIPMENT SUPPLIER**

Check Either (A) or (B):

☐ (A) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.

☐ (B) We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the following deviations (list deviations):

General Contractor's Authorized Signature: _____

PM/CM Office Use

Date Received GC to PM/CM: _____

Date Received PM/CM to Reviewer: _____

Date Received Reviewer to PM/CM: _____

Date Sent PM/CM to GC: _____

SECTION 01340

PHOTOGRAPHIC AND VIDEOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for:
   1. Pre-construction photographs.
   2. Pre-construction videos.
   3. Post-construction photographs.
   4. Post-construction videos.

B. The purpose of the photographs and videos is to document the condition of the facilities prior to the CONTRACTOR beginning work at the Project site and after Substantial Completion of the Work.

C. Areas to be photographed and videoed shall include the site of the Work and all existing facilities adjoining the Project site that could be damaged as a result of the CONTRACTOR's Work.

D. The scope of the photographic and videographic documentation shall be the sole responsibility of the CONTRACTOR, but shall be acceptable to the ENGINEER.

E. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01312 - Project Meetings.
      b. Section 01770 - Closeout Procedures.

1.02 SUBMITTALS

A. Key plan: Submit key plan of Project site with notation of vantage points marked for location and direction of each photograph. Include the same label information as the corresponding set of photographs.

B. Photographs:
   1. Paper media:
      a. Submit 4 prints of each photographic view within 7 days of taking photographs.

b. Format:
   1) 4- by 6-inch photos.
   2) Photographs shall be enclosed in clear plastic sleeves that are punched for standard 3-ring binders.
c. Identification: On back or below each print, provide the following information:
   1) Name of project.
   2) Date photograph was taken.
   3) Description of vantage point, indicating location and direction by compass point.

2. Digital media:
   a. Provide photos as individual, indexed JPG files with the following characteristics:
      1) Compression shall be set to preserve quality over file size.
      2) Highest resolution JPG images shall be submitted. Resizing to a smaller size when high resolution JPGs are available shall not be permitted.
      3) JPG image resolution shall be 800 by 600 or higher.
      4) Images shall have rectangular clean images. Artistic borders, beveling, drop shadows, etc., are not permitted.

C. Videos:
   1. Submit 4 copies of each video within 7 days of recording.
   2. Videos shall be submitted in a digital color video format on a DVD suitable for playback on a standard DVD player.
   3. Identification: On each copy provide a label with the following information:
      a. Name of project.
      b. Date video was recorded.

D. Pre-construction photographs and videos: Submit prior to beginning work at the Project site or prior to the Preconstruction Conference specified in Section 01312, whichever occurs earlier.

E. Post-construction photographs and videos: Submit with project closeout documents as specified in Section 01770.

PART 2 PRODUCTS

2.01 MEDIA

A. Paper media:
   1. Commercial grade, glossy surface, acid-free photographic paper.

B. Digital media:
   1. 120 millimeters, 700-MB, 80-minute CD compatible with Microsoft Windows XP.

C. Videos:
   1. 120 millimeters, DVD compatible with standard DVD players.

PART 3 EXECUTION

3.01 GENERAL

A. Photographs (paper and digital media):
   1. Date stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.

B. Videos:
   1. Display continuous running time.
   2. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.

END OF SECTION

SECTION 01350

SPECIAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Special procedures for locating and verifying concealed existing facilities.

1.02 CONCEALED EXISTING FACILITIES

A. Verify locations of utilities and facilities which may exist by consulting with the Owner, utility companies, and Underground Services Alert (USA) or other service available in area of Project:
   1. Abide by easement and right-of-way restrictions.

B. Notify the Owner and owners of facilities when the Work will be in progress. Make arrangements for potential emergency repairs in accordance with requirements of owners of utility facilities, including individual or residential facilities.

C. Assume responsibility for repair of facilities damaged by performance of the Work.

D. Expose sanitary sewers, water, gas, electric, telephone utility lines, and other underground facilities indicated to permit survey location prior to commencement of Work in affected area:
   1. Expose in ample time to permit relocation of interfering utilities with minimum delaying effect on Contract Time.

E. Work required for raising, lowering, or relocating utilities not indicated will be performed by affected utility owners or as part of the Work at option of affected owners of utilities:
   1. When part of the Work, perform work in accordance with standards of affected utility owner, and adjustment to Contract Price and Contract Times will be made as stipulated in conditions of Contract.

F. Refer to Section 00700 (General Conditions), Article 4 for additional requirements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01410

CODE REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Regulatory requirements:
   1. Building code.
   2. Electrical code.
   3. Energy code.
   4. Fire code.
   5. Mechanical code.
   6. Plumbing code.

1.02 REFERENCES

A. National Fire Protection Association (NFPA):
   1. NFPA 70: National Electrical Code, 2011.

B. State or Local Building Codes and Amendments.
   1. California Code of Regulations (CCR),
      a. Title 24:- California Building Standards Code.
         1) California Building Code - 2010 (CBC). (Title 24, Part 2.)
         2) California Electrical Code - 2010 (CEC). (Title 24, Part 3.)
         3) California Mechanical Code - 2010 (CMC). (Title 24, Part 4.)
         4) California Plumbing Code - 2010 (CPC). (Title 24, Part 5.)
         5) California Energy Code - 2010 (CEC). (Title 24, Part 6.)
         6) California Fire Code - 2010 (CFC) with San Luis Obispo County amendments. (Title 24, Part 9.)
         7) California Green Building Standards Code -2010 (Cal Green). (Title 24, Part 11.)
      b. Title 8: Industrial Relations. Division 1: Department of Industrial Relations. Chapter 4: Division of Industrial Safety
         1) California Elevator Safety Construction Code - 2007.
   2. San Luis Obispo County Code, Coastal Zone Land Use Ordinance (CALUO, Title 23).

1.03 SYSTEM DESCRIPTION

A. Design requirements:
   1. Building code:
      a. California Building Code.
      b. California Green Building Standards Code.
   2. Electrical code:
      a. NFPA 70: National Electric Code.
      b. California Electrical Code.
   3. Energy conservation code:
      a. California Energy Code.

4. Fire code:
    a. California Fire Code, with San Luis Obispo County Amendments.
    b. NFPA 13: Standard for the Installation of Sprinkler Systems.
    c. NFPA 20: Standard for the Installation of Stationary Pumps for Fire Protection.
    d. NFPA 30: Flammable and Combustible Liquids Code.
    e. NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
    f. NFPA 1142: Standard on Water Supplies for Suburban and Rural Fire Fighting.
5. Mechanical codes:
    a. California Mechanical Code.
6. Plumbing code:
    a. California Plumbing Code.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01424

ABBREVIATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Abbreviations and meanings.

1.02 INTERPRETATIONS

A. Interpret abbreviations by context in which abbreviations are used.

1.03 ABBREVIATIONS

A. Abbreviations used to identify reference standards:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AAN	American Association of Nurserymen
AASHTO	American Association of State Highway and Transportation Officials
ABC	Associated Air Balance Council
AATCC	American Association of Textile Chemists and Colorists.
ABPA	Acoustical and Board Products Association
ACGIH	American Conference of Government Industrial Hygienists
ACI	American Concrete Institute
ACIL	American Council of Independent Laboratories
ADC	Air Diffusion Council
ABMA	American Bearing Manufacturers' Association (formerly AFBMA, Anti-Friction Bearing Manufacturers' Association)
AGA	American Gas Association
AGC	Associated General Contractors
AGMA	American Gear Manufacturers' Association
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AI	Asphalt Institute
AIA	American Institute of Architects
AIMA	Acoustical and Insulating Materials Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association International, Inc.
AMG	Arizona Masonry Guild
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers

ASME	American Society of Mechanical Engineers
ASTM	ASTM International
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWSC	American Welding Society Code
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America
BSI	Building Stone Institute
Caltrans	California Department of Transportation
Cal-OSHA	California Occupational Safety and Health Administration
CCR	California Code of Regulations
CFR	United States Code of Federal Regulations
CLFMI	Chain Link Fence Manufacturers Institute
CLSM	Controlled Low-Strength Material
CPSC	U.S. Consumer Product Safety Commission
CRA	California Redwood Association
CRI	Carpet and Rug Institute
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standards
CSA	CSA International
CSI	Construction Specifications Institute
CTI	Ceramic Tile Institute
DHI	Door and Hardware Institute
EIFS	Exterior Insulation and Finish System
EJCDC	Engineers Joint Contract Documents Committee
EPA	United States Environment Protection Agency
FDA	Food and Drug Administration
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	FM (Factory Mutual) Global
FS	Federal Specifications
FTI	Facing Tile Institute
GA	Gypsum Association
HI	Hydraulic Institute
HMMA	Hollow Metal Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
ICC	International Code Council
ICEA	Insulated Cable Engineer’s Association
IEEE	Institute of Electrical and Electronics Engineers

ISA	International Society of Automation
ISO	International Organization for Standardization
JIC	Joint Industrial Council
LOVR	Los Osos Valley Road
LOWRF	Los Osos Water Recycling Facility
MAG	Maricopa Association of Governments
MIA	Marble Institute of America
ML/SFA	Metal Lath/Steel Framing Association
MS	Military Specifications
NAAMM	National Association of Architectural Metal Manufacturers
NACE	NACE International
NAPA	National Asphalt Pavement Association
NAVFAC	Department of the Navy Facilities Engineering Command
NBHA	National Builders Hardware Association
NCMA	National Concrete Masonry Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NETA	International Electrical Testing Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NMWIA	National Mineral Wool Insulation Association
NPCA	National Paint and Coatings Association
NRCA	National Roofing Contractors Association
NSF	NSF International
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturer's Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDCA	Paint and Decorating Contractors of America
PDI	Plumbing and Drainage Institute
PEI	Porcelain Enamel Institute
PS	Product Standard
RCSC	Research Council on Structural Connections
RILEM	International Union of Testing and Research Laboratories for Materials and Structures
RTI	Resilient Tile Institute
SAE	SAE International
SCPA	Structural Clay Products Association
SDI	Steel Door Institute

SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SLOC	San Luis Obispo County
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Society for Protective Coatings
TABB	Testing, Adjusting, and Balancing Bureau
TCA	Tile Council of America
UL	Underwriters Laboratories, Inc.
UNS	Unified Numbering System
USDA	United States Department of Agriculture
USACE	U.S. Army Corps of Engineers
VA	Vermiculite Association
WCLA	West Coast Lumberman's Association
WCLIB	West Coast Lumber Inspection Bureau
WPA	Western Pine Association
WPOA	Western Plumbing Officials Association
WRC	Welding Research Council
WSCPA	Western States Clay Products Association
WWPA	Western Wood Products Association

B. Abbreviations used in Specifications and Drawings:

a	year or years (metric unit)
A	ampere or amperes
am	ante meridian (before noon)
ac	alternating current
ac-ft	acre-foot or acre-feet
atm	atmosphere
AWG	American Wire Gauge
bbl	barrel or barrels
bd	board
bhp	brake horsepower
BIL	basic impulse insulation level
bil gal	billion gallons
BOD	biochemical oxygen demand
Btu	British thermal unit or units
Btuh	British thermal units per hour
bu	bushel or bushels
BV	bed volume(s)
C	degrees Celsius
cal	calorie or calories
cap	capita
cd	candela or candelas
cfm	cubic feet per minute
Ci	curie or curies
CIPP	Cured-in-Place Pipe

cm	centimeter or centimeters
cmu	concrete masonry unit
CO	carbon monoxide
Co.	Company
CO_2	carbon dioxide
COD	chemical oxygen demand
Corp.	Corporation
counts/min	counts per minute
cu	cubic
cu cm	cubic centimeter or centimeters
cu ft	cubic foot or feet
cu ft/day	cubic feet per day
cu ft/hr	cubic feet per hour
cu ft/min	cubic feet per minute
cu ft/sec	cubic feet per second
cu in	cubic inch or inches
cu m	cubic meter or meters
cu yd	cubic yard or yards
d	day (metric units)
day	day (English units)
db	decibels
D/d	column diameter to particle diameter ratio
DB	dry bulb (temperature)
dc	direct current
diam	diameter
DO	dissolved oxygen
DS	dissolved solids
EBCT	empty bed contact time
emf	electromotive force
fpm	feet per minute
F	degrees Fahrenheit
ft	feet or foot
fc	foot-candle or foot candles
ft/day	feet per day
ft/hr	feet per hour
ft/min	feet per minute
ft/sec	feet per second
g	gram or grams
G	gravitational force
gal	gallon or gallons
gal/day	gallons per day
gal/min	gallons per minutes
gal/sec	gallons per second
gfd	gallons per square foot per day
g/L	grams per liter
gpd	gallons per day
gpd/ac	gallons per day per acre
gpd/cap	gallons per day per capita

gpd/sq ft	gallons per day per square foot
gph	gallons per hour
gpm	gallons per minute
gpm/ft^2	gallons per minute per square foot
gps	gallons per second
g/cm^3	grams per cubic centimeter
h	hour or hours (metric units)
ha	hectare or hectares
hp	high point
hp	horsepower
hp-hr	horsepower-hour or horsepower-hours
hr	hour or hours (English units)
Hz	hertz
ID	inside diameter
ihp	indicated horsepower
Inc.	Incorporated
inch	inch
inches	inches
inches/sec	inches per second
J	joule or joules
JTU	Jackson turbidity unit or units
k	kips
K	kelvin
K	thermal conductivity
kA	kiloampere
kcal	kilocalorie or kilocalories
kcmil	thousand circular mils
kg	kilogram or kilograms
kip	kilopound or kilopounds
km	kilometer or kilometers
kN	kilonewton or kilonewtons
kPa	kilopascal or kilopascals
ksi	kips per square inch
kV	kilovolt or kilovolts
kVA	kilovolt-ampere or kilovolt-amperes
kW	kilowatt or kilowatts
kWh	kilowatt hour
L	liter or liters
lb/1000 cu ft	pounds per thousand cubic foot
lb/acre-ft	pounds per acre-foot
lb/ac	pounds per acre
lb/cu ft	pounds per cubic foot
lb/day/cu ft	pounds per day per cubic foot
lb/day/acre	pounds per day per acre
lb/sq ft	pounds per square foot
L/D Ratio	Ratio of filter height to filter media particle diameter
lin	linear, lineal

lin ft	linear foot or feet
lm	lumen or lumens
lmh	liters per square meter per hour
log	logarithm (common)
ln	logarithm (natural)
lx	lux
m	meter or meters
M	molar (concentration)
mA	milliampere or milliamperes
max	maximum
mCi	millicurie or millicuries
meq	milliequivalent
meq/mL	milliequivalents per milliliter
MFBM	thousand feet board measure
mfr	manufacturer
mg	milligram or milligrams
mgd/ac	million gallons per day per acre
mgd	million gallons per day
mg/L	milligrams per liter
mrem	millirem
µF	microfarad or microfarads
Mil	0.001 inch (used for coating thickness)
mile	mile
mil. gal	million gallons
miles	miles
min	minimum
min	minute or minutes
MLSS	mixed liquor suspended solids
MLVSS	mixed liquor volatile suspended solids
mm	millimeter or millimeters
mol wt	molecular weight
mol	mole
Mpa	megapascal or megapascals
mph	miles per hour
MPN	most probable number
MPT	National Pipe Thread, male fitting
mR	milliroentgen or milliroentgens
Mrad	megarad or megarads
mV	millivolt or millivolts
MW	megawatt or megawatts
µg/L	micrograms per liter
µm	micrometer or micrometers
µS/cm	microSeimens per centimeter
N	newton or newtons
N	normal (concentration)
ND	not detected
No.	number
Nos	numbers
NPT	National Pipe Thread
NRC	noise reduction coefficient

NTU or ntu	nephelometric turbidity unit
oc	on center
OD	outside diameter
ORP	oxidation-reduction potential
OT	ortho-tolidine
OTA	ortha-tolidine-arsenite
oz	ounce or ounces
oz/sq ft	ounces per square foot
Pa	pascal or pascals
pl	plate or property line
pm	post meridiem (afternoon)
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand
pr	pair
psf/hr	pounds per square foot per hour
psf	pounds per square foot
psi	pounds per square inch
psia	pounds per square inch absolute
psig	pounds per square inch gauge
PVC	polyvinyl chloride
qt	quart or quarts
R	radius
R	roentgen or roentgens
rad	radiation absorbed dose
RH	relative humidity
rpm	revolutions per minute
rps	revolutions per second
s	second (metric units)
S	Siemens (mho)
scfh	standard cubic feet per hour
SDI	sludge density index or silt density index
sec	second (English units)
SI	International System of Units
sp	static pressure
sp gr	specific gravity
sp ht	specific heat
sq	square
cm^2 or sq cm	square centimeter or centimeters
sq ft	square feet or foot
sq inch	square inch
sq inches	square inches
km^2 or sq km	square kilometer or kilometers
m^2 or sq m	square meter or meters
mm^2 or sq mm	square millimeter or millimeters
sq yd	square yard or yards
SS	suspended solids
STC	Sound Transmission Class

SVI	sludge volume index
TDS	total dissolved solids
TEFC	totally enclosed, fan-cooled
TKN	total Kjeldahl nitrogen
TLM	median tolerance limit
TOC	total organic carbon
TOD	total oxygen demand
TOW	top of weir
TS	total solids
TSS	total suspended solids
TVS	total volatile solids
U	U Factor/U Value
U	Coefficient of Heat Transfer
U	heat transfer coefficient
UNS	Uniform Numbering System
US	United States
V	volt or volts
VA	volt-ampere or volt-amperes
W	watt or watts
WB	wet bulb
wg	water gauge
wk	week or weeks
WRT	water remediation technologies
wt	weight
yd	yard or yards
yr	year or years (English unit)

C. Abbreviations used on Drawings: As listed on Drawings or in Specifications.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01450

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Quality control and control of installation.
   2. Tolerances.
   3. References.
   4. Mock-up requirements.
   5. Authority and duties of Owner's representative or inspector.
   6. Sampling and testing.
   7. Testing and inspection services.
   8. Contractor's responsibilities.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01455 - Special Tests and Inspections.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. When specified, products will be tested and inspected either at point of origin or at Work site:
   1. Notify Engineer in writing well in advance of when products will be ready for testing and inspection at point of origin.
   2. Do not construe that satisfactory tests and inspections at point of origin is final acceptance of products. Satisfactory tests or inspections at point of origin do not preclude retesting or re-inspection at Work site.

I. Do not ship products which require testing and inspection at point of origin prior to testing and inspection.

1.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When Manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES

A. American Society for Testing and Materials (ASTM): E 329 - Standard for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

B. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

C. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

D. Obtain copies of standards where required by product specification sections.

E. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.05 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this Section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

1.06 AUTHORITY AND DUTIES OF OWNER'S REPRESENTATIVE OR INSPECTOR

A. Owner's Project Representative employed or retained by Owner is authorized to inspect the Work.

B. Inspections may extend to entire or part of the Work and to preparation, fabrication, and manufacture of products for the Work.

C. Deficiencies or defects in the Work which have been observed will be called to Contractor's attention.

D. Inspector will not:
   1. Alter or waive provisions of Contract Documents.
   2. Inspect Contractor's means, methods, techniques, sequences, or procedures for construction.
   3. Accept portions of the Work, issue instructions contrary to intent of Contract Documents, or act as foreman for Contractor. Supervise, control, or direct Contractor's safety precautions or programs; or inspect for safety conditions on Work site, or of persons thereon, whether Contractor's employees or others.

E. Inspector will:
   1. Conduct on-site observations of the Work in progress to assist Engineer in determining when the Work is, in general, proceeding in accordance with Contract Documents.
   2. Report to Engineer whenever Inspector believes that Work is faulty, defective, does not conform to Contract Documents, or has been damaged; or whenever there is defective material or equipment; or whenever Inspector believes the Work should be uncovered for observation or requires special procedures.

1.07 SAMPLING AND TESTING

A. General:
   1. Prior to delivery and incorporation in the Work, submit listing of sources of materials, when specified in sections where materials are specified.
   2. When specified in sections where products are specified:
      a. Submit sufficient quantities of representative samples of character and quality required of materials to be used in the Work for testing or examination.
      b. Test materials in accordance with standards of national technical organizations.

B. Sampling:
   1. Furnish specimens of materials when requested.
   2. Do not use materials which are required to be tested until testing indicates satisfactory compliance with specified requirements.
   3. Specimens of materials will be taken for testing whenever necessary to determine quality of material.
   4. Assist Engineer in preparation of test specimens at site of work, such as soil samples and concrete test cylinders.

C. Testing:
   1. Owner will employ and pay for services of independent testing laboratory to perform routine tests of materials to confirm compliance with requirements of Contract Documents:
      a. Mill tests and other specified tests shall be paid for by Contractor.
   2. When protesting failed tests of material in place or to be used, take additional specimens and have specimens tested:
      a. When original test proves to have been in error, file claim for reimbursement of direct costs for sampling and testing.

D. Test standards:
   1. Perform sampling, specimen preparation, and testing of materials in accordance with specified standards, and when no standard is specified, in accordance with standard of nationally recognized technical organization.
   2. Physical characteristics of materials not particularly specified shall conform to standards published by ASTM, where applicable.
   3. Standards and publication references in Contract Documents shall be edition or revision in effect on date stipulated in the Contract Documents.

1.08 TESTING AND INSPECTION SERVICES

A. Contractor will employ and pay for specified services of an independent firm to perform Contractor quality control testing as required in the technical specifications for various work and materials.

B. Owner will employ and pay for specified services of an “Owner’s independent testing firm” to perform testing and inspection as required in the technical specifications for various work and materials or stipulated in Section 01455 to confirm Contractor’s compliance with Contract Documents. If Engineer or Owner’s independent testing firm is not properly certified to perform specialty inspections required by the building department, Owner will employ and pay for a quality specialty inspection firm to perform required testing and inspection.

C. The Owner’s independent testing firm will perform tests, inspections and other services specified in individual specification sections and as required by Owner and requested by the Engineer.

D. The qualifications of laboratory that will perform the testing, contracted by the Owner or by the Contractor, shall be as follows:
   1. Has authorization to operate in the state where the project is located.
   2. Meets “Recommended Requirements for Independent Laboratory Qualification,” published by American Council of Independent Laboratories.
   3. Meets requirements of ASTM E 329.
   4. Laboratory Staff: Maintain full time specialist on staff to review services.
   5. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Bureau of Standards (NBS) or accepted values of natural physical constants.
   6. Will submit copy of report of inspection of facilities made by Materials Reference Laboratory of NBS during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.

E. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing inspections and source quality control as required by Engineer or Owner.

F. Reports will be submitted by Owner's independent testing firm to Engineer, Contractor, and Owner in triplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents. Each report shall include:
   1. Date issued.
   2. Project title and number.
   3. Testing laboratory name, address, and telephone number.
   4. Name and signature of laboratory inspector.
   5. Date and time of sampling or inspection.
   6. Record of temperature and weather conditions.
   7. Date of test.
   8. Identification of product and specification section.
   9. Location of sample or test in Project.
   10. Type of inspection or test.
   11. Results of tests and compliance with Contract Documents.
   12. Interpretation of test results, when requested by Engineer.

G. Contractor shall cooperate with Owner's independent testing firm, furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Engineer and Owner's independent testing firm 48 hours prior to expected time for operations requiring testing.
   2. Make arrangements with Owner's independent testing firm and pay for additional samples and tests required for Contractor's use.

H. Limitations of authority of testing Laboratory: Owner's independent testing firm or Laboratory is not authorized to:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

I. Testing and employment of an Owner's independent testing firm or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

J. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same Owner's independent testing firm on instructions by Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

K. The Owner's independent testing firm responsibilities will include:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.

4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests required by Engineer.
7. Attend preconstruction meetings and progress meetings.

L. Owner's independent testing firm individual test reports: After each test, Owner's independent testing firm will promptly submit electronically and three hard copies of report to Engineer and to Contractor. When requested by Engineer, the Owner's independent testing firm will provide interpretation of test results. Include the following:
1. Date issued.
2. Project title and number.
3. Name of inspector.
4. Date and time of sampling or inspection.
5. Identification of product and specifications section.
6. Location in Project.
7. Type of inspection or test.
8. Date of test.
9. Certified test results stamped and signed by a registered Engineer in the State of California.
10. Summary of conformance with Contract Documents.

M. Owner's independent testing firm will provide monthly report of certification to identify all work performed for special inspections and other contract requirements on this project. The following certified monthly report at a minimum will include but not limited to:
1. Results of testing.
2. Testing logs.
3. Outstanding deficiencies.
4. Various statistical data.
5. Testing curves (up to 4 types) as required by the Engineer.

1.09 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Owner's independent testing firm or laboratory personnel and provide access to construction and manufacturing operations.

B. Secure and deliver to Owner's independent testing firm or laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

C. Provide to Owner's independent testing firm or laboratory and Engineer preliminary mix design proposed to be used for concrete, and other materials mixes which require control by testing laboratory.

D. Furnish electronically and 5 hard copies of product test reports.

E. Furnish incidental labor and facilities:
1. To provide access to construction to be tested.
2. To obtain and handle samples at Work site or at source of product to be tested.

3. To facilitate inspections and tests.
4. For storage and curing of test samples.

F. Notify Owner's independent testing firm or laboratory 48 hours in advance of when observations, inspections, and testing is needed for laboratory to schedule and perform in accordance with their notice of response time.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01455

SPECIAL TESTS AND INSPECTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: This Section describes the requirements for providing special tests and inspections

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Code Requirements.
      b. Section 01450 - Quality Control.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. 341 - Seismic Provisions for Structural Steel Buildings.

B. ASTM International (ASTM):
   1. C 140 -Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   2. C 270 - Standard Specification for Mortar for Unit Masonry.
   3. C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
   4. C 1019 - Standard Test Method for Sampling and Testing Grout.
   5. C 1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

A. California Building Code (CBC).

1.03 DESCRIPTION

A. This Section describes special tests and inspections of structural assemblies and components to be performed in compliance with the regulatory building code specified in Section 01410.

B. These special tests and inspections are in addition to the requirements specified in Section 01450, and by the individual Sections

C. The OWNER will employ 1 or more inspectors who will provide special inspections during construction.

1.04 INSPECTION

A. Duties of Special Inspector:
   1. General: Required duties of the Special Inspector are described in the regulatory building code specified in Section 01410.

1.05 TESTS

A. Selection of the material required to be tested shall be by the OWNER's Testing Laboratory and not the CONTRACTOR.

1.06 SPECIAL TESTING AND INSPECTIONS

A. Testing laboratory: Special tests will be performed by the OWNER's testing laboratory as specified in Section 01450.

B. OWNER reserves the right to positive material identification tests.
   1. Contractor must make materials available for testing.

C. The following types of work require special inspection as described in CBC. Refer to the following verification, testing, and inspection schedules.
   1. Appendix A, Cast-In-Place Concrete Special Inspection Schedule.
   2. Appendix B, Essential Architectural, Mechanical And Electrical Inspection Schedule.
   3. Appendix C, Essential Masonry Special Inspection Schedule.
   4. Appendix D, Soils Verification And Inspection Schedule.
   5. Appendix E, Structural Steel Special Inspection Schedule.
   6. Appendix F, Other Specific Tests Schedule.

1.07 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

A. Special inspections for structural steel shall be made in accordance with the quality assurance plan requirements set forth in AISC 341.

1.08 STRUCTURAL TESTING FOR SEISMIC RESISTANCE

A. The following nonstructural components shall be tested in accordance with ASCE 7-05, Section 13.2.2 and shall require a submittal of a certificate of compliance for review by the ENGINEER:

1.09 OTHER SPECIFIC TESTS

A. Masonry shall be tested in accordance with the regulatory building code specified in Section 01410.
   1. Minimum strength of units shall be tested in accordance with ASTM C 140.
   2. Minimum strength of grout shall be tested in accordance with ASTM C 1019.
   3. Prior to construction, obtain samples of the aggregates, additives, and water; mix and test in laboratory in accordance with ASTM C 270.
   4. During construction, sample and test masonry for consistency prior to use on each structure in accordance with ASTM C 780.
   5. When approved by the building official, if installed masonry does not meet requirements, conduct prism tests in accordance with ASTM C 1314.

B. Special precise facia panels and associated connections.

C. Plastic skylight assemblies and other unusual materials that are expected to support design live loads.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 SCHEDULE

A. The CONTRACTOR shall allow time necessary for Special Inspections as listed above.

B. Sufficient notice shall be given so that the Special Inspections can be performed. This includes time for off-site Special Inspectors to plan the inspection and travel to site.

3.02 PROCEDURE

A. The Special Inspector will immediately notify the ENGINEER of any corrections required and follow notification with appropriate documentation.

B. The Special Inspector shall keep records of all inspections and furnish reports to the OWNER and ENGINEER in accordance with the regulatory building code specified in Section 01410.

C. The CONTRACTOR shall not proceed until the work is satisfactory to the ENGINEER.

END OF SECTION

APPENDIX A
CAST-IN-PLACE CONCRETE SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Referenced Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Inspection of reinforcing steel, including prestressing tendons, and placement.	ACI 318: 3.5, 7.1-7.7	–	X
2. Inspection of reinforcing steel welding in accordance with Table 1704.3, Item 5b of the CBC.	AWS D1.4 ACI 318: 3.5.2	–	–
3. Inspect bolts to be installed in concrete prior to and during placement of concrete.	ACI 318: 8.1.3, 21.2.8	X	–
4. Inspection of anchors installed in hardened concrete.	ACI 318: 3.8.6, 8.1.3, 21.2.8	–	X
5. Verifying use of required design mix.	ACI 318: Ch. 4, 5.2-5.4	–	X
6. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	ASTM C 172 ASTM C 31 ACI 318: 5.6, 5.8	X	–
7. Inspection of concrete and shotcrete placement for proper application techniques.	ACI 318: 5.9, 5.10	X	–
8. Inspection for maintenance of specified curing temperature and techniques.	ACI 318: 5.11-5.13	–	X
9. Inspect formwork for shape, location, and dimensions of the concrete member being formed.	ACI 318: 6.1.1	–	X

APPENDIX B
ESSENTIAL ARCHITECTURAL, MECHANICAL AND ELECTRICAL INSPECTION SCHEDULE

Verification and Inspection	Referenced Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Suspended ceiling system including anchorage.		–	X
2. Anchorage of electrical equipment for emergency or standby power systems.		–	X
3. Anchorage of other electrical or mechanical equipment over 1,000 lb. on floors or roofs.		–	X
4. Anchorage of ducts greater than 6 s.f. in cross-section.		–	X
5. Anchorage of pipelines greater than 8 inches in diameter.		–	X
6. Erection and fastening of exterior cladding and interior sound proofing at Electrical Building.		–	X

APPENDIX C
ESSENTIAL MASONRY SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Referenced Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	TMS 602/ACI 530.1/ ASCE 6, Art. 1.5	–	X
2. Verification of f'_m and f'_{AAC} prior to construction except where specifically exempted by the building code.	TMS 602/ACI 530.1/ ASCE 6, Art. 1.4B	–	X
3 Verification of slump flow and VSI as delivered to the site for self-consolidating grout.	TMS 602/ACI 530.1/ ASCE 6, Art. 1.5B.1.b.3	–	–
4. As masonry construction begins, the following shall be verified for compliance:			
a. Proportions of site-prepared mortar and grout.	TMS 602/ACI 530.1/ ASCE 6 Art. 2.6A	–	X
b. Construction of mortar joints.	TMS 602/ACI 530.1/ ASCE 6 Art. 3.3B	–	X
c. Placement of reinforcement and connectors.	TMS 602/ACI 530.1/ ASCE 6 Art. 3.4, 3.6A	–	X
5. During construction the inspection program shall verify:			
a. Size and location of structural elements.	TMS 602/ACI 530.1/ ASCE 6 Art. 3.3F	–	X
b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction.	TMS 402/ACI 530/ ASCE 5 Sec. 1.2.2(e), 1.16.1	–	X
c. Specified size, grade and type of reinforcement and anchor bolts.	TMS 402/ACI 530/ ASCE 5 Sec. 1.15	–	X
d. Welding of reinforcing bars.	TMS 402/ACI 530/ ASCE 5 Sec. 2.1.9.7.2, 3.3.3.4(b)	X	–
e. Preparation, construction, and protection of masonry during cold weather (temperature below 40° F) or hot weather (temperature above 90° F).	TMS 602/ACI 530.1/ ASCE 6 Art. 1.8C, 1.8D	–	X

Verification and Inspection	Referenced Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
6. Prior to grouting, the following shall be verified to ensure compliance:			
a. Grout space is clean.	TMS 602/ACI 530.1/ ASCE 6 Art. 3.2D	–	X
b. Placement of reinforcing steel and connectors.	TMS 602/ACI 530.1/ ASCE 6 Art. 3.4	–	X
c. Proportions of site-prepared grout.	TMS 602/ACI 530.1/ ASCE 6 Art. 2.6B	–	X
d. Construction of mortar joints.	TMS 602/ACI 530.1/ ASCE 6 Art. 3.3B	–	X
7. Grout placement shall be verified to ensure compliance.	TMS 602/ACI 530.1/ ASCE 6, Art. 3.5	X	–
8. Preparation of any required grout specimens, mortar specimens, and/or prisms shall be observed.	TMS 602/ACI 530.1/ ASCE 6, Art. 1.4	–	X

APPENDIX D
SOILS VERIFICATION AND INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Verify materials below footings are adequate to achieve the design bearing capacity.		–	X
2. Verify excavations are extended to proper depth and have reached proper material.		–	X
3. Perform classification and testing of controlled fill materials.		–	X
4. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of controlled fill.		X	–
5. Prior to placement of controlled fill, observe subgrade and verify that site has been prepared properly.		–	X

APPENDIX E
STRUCTURAL STEEL SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Referenced Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Material verification of high-strength bolts, nuts and washers:			
a. Identification markings to conform to ASTM standards specified in the approved construction documents.	AISC 360, Section A3.3 and applicable ASTM material standards	–	X
b. Manufacturer's certificate of compliance required.	–	–	X
2. Inspection of high-strength bolting:			
a. Snug-tight joints.	AISC 360, Section M2.5	–	X
3. Material verification of structural steel and cold-formed steel deck:			
a. For structural steel, identification markings to conform to ASTM 360.	AISC 360, Section M5.5	–	X
b. For other steel, identification markings to conform to ASTM standards specified in the approved construction documents.	Applicable ASTM material standards	–	X
c. Manufacturer’s certified test reports.	–	–	X
4. Material verification of weld filler materials:			
a. Identification markings to conform to AWS specification in the approved construction documents.	AISC 360, Section A3.5 and applicable AWS A5 documents	–	X
b. Manufacturer's certificate of compliance required.	–	–	X
5. Inspection of welding:			
a. Structural steel and cold-formed steel deck:			
1) Complete and partial joint penetration groove welds.	AWS D1.1	X	–
2) Multi-pass fillet welds.		X	–
3) Single-pass fillet welds > 5/16".		X	–
4) Single-pass fillet welds ≤ 5/16".		–	X
5) Floor and roof deck welds.	AWS D1.3	–	X
b. Reinforcing steel:			
1) Verification of weldability of reinforcing steel other than ASTM A 706.	AWS D1.4, ACI 318: 3.5.2	–	X
2) Reinforcing steel-resisting flexural and axial forces in boundary elements of special reinforced concrete shear walls and shear reinforcement.		X	–
3) Shear reinforcement.		X	–
4) "Form Saver" (reinforcing couplers).		X	–

APPENDIX F
OTHER SPECIFIC TESTS SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection	
		Continuous During Task Listed	Periodic During Task Listed
1. Crane monorails and support connections.		X	
2. Special precise facia panels and associated connections.		X	
3. Plastic skylight assemblies and other unusual materials that are expected to support design live loads.		X	
4. Diesel generator anchorage.		X	
5. Diesel generator silencer supports.			X
6. Diesel generator exhaust pipe supports.		X	
7. Open web steel joist connections to walls.			X
8. Open web steel joist connections to generator exhaust pipe supports.		X	

SECTION 01460

CONTRACTOR QUALITY CONTROL PLAN

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Contractor Quality Control Plan.

1.02 SUBMITTALS

A. Qualifications of the Contractor's Quality Control (CQC) Plan Manager must include all qualifying registrations and show that the candidate has had experience on projects of similar type and size.

B. Contractor's Daily Quality Control Report: Submit to Engineer within 1 day of completion of each inspection.

C. Daily Inspection Report: Submit to Engineer at the end of each working day or no later than prior to the beginning of the next working day.

1.03 CONTRACTOR'S INSPECTION OF THE WORK

A. Work performed by Contractor shall be inspected by the Contractor's CQC Plan Manager. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.

B. No materials or equipment shall be used in Work without inspection and acceptance by Contractor's CQC Plan Manager.

1.04 QUALIFICATIONS

A. Contractor's CQC Plan Manager: Demonstrate having performed similar CQC functions on similar type projects. Submit records of personnel experience, training, and qualifications.

1.05 COVERING WORK

A. Whenever Contractor intends to backfill, bury, cast in concrete, or otherwise cover any Work, notify Engineer not less than 24 hours in advance to request inspection before beginning any such Work of covering. Failure of Contractor to notify Engineer in accordance with this requirement shall be resolved according to Article 13 of the General Conditions.

1.06 REJECTED WORK

A. Failure to promptly remove and replace rejected Work will be considered a breach of this Contract, and Owner may proceed under provisions of the General Conditions.

1.07 CONTRACTOR'S QUALITY CONTROL PROGRAM

A. General: Establish and execute a Quality Control (CQC) Plan for Work. The plan shall establish adequate measures for verification and conformance to defined requirements by Contractor personnel and lower-tier Subcontractors (including Fabricators, Suppliers, and Subcontractors). This program shall be described in a Plan responsive to this Section.

B. CQC personnel:
   1. Contractor's CQC Plan Manager shall report to a Senior Project Manager of the Contractor and shall have no supervisory or managerial responsibility over the workforce.
   2. The Contractor CQC Plan Manager shall be on-site as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.
   3. The Contractor is to furnish personnel with assigned CQC functions reporting to the CQC Manager. Persons performing CQC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.

C. CQC Plan:
   1. Contractor's CQC Plan shall include a statement by the Senior Project Manager designating the CQC Plan Manager and specifying the authority delegated to the CQC Plan Manager to direct cessation or removal and replacement of defective Work.
   2. Describe the CQC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.
   3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specifications section).
   4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed and tested.
   5. Include procedures to verify that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
   6. Startup and testing quality control: Include procedures to verify that the startup and testing requirements of the Contract Documents are integrated into the Contractor's CQC Plan and conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and the lower-tier Suppliers and/or Subcontractors.
   7. Include instructions for recording inspections and requirements for demonstrating through the Daily Inspection Reports that Work inspected was in compliance or a deficiency was noted and action to be taken.
   8. Procedures to preclude the covering of deficient or rejected Work.
   9. Procedures for halting or rejecting Work.
   10. Procedures for resolution of differences between the CQC Plan Manager and the production personnel.
   11. Identify contractual hold/inspection points as well as any Contractor-imposed hold/inspection points.

D. Daily Inspection Report: Include, at a minimum:
   1. Inspection of specific work.
   2. Quality characteristics in compliance.
   3. Quality characteristics not in compliance.
   4. Corrective/remedial actions taken.
   5. Statement of certification.
   6. CQC Manager's signature.
   7. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents.

E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent reoccurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documents and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
   1. Personnel responsible for identifying deficient and non-complying items within Work.
   2. How and by whom deficient and non-compliant items are documented "in the field."
   3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
   4. Tracking processes and tracking documentation for deficient and non-conforming Work.
   5. Personnel responsible for achieving resolution of outstanding deficiencies.
   6. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).

F. Audits: The CQC program shall provide for regularly scheduled documented audits to verify that CQC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to Engineer upon request.

G. Documented control/quality records:
   1. Establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to assure the correct issue of the document being used. Describe how record document/drawing data are documented and furnished to Engineer.
   2. Maintain evidence of activities affecting quality. Including operating logs, records of inspection, audit reports, personnel qualification and certification records, procedures, and document review records.
   3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage and destruction.
   4. Develop a list of specific records as required by the Contract Documents that will be furnished to Engineer at the completion of activities.

H. Acceptance of CQC Plan: Engineer's acceptance of the CQC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's CQC staffing is subject to Engineer's review and continued acceptance. Owner, at its sole option, and without cause, may direct Contractor to remove and replace the CQC Plan Manager.
   1. Acceptance of the CQC Plan by the Engineer is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.
   2. After acceptance of the CQC Plan, notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Furnishing, maintaining, and removing construction facilities and temporary controls, including temporary utilities, construction aids, barriers and enclosures, security, access roads, temporary controls, project sign, field offices and sheds, and removal after construction.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 00810 - Project Sign.
      b. Section 01060 - Regulatory Agency and Utility Requirements.
      c. Section 01140 - Work Restrictions.
      d. Section 01330 - Submittal Procedures.
      e. Section 01570 - Stormwater Pollution Prevention Plan.
      f. Section 01660 - Testing, Training, and Commissioning.
      g. Section 01759 - Water Leakage Test for Concrete Structures.
      h. Section 02553 - In Plant Temporary Pumping.
      i. Section 15050 - Common Work Results for Mechanical Equipment.

1.02 REFERENCE

A. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. General: For products specified to be furnished under this Section, submit product data as specified in Section 01330.

B. For temporary piping systems:
   1. Submit layout drawings showing proposed routing of piping, including proposed pipe support and pipe restraint locations.
   2. Submit product data for piping, fittings, appurtenances, restraints, supports, and all other components of the temporary piping system.
   3. Submit all information at least 28 days prior to when each temporary piping system is scheduled to be installed and allow 14 days for review and comment by Engineer and Owner.

C. For temporary pumping systems:
   1. Submit pump data, performance curves, and other operating information as specified in Section 15050.
   2. Submit sketches showing layout of temporary pumping system, including pump quantity, configuration in wet well, and proposed piping layout specified in this Section.
   3. Submit piping head loss calculations based on proposed temporary piping system layout.

D. Submit all information at least 28 days prior to when the temporary pumping system is scheduled to be installed and allow 14 days for review and comment by Engineer and Owner.

1.04 CONTRACTOR USE OF CONSTRUCTION STAGING AREAS

A. Do not use staging areas for:
   1. Storage of vehicles or equipment not directly used for construction of the project.
   2. Overnight camping or overnight accommodation of non-security personnel.
   3. Storage of motor fuel in excess of 5 gallons, unless in the onboard tank of engine-driven equipment or self-propelled vehicle.

B. Equipment maintenance and materials fabrication in staging areas must be conducted during normal working hours in accordance with the Noise Abatement Requirements of Section 01060.

C. Copies of the signed COASTAL DEVELOPMENT PERMIT shall be maintained in a conspicuous location at all construction staging areas at all times.

D. Use of any building or site for field offices or related purposes not previously designated in the project's COASTAL DEVELOPMENT PERMIT is prohibited.

1.05 TEMPORARY UTILITIES

A. Temporary electrical power:
   1. Arrange with local utility to provide adequate temporary electrical service.
   2. Provide and maintain adequate jobsite power distribution facilities conforming to applicable Laws and Regulations.
   3. Provide, maintain, and pay for electric power for performance of the Work,.

B. Temporary electrical lighting:
   1. In work areas, provide temporary lighting sufficient to maintain lighting levels during working hours not less than lighting levels required by OSHA and state agency which administers OSHA regulations where Project is located.
   2. When available, permanent lighting facilities may be used in lieu of temporary facilities:
      a. Prior to Substantial Completion of the Work, replace bulbs, lamps, or tubes used by CONTRACTOR for lighting.

C. Temporary heating, cooling, and ventilating:
   1. Heat and ventilate work areas to protect the Work from damage by freezing, high temperatures, weather, and to provide safe environment for workers.
   2. Permanent heating system may be utilized when sufficiently completed to allow safe operation.

D. Temporary water:
   1. Pay for and construct facilities necessary to furnish potable water for human consumption and non-potable water for use during construction.
   2. Remove temporary piping and connections and restore affected portions of the facility to original condition before Completion of Start-Up Phase , which is defined in Section 01660.
   3. Pay for water used for construction prior to Completion of Start-Up Phase.
   4. Development of potable water supply:
      a. Potable water is not available at construction site.
      b. Provide potable water for human consumption during construction period.
      c. Furnish potable water that meets requirements of Laws and Regulations.
   5. Development of non-potable water supply:
      a. Non-potable water is not available on the site.
         1) Provide water necessary for the performance of the Work, including for the purposes of conducting water leakage test for concrete structures specified in Section 01759, of conducting a 10-day operational test specified in Section 01660, and of landscape irrigation. Obtain water by piping from existing remote source, drilling temporary wells, or by filtering and treating water from local irrigation or other surface water sources.
         2) Abide by laws and regulations when drilling temporary wells or using irrigation water.
         3) Be responsible for adequate and lawful disposal of all water used for testing.
         4) Observe any water use restrictions in place during the execution of the Contract.
      b. If water is stored in a newly constructed concrete structure on-site, it would, over time, increase in pH and can potentially reach a pH level detrimental to piping, valving, equipment, or instruments. Periodically measure pH of such water and implement pH control measures in order to maintain the pH of such waters between 7.0 and 9.0 at all times.
      c. At its sole discretion, the OWNER may make some of the collection system infrastructure available for CONTRACTOR's use in water conveyance to the site. Such infrastructure includes the Mid-town Pump Station and the influent forcemain, which are currently under construction as part of the Los Osos Collection System Project.
         1) If the CONTRACTOR wishes to use this collection system infrastructure following its construction completion, CONTRACTOR shall make a written request at least 4 weeks in advance, followed by a written confirmation for the request 1 week in advance. OWNER's approval is not guaranteed.
      d. CONTRACTOR shall be solely responsible for moving, managing, and storing this non-potable water on-site throughout construction. Provide and pay for any temporary pumps, piping and valving, power, and other appurtenances necessary for managing this water in accordance with Section 02553.

e. In addition to conveying or transporting water to the site, the CONTRACTOR may choose to use one of the two permanent groundwater wells detailed on Sheet 03C01; if the Contractor so chooses, the Contractor shall furnish temporary pumps, piping, water storage, power, and other required appurtenances for this operation, and bear full responsibility for any damages to the groundwater well incurred during this period. It is projected that one well will supply 5 to 10 gpm continuously. The production capacity of the groundwater wells is estimated, and is expressively not guaranteed. As such, if the CONTRACTOR wishes to pursue this option, the CONTRACTOR shall be responsible for verifying the well production rate and the overall feasibility for this option.

E. Temporary sanitary facilities:
   1. Provide suitable and adequate sanitary facilities that are in compliance with applicable Laws and Regulations.
   2. At completion of the Work, remove sanitary facilities and leave site in neat and sanitary condition.

F. Temporary fire protection:
   1. Provide a temporary water storage tank and appurtenances compatible with local fire department equipment, until permanent fire suppression systems are complete and operational:
      a. Design:
         1) Water storage: 21,225 gallons minimum.
         2) Valve and 4-inch male connection with National Standard Fire Threads, with signage “FIRE DEPARTMENT ONLY”, lettering 4-inch red with white background.
      b. Installation:
         1) Install and make it operational prior to start of construction or material arriving on site, including temporary offices or construction trailers.
         2) Location as directed by Cal Fire.
         3) Construct an access road to the tank location. The road shall have all weather driving surface capable of supporting 20-ton vehicles.
      c. Operation:
         1) Keep the tank in service and full at all times, until authorized by Cal Fire for removal from service.
         2) This tank and water shall not be used for any purposes other than fire fighting.
   2. Provide sufficient number of fire extinguishers of type and capacity required to protect the Work and ancillary facilities.

G. First aid: Post first aid facilities and information posters conforming to requirements of OSHA and other applicable Laws and Regulations in readily accessible locations.

1.06 CONSTRUCTION AIDS

A. Provide railings, kick plates, enclosures, safety devices, and controls required by Laws and Regulations and as required for adequate protection of life and property.

B. Use construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities of ample size and capacity to adequately support and move loads.

C. Design temporary supports with adequate safety factor to assure adequate load bearing capability:
   1. When requested, submit design calculations by professional registered Engineer prior to application of loads.
   2. Submitted design calculations are for information and record purposes only.

D. Accident prevention:
   1. Exercise precautions throughout construction for protection of persons and property.
   2. Observe safety provisions of applicable Laws and Regulations.
   3. Guard machinery and equipment, and eliminate other hazards.
   4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.
   5. Before commencing construction work, take necessary action to comply with provisions for safety and accident prevention.

E. Barricades:
   1. Place barriers at ends of excavations and along excavations to warn pedestrian and vehicular traffic of excavations.
   2. Provide barriers with flashing lights after dark.
   3. Keep barriers in place until excavations are entirely backfilled and compacted.
   4. Barricade excavations to prevent persons from entering excavated areas in streets, roadways, parking lots, treatment plants, or other public or private areas.

F. Warning devices and barricades: Adequately identify and guard hazardous areas and conditions by visual warning devices and, where necessary, physical barriers:
   1. Devices shall conform to minimum requirements of OSHA and State agency which administers OSHA regulations where Project is located.

G. Hazards in public right-of-way:
   1. Mark at reasonable intervals, trenches, and other continuous excavations in public right-of-way, running parallel to general flow of traffic, with traffic cones, barricades, or other suitable visual markers during daylight hours:
      a. During hours of darkness, provide markers with torches, flashers, or other adequate lights.
   2. At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, protect excavations by continuous barricades:
      a. During hours of darkness, provide warning lights at close intervals.

H. Hazards in protected areas: Mark or guard excavations in areas from which public is excluded, in manner appropriate for hazard.

I. Above grade protection: On multi-level structures, provide safety protection that meets requirements of OSHA and State agency which administers OSHA regulations where Project is located.

J. Provide protective fence (type ESA) where indicated on the Drawings. Refer to Section 01060 for the specifications for ESA fence. In addition, protect existing structures, trees, shrubs, drainage ditches, and other items with ESA fence to be preserved in other construction areas from injury, damage, or destruction by

vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards. .

K. Fences:
   1. Protect the Work against acts of theft, violence, and vandalism. CONTRACTOR may, at its own discretion, enclose the LOWRF site with temporary fence for this purpose. At the minimum, provide temporary fences and gates where indicated on the Drawings.
   2. Protect temporary facilities, offices, and staging areas against acts of theft, violence, and vandalism. CONTRACTOR may, at its own discretion, enclose these facilities with temporary fence for this purpose. At the minimum, provide temporary fences where indicated on the Drawings.
   3. Permanent fence may be built to serve for both permanent and temporary protection of the work site, provided that damaged or defaced fencing is replaced prior to Completion of Start-Up Phase.
   4. Protect temporary and permanent openings and close openings in existing fences to prevent intrusion by unauthorized persons.
      a. Bear responsibility for protection of plant and material on site of the Work when openings in existing fences are not closed.
   5. During night hours, weekends, holidays, and other times when no work is performed at site, provide temporary closures or enlist services of security guards to protect temporary openings.
   6. Fence temporary openings when openings are no longer necessary.

1.07 SECURITY

A. Make adequate provision for protection of the work area against fire, theft, and vandalism, and for protection of public against exposure to injury.

1.08 ACCESS ROADS

A. General:
   1. Build and maintain access roads to and on site of the Work to provide for delivery of material.
   2. Build and maintain dust free roads that are suitable for travel at 20 miles per hour.

B. Off-site access roads:
   1. Build and maintain graded earth roads.
   2. Build roads only in public right-of-way or easements obtained by Owner.
   3. Obtain rights-of-way or easements when electing to build along other alignment.

C. On-site access roads:
   1. Maintain access roads to staging areas and other areas to which frequent access is required.
   2. Protect buried vulnerable utilities under temporary roads with steel plates, wood planking, or bridges.
   3. Maintain on-site access roads free of mud. Under no circumstances shall vehicles leaving the site track mud off the site onto the public right-of-way.

1.09 TEMPORARY CONTROLS

A. Dust control:
   1. Prevent dust nuisance caused by operations, unpaved roads, excavation, backfilling, demolition, or other activities.
   2. Control dust by sprinkling with water, use of dust palliatives, modification of operations, or other means acceptable to agencies having jurisdiction.

B. Noise control:
   1. In inhabited areas, particularly residential, perform operations in manner to minimize noise.
   2. In residential areas, take special measures to suppress noise during night hours.

C. Mud control:
   1. Prevent mud nuisance caused by construction operations, unpaved roads, excavation, backfilling, demolition, or other activities.

D. Erosion control:
   1. As specified in Section 01570.

1.10 PROJECT SIGN

A. As specified in Section 00810.

B. Erect Project identification sign where directed.

1.11 FIELD OFFICES AND SHEDS

A. Contractor's field office:
   1. Maintain on Project Site weathertight space in which to keep copies of Contract Documents, progress schedule, shop drawings, and other relevant documents.
   2. Provide field office with adequate space to examine documents, and provide lighting and telephone service in that space.

B. Engineer's field office:
   1. Engineer will use the existing house on the Andre Property, which is owned by the Owner.

1.12 REMOVAL

A. Remove temporary buildings and furnishings before inspection for Substantial Completion or when directed.

B. Clean and repair damage caused by installation or use of temporary facilities.

C. Remove underground installations to minimum depth of 24 inches and grade to match surrounding conditions.

D. Restore existing facilities used during construction to specified or original condition.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01561

BIOLOGICAL AND CULTURAL RESOURCES ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 BIOLOGICAL RESOURCES

A. The CONTRACTOR shall conform to the Conditions of Approval for the California Coastal Commission, Coastal Development Permit CDP A-3-SLO-09-055/069 (appended to these Specifications). The CONTRACTOR's attention is also directed to the Final Environmental Impact Report (EIR) for the Los Osos Wastewater Project Report dated March 2009 (EIR is located at http://www.slocounty.ca.gov/PW/LOWWP/DOCS/Environmental_Documents/Final_EIR_1_0.htm).

B. The CONTRACTOR shall conform to the applicable requirements of the Federal Endangered Species Act and California Environmental Species Act as it relates to the protection of threatened and endangered species and special status species, see Biological Opinion (appended to these Specifications).

C. The CONTRACTOR's onsite personnel shall participate in an environmental awareness training session provided by OWNER's Environmental Monitor and adhere to guidelines and directions provided in the session.

D. Locations of sensitive biological resources within the Site are identified in the Drawings.

E. The CONTRACTOR shall adhere to OWNER protocol concerning Special-Status Species outlined in Paragraph 3.01of this section.

F. The CONTRACTOR shall identify a Project Liaison to consult with OWNER's Environmental Monitors during construction.

1.02 CULTURAL RESOURCES

A. The CONTRACTOR shall conform to the applicable requirements of the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800, which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").

B. The CONTRACTOR shall conform to the applicable requirements of Historic Resources Evaluation and Treatment Plan prepared by Far Western Anthropological Research Group Inc., March 2010 (available prior to construction) by the State Historic Preservation Office. (Condition 28).

C. The CONTRACTOR shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources. The entire Site as described in the Cultural Resources Treatment Plan shall be considered an area of archaeological sensitivity and the CONTRACTOR

shall assume that all areas of subsurface construction have a high likelihood of encountering significant archaeological resources. (Condition 73).

D. The CONTRACTOR shall adhere to OWNER protocol concerning Archaeological Resources outlined in Paragraph 3.02.

E. The CONTRACTOR's onsite personnel shall participate in an environmental awareness training session provided by OWNER's Environmental Archaeological Monitor and adhere to guidelines and directions provided in the session.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 SPECIFIC BIOLOGICAL RESOURCES REQUIREMENTS

A. The CONTRACTOR shall attend a meeting prior to construction that will describe in detail the protocol and CONTRACTOR responsibilities concerning sensitive species. The OWNER's Environmental Monitor will advise the CONTRACTOR if the protocol changes as more information is received and project permits from the US Fish and Wildlife Service are obtained. General conditions of the protocol are:

1. CONTRACTOR shall attend a pre-construction meeting to review the protocol.
2. All CONTRACTOR workers shall attend pre-construction biological training session and be able to recognize sensitive species and understand and employ proper protocol if any are encountered.
3. The CONTRACTOR shall obtain approval from the OWNER or OWNER's Environmental Monitor in advance of construction for activity areas in vegetated, sandy, or otherwise unimproved portions of the construction area including areas of proposed disturbance, equipment storage, stockpiles, and access roads and areas. The CONTRACTOR shall consult with the OWNER's Environmental Monitor prior to removal of vegetation.
4. The CONTRACTOR shall submit a schedule to the OWNER or OWNER's Environmental Monitor prior to construction as specified in Section 01324A. The schedule shall indicate proposed construction dates and locations. The CONTRACTOR shall provide written weekly updates on construction progress to the ENGINEER and OWNER's Environmental Monitor.
5. The CONTRACTOR shall post signs in neighborhoods where construction equipment and/or activities would obstruct travel on Los Osos Valley Road at least 1 week prior to start of construction. The CONTRACTOR shall identify alternate access in consultation with the OWNER and/or OWNER's Environmental Monitor in accordance with a construction traffic mitigation program. The OWNER shall provide signs to the CONTRACTOR at least 2 weeks prior to start of construction.
6. The OWNER or the OWNER's Environmental Monitor shall conduct pre-construction surveys of construction areas and/or materials stockpiles in sensitive areas including but not limited to coastal scrub, wetlands and chaparral where required. The CONTRACTOR shall be responsible for following the OWNER's Environmental Monitor's recommendations that include but are not limited to limiting access to an area, limiting disturbance of

an area, suggest alternate routing or areas for materials stockpiling and limiting activity to designated access routes and construction areas.

7. Not Used.
8. The CONTRACTOR shall not bring road base or other materials for deposition onto sandy areas of the construction areas, roads or stockpile areas until approved by the OWNER and/or the OWNER's Environmental Monitor.
9. CONTRACTOR shall clearly mark construction areas with high visibility flagging or fencing. Construction equipment and personnel will be restricted to the marked areas.

B. Not Used.

C. Not Used.

D. Not Used.

E. NESTING BIRD SURVEY. The ENGINEER will provide to the CONTRACTOR a map showing the location of nest trees and other areas where nesting birds or species protected by State and/or Federal laws are present on or within the Site. The areas will be identified during preconstruction surveys or prior. All potentially suitable nesting trees identified will be removed prior to or after the breeding season as feasible. The nest trees and areas identified in the spring and early summer preconstruction surveys will be fenced or otherwise demarcated by the OWNER's Environmental Monitor and a 250-foot non-disturbance buffer or a buffer area will be established. This no-disturbance buffer will be established until the nesting activity is completed and young have fledged, CONTRACTOR is responsible to ensure construction activities do not encroach upon the buffer area. Construction in the area of the buffer and nest trees will be allowed to resume only after nesting activities have been completed as indicated by the OWNER's Environmental Monitor. (Condition 69).

F. NESTING RAPTOR SURVEY. The ENGINEER will provide to the CONTRACTOR a map showing the location of nest trees and other areas where nesting raptors or species protected by State and/or Federal laws are present on or within the Site. The areas will be identified during preconstruction surveys (February through August) and also possibly during winter surveys. All potentially suitable nesting trees identified will be removed prior to or after the breeding season as feasible. The nest trees and areas identified in the spring and early summer preconstruction surveys will be fenced or otherwise demarcated by the OWNER's Environmental Monitor and a 500-foot non-disturbance buffer or a buffer area will be established. This no-disturbance buffer will be established until the nesting activity is completed and young have fledged, CONTRACTOR is responsible to ensure construction activities do not encroach upon the buffer area. Construction in the area of the buffer and nest trees will be allowed to resume only after nesting activities have been completed as indicated by the OWNER's Environmental Monitor. (Condition 70).

G. Not Used.

H. CONTROL OF INVASIVE EXOTIC PLANTS. To control introduction of invasive exotic plants on site, the CONTRACTOR shall implement the following measures during construction.
   1. Use only clean fill material (free of weed seeds) within the construction zone of the proposed project.
   2. Thoroughly clean all construction equipment prior to being moved onto and used at the site.
   3. Prohibit planting or seeding of disturbed areas with nonnative plant species.
   4. Control the establishment of invasive exotic weeds in all disturbed areas. Remove existing stands of invasive exotic plants, including but not limited to veldt grass, pampas grass and ice plants, in order to limit their spread. (Condition 81).

I. WORKER EDUCATION PROGRAM. The OWNER's Environmental Monitor shall provide construction personnel specific instruction on general detection and avoidance of sensitive resources during construction. The worker education program shall include: descriptions and pictures of listed species; the provisions of the Endangered Species Act; those specific measures being implemented to avoid and minimize take or impacts to listed or otherwise sensitive species (e.g., conserve listed and sensitive species as they relate to the project); and the project boundaries within which the work will occur. (Condition 68).

J. Not Used.

3.02 SPECIFIC CULTURAL RESOURCES REQUIREMENTS

A. The CONTRACTOR shall provide a construction plan and schedule to the ENGINEER who shall provide the plan to the OWNER's Archaeological Environmental Monitor for development of the cultural resources monitoring schedule.

B. In the event potential cultural resources are discovered during subsurface excavations at the site of construction (Condition 28), the following procedures shall be instituted:
   1. The OWNER's Archaeological Environmental Monitor will inform the ENGINEER of the find and the ENGINEER will issue a Field Order directing the CONTRACTOR to cease all construction operations at the location of such potential cultural resources find.
   2. Such Field Order shall be effective until such time as the OWNER's Archaeological Monitor assesses the significance of these potential cultural resources and make recommendations to the State Historic Preservation Office.

C. In the event human remains are discovered during subsurface excavations at the site of construction (Condition 73), the following procedures shall be instituted:
   1. The CONTRACTOR shall stop work. The OWNER's Archaeological Environmental Monitor will inform the ENGINEER of the find and the ENGINEER shall issue a Field Order directing the CONTRACTOR to cease all construction operations at the location of the human remain.
   2. Such Field Order shall be effective until such time as the Archaeological Environmental Monitor consults with the County Coroner and provisions in the California Public Resources Code (Section 5097.98 and 5097.99 and Health

and Safety Code Section 7050.5, as amended by Assembly Bill 2641) are completed and if Native American Remains are found, recommendations of the Most Likely Descendent as designated by the Native American Heritage Commission are completed.

D. If the OWNER's Archaeological Environmental Monitor determines that the potential find is a bona fide cultural resource, at the direction of the OWNER's Archaeological Monitor and State Historic Preservation Office, or a human remain at the direction of the Coroner or Native American Heritage Commission, the CONTRACTOR shall suspend work at the location of the find. The CONTRACTOR shall resume work upon direction of the OWNER and/or Archaeological Environmental Monitor.

END OF SECTION

SECTION 01562

DUST CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Perform dust control operations, in an approved manner, whenever necessary or when directed by the ENGINEER, even though other work on the project may be suspended. Dust control shall be generally accomplished by the use of water; however, the use of calcium chloride may be used when necessary as approved by ENGINEER to control dust nuisance.

B. Calcium chloride shall conform to AASHTO M144, Type I except the requirements for "total alkali chlorides" and other impurities shall not apply.

C. Methods of controlling dust shall meet all air pollutant standards as set forth by Federal and State regulatory agencies, and in compliance with the Coastal Development Permit.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 SPECIFIC REQUIREMENTS

A. Reduce the amount of the disturbed area where possible,

B. Use water trucks or sprinkler systems in sufficient quantities to prevent airborne dust from leaving the site. Increased watering frequency will be required whenever wind speeds exceed 15 mph. Dewatering water should be used whenever possible.

C. All dirt stockpile areas will be sprayed daily as needed.

D. Permanent dust control measures identified in the re-vegetation and landscape plans will be implemented as soon as possible following completion of any soil disturbing activities.

E. Exposed ground areas that are planned to be reworked at dates greater than one month after initial grading will be covered with fiber, mulch, mats, or other erosion control material.

F. All disturbed soil areas not subject to revegetation will be stabilized using approved chemical soil binders, jute netting, or other methods approved in advance by the APCD. Any erosion and sedimentation control netting or other erosion and sedimentation control devises used for temporary or permanent erosion and

sedimentation control, shall be limited to biodegradable mesh or other biodegradable products.

G. All roadways, driveways, sidewalks, etc., to be paved will be completed as soon as possible. In addition, building pads will be laid as soon as possible after grading unless seeding or soil binders are used.

H. Vehicle speed for all construction vehicles will not exceed 15 mph on any unpaved surface at the construction site.

I. All trucks hauling dirt, sand, soil, or other loose materials are to be covered or will maintain at least 2 feet of freeboard (minimum vertical distance between top of load and top of trailer) in accordance with CVC Section 23114.

J. Install wheel washers where vehicles enter and exit unpaved roads onto streets, or wash off trucks and equipment leaving the site.

K. Sweep streets at the end of each day if visible soil material is carried onto adjacent paved roads. Water sweepers with reclaimed water should be used where feasible.

L. If visible emissions of fugitive dust persist beyond a distance of 200 feet from the boundary of the construction site, all feasible measures shall be implemented to eliminate potential nuisance conditions at off-site receptors (e.g., increase frequency of watering or dust suppression, install temporary wind breaks where appropriate, suspend excavation and grading activity when winds exceed 25 mph).

M. The CONTRACTOR will designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust offsite. Their duties will include holidays and weekend periods when work may not be in progress. The name and telephone number of such persons will be provided to the SLOAPCD prior to the start of construction.

N. If the above mitigation measure do not bring the construction emissions below the thresholds, the ENGINEER reserves the right to assess damages to the CONTRACTOR to secure emission reductions from other projects in close proximity to the construction site.

END OF SECTION

SECTION 01570

STORMWATER POLLUTION PREVENTION PLAN

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The CONTRACTOR shall implement a site-specific Stormwater Pollution Prevention Plan (SWPPP) for this Project pursuant to the requirements of the National Pollution Discharge Elimination System (NPDES) General Permit [Order No. 2009-0009-DWQ] for Stormwater Discharges Associated with Construction and Land Disturbance Activities (General Permit). CONTRACTOR shall implement the SWPPP as shown and as specified by the document in Appendix C to these Specifications prior to start of construction and shall amend the SWPPP as necessary to ensure compliance. The CONTRACTOR shall submit an amended SWPPP to the ENGINEER for review, acceptance, and forwarding to other County and/or regulatory agencies, as appropriate as, no later as 30 days after NTP.

B. The project has been assigned a Risk Level Type. The water quality sampling points necessary for the compliance with the risk-based system shall be as shown or as amended and approved. CONTRACTOR will be fully responsible for compliance with, execution and implementation of the SWPPP.

C. The CONTRACTOR will provide both a Qualified SWPPP Developer (QSD) and a Qualified SWPPP Practitioner (QSP) for this Project. The QSD and QSP shall both meet the requirements listed in Paragraph 1.05 below.

D. The CONTRACTOR shall perform all necessary erosion control and stormwater management measures in compliance with all federal, state and local requirements for erosion control and pollution prevention, including all requirements set forth in the SWPPP. Requirements for erosion control and disposal of surface water during construction may include, but are not limited to, conducting a sampling, monitoring and reporting program, construction of sedimentation ponds, ditches, culverts, silt fences, straw wattles, pumping, draining and other measures required for the removal or exclusion of water from the excavations, stockpile, and other incidental work areas.

E. The CONTRACTOR QSP shall conduct the water quality monitoring, sampling, analysis, and reporting program required by the General Permit. This program includes a minimum of 3 samples per day at each discharge location, including characterization for a minimum, but not limited to, turbidity, pH, and suspended sediment concentrations. The sampling program will be governed by the project's risk level in accordance with the General Permit, the CONTRACTOR shall ensure that all stormwater sample collection preservation and handling requirements are in accordance with the "Stormwater Sample Collection and Handling Instructions" and the General Permit.

F. The CONTRACTOR QSP shall conduct daily inspections and observations during working hours or in after hour emergency storm events and at least once each 24-hour period during extended storm events. CONTRACTOR QSP shall conduct visual inspections to identify and record BMPs that need maintenance to operate effectively, that have failed, or that could fail to operate as intended and correct any deficiencies within a 24-hour time period.

G. The CONTRACTOR shall install a rain gauge on-site at an accessible and secure location with readings made during all rainfall events. When readings are unavailable, data from the closest rain gauges may be used for nearby sites for example as listed in these links (http://cdec.water.ca.gov/cgiprogs/staMeta?station_id=lso) or other data as approved by the ENGINEER.

H. The CONTRACTOR QSD shall develop and implement Rain Event Action Plans (REAP) designed to protect all exposed portions of their sites within 48 hours prior to any likely precipitation event in accordance with the General Permit.

I. CONTRACTOR will be fully responsible for compliance with, execution and implementation of the SWPPP and all related requirements, including any fines or penalties assessed for non-compliance of the General Permit.

J. All work included in this Section and necessary to comply with the General Permit is deemed incidental work and shall be included in CONTRACTOR's Total Bid Price.

1.02 RELATED SECTIONS

A. Appendix C: SWAPP.

B. Section 01060: Regulatory Agency and Utility Requirements.

C. Section 01330: Submittal Procedures.

1.03 REFERENCES

National Pollution Discharge Elimination System (NPDES) General Permit [Order No. 2009-0009-DWQ] for Stormwater Discharges Associated with Construction and Land Disturbance Activities at: http://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/constpermits/wqo_2009_0009_complete.pdf.

A. Project Environmental Impact Report.

1.04 REGULATORY REQUIREMENTS

A. The Clean Water Act (CWA), as amended in 1972, prohibits the discharge of pollutants into the waters of the United States from stormwater. No debris, soil, ash, silt, sand, cement or concrete, or washing thereof, oil or petroleum products or other organic materials from CONTRACTOR’s operation shall be allowed to enter or be placed where it may be washed by rainfall or runoff directly into creek or other waters of the United States.

B. National Pollution Discharge Elimination System (NPDES) General Permit [Order No. 2009-0009-DWQ] for Stormwater Discharges Associated with Construction and Land Disturbance Activities (General Permit).

C. CONTRACTOR shall comply with all provisions of the SWPPP and comply with the Central Coast Water Board's Basin Plan water quality objectives.

D. Any governing provisions related to stormwater pollution prevention, erosion and sediment control, and water quality that are in conflict with this specification shall be guided by the terms of the General Permit, the Central Coast Water Board and the State Water Resources Control Board.

E. Under no circumstances shall a creek or natural waterway be disturbed, filled in, dammed, or altered.

F. CONTRACTOR shall report any significant sediment release immediately to the ENGINEER so that the appropriate public agencies are notified. CONTRACTOR will be responsible for payment of all fines, cleanup and restoration efforts related to such sediment release.

1.05 SWPPP CERTIFICATION REQUIREMENTS

A. Qualified SWPPP Developer: The CONTRACTOR shall provide a Qualified SWPPP Developer (QSD). The CONTRACTOR shall submit qualifications for the QSD including one of the following registrations or certifications, and appropriate experience, as required for and provide the required information:
   1. A California registered professional civil engineer, California registered professional geologist or engineering geologist, California registered landscape architect, professional hydrologist registered through the American Institute of Hydrology, Certified Professional in Erosion and Sediment Control (CPESC)TM registered through Enviro Cert International, Inc, Certified Professional in Stormwater Quality (CPSWQ) TM registered through Enviro Cert International, Inc, or professional in erosion and sediment control registered through the National Institute for Certification in Engineering Technologies (NICET). Proof of QSD credentials shall be included in the SWPPP.
   2. Effective September 1, 2011, the QSD shall have completed a State Water Board-sponsored or approved QSD training course as specified in the General Permit and shall include proof of approved coursework in the SWPPP.
   3. The CONTRACTOR shall list the name and telephone number of the currently designated QSD in the SWPPP including a 24-hour emergency telephone number.
   4. The CONTRACTOR shall ensure that the SWPPP is written and amended by a QSD, as needed, to address the specific circumstances for each construction site covered by this General Permit prior to commencement of construction activity for any stage.

B. Qualified SWPPP Practitioner: The CONTRACTOR shall provide a Qualified SWPPP Practitioner (QSP) to ensure that all elements of any SWPPP for each project will be implemented. The CONTRACTOR assigned QSP is a person responsible for non-stormwater and stormwater visual observations, sampling and analysis, and for ensuring full compliance with the permit and implementation of all

elements of the SWPPP. The CONTRACTOR shall ensure that the QSP shall be either a QSD or have one of the following certifications and provide the required information:

1. A certified erosion, sediment, and stormwater inspector registered through Certified Professional in Erosion and Sediment Control, Inc. or certified inspector of sediment and erosion control registered through Certified Inspector of Sediment and Erosion Control, Inc. Proof of QSP credentials shall be included in the SWPPP.
2. Effective September 1, 2011, a QSP shall have completed a State Water Board-sponsored or approved QSP training course and shall include proof of approved coursework in the SWPPP.
3. The CONTRACTOR shall list the name and telephone number of the currently designated QSP in the SWPPP including a 24-hour emergency telephone number.
4. The CONTRACTOR shall ensure that the SWPPP include a list of names of all contractors, subcontractors, and individuals who will be directed by the QSP, and who is ultimately responsible, as assigned by the CONTRACTOR for implementation of the SWPPP. The SWPPP shall include a list contacts, telephone numbers and work addresses for all of these parties. Specific areas of responsibility of each subcontractor and 24-hour emergency contact numbers shall also be included.

1.06 SWPPP AMENDMENTS, ANNUAL COMPLIANCE CERTIFICATION AND QUARTERLY REPORTING REQUIREMENTS

A. When changes in the SWPPP are required during the course of the Project, CONTRACTOR QSD shall prepare, certify and sign an amendment to the SWPPP and submit it to the ENGINEER for review andupload to the Stormwater Multi-Application Reporting and Tracking System (SMARTS) upon approval by ENGINEER. CONTRACTOR QSD shall prepare an amendment to the SWPPP when one or more of the following conditions exist:
   1. No later than 30 days after execution of Contract.
   2. Whenever there is a change in construction or operations that may affect the discharge of pollutants to surface waters, groundwater(s), or a municipal separate storm sewer system.
   3. Annually, prior to the defined rainy season, if required by the Project's Contract Documents or when deemed necessary by the ENGINEER or governing resource agency.

B. CONTRACTOR shall include the following information with each proposed amendment to the SWPPP:
   1. Describe who requested the proposed amendment.
   2. Describe the location of the proposed change.
   3. Describe reason for change.
   4. Describe the new BMP proposed.

C. All proposed amendments to the SWPPP shall be submitted electronically to the ENGINEER in accordance with Section 01330. All proposed amendments shall include a completed SWPPP Certification and Approval form signed by CONTRACTOR and the CONTRACTOR’s QSD. CONTRACTOR shall include a listing of the date of initial preparation and the date of each amendment in the SWPPP.

D. CONTRACTOR shall insert all accepted amendments into the CONTRACTOR's SWPPP. CONTRACTOR shall also record all accepted amendments in the SWPPP amendment log.

E. In no event will CONTRACTOR be entitled to increases in the Contract Sum or the Contract Time for SWPPP amendments and resulting Work caused by CONTRACTOR's failure to comply with the General Permit, the SWPPP, or the requirements set forth in this Specification.

F. CONTRACTOR QSD shall annually report and certify that the site is in compliance with the requirements of the General Permit. The CONTRACTOR will be required to provide information and submit an annual report no later than August 1 of each year using SMARTS. The Annual Report must include a summary and evaluation of all sampling and analysis results, original laboratory reports, chain–of-custody forms, a summary of all corrective actions taken during the compliance year, and identification of any compliance activities or corrective actions that were not. The CONTRACTOR is required to retain paper or electronic copies of all records required by the project's General Permit for a period of at least 3 years from the date generated or the date submitted to the State Water Board or Central Coast Water Board. The CONTRACTOR must retain records for a period beyond 3 years as directed by Regional Water Board.

G. The CONTRACTOR shall perform Quarterly Reporting requirements in accordance with the General Permit.

H. The CONTRACTOR will not be entitled to increases in the Contract Price or the Contract Time for SWPPP amendments and/or work caused by CONTRACTOR's failure to comply with the General Permit, the SWPPP, or the requirements set forth in this Specification.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use certified, weed free, natural/biodegradable imported erosion control materials (e.g., fiber rolls, coir rolls, erosion mats, etc.).

B. No plastic monofilament netting shall be allowed in any biodegradable BMP's.

C. Erosion Control Mats shall be approximately 30% Coco, 70% Wheat Straw and shall utilize either jute, hemp or cotton netting or mesh and shall be the lowest sodium content possible.

D. Filter fabric used for drop inlet protection, filter mesh, filter bags or alike shall be minimum of a nonwoven 8 oz. geotextile fabric.

E. Coir Wattles shall be 9" or 12" diameter as shown on the plans. The materials shall be mattress coir fiber with coir twine netting rolls shall be certified weed free and low sodium.

F. Straw Wattles shall be 100% biodegradable 100% wheat straw with jute netting natural fibers and shall be 9" or 12" as indicated on the drawings.

G. Wind Erosion covers shall be either 30 mil plastic or minimum 7 oz. nonwoven geotextile fabric with roped gravel or sand bags or other approved hold down method.

H. General use of more environmentally safe, biodegradable materials on construction sites to minimize the potential risk to water quality.

PART 3 EXECUTION

3.01 EROSION AND STORMWATER CONTROL, HOUSEKEEPING, CLEAN UP AND DISPOSAL

A. The CONTRACTOR shall implement the SWPPP, amend, and maintain the SWPPP document to be made available at the Project Site at all times. The SWPPP shall be made available to the OWNER and the Central Coast Water Board during normal working hours and on a 24-hour basis during emergencies or non-compliances. The CONTRACTOR shall abide by all SWPPP requirements contained therein and described below.

1. Install erosion control blanket on fill slopes and to cover and protect disturbed soil areas from erosion by wind or water.
2. Install fiber rolls along the top, face, and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow, and as shown on the approved SWPPP.
3. Install silt fence along toe of exposed and erodible slopes, down slope of exposed soil areas, around temporary stockpiles and along the top of streambank and channels, and as shown on the approved SWPPP.

B. CONTRACTOR shall arrange to have sediment catch basins cleaned on a routine basis so that sediment does not enter receiving bodies of water, storm drains, and reservoirs.

C. The CONTRACTOR shall remove all erosion and sediment control devices and material, equipment, and temporary structures used for the control and disposal of stormwater from the Site once work is completed.

END OF SECTION

SECTION 01571

TRAFFIC CONTROL

PART 1 GENERAL

1.01 REQUIREMENTS

A. The CONTRACTOR shall provide all traffic control required to construct the Work, to ensure public safety, and to minimize traffic impacts and delays. Traffic control shall be as required in the California Manual on Uniform Traffic Control Devices, 2012 Edition (CA MUTCD), the 2010 State Standard Specifications (Caltrans) Section 7, Section 12, and other sections as well as with Caltrans traffic control manuals and plans, as applicable.

B. CONTRACTOR shall conform with all requirements of these provisions, including but not limited to, preparation of Traffic Control Plans; construction and maintenance of temporary pavement (if any); placement of signs, barricades, and safety devices; providing flag person, providing and placement of temporary striping, traffic cones, and other channelizing devices; and all activities to conform to requirements of the State Standard Specifications and these specifications.

C. The CONTRACTOR shall be responsible for the safety of vehicular traffic within the Project limits and on the approaches to the Project. The CONTRACTOR shall be responsible for the safety of pedestrians, cyclists, and animals within the Project limits.

1.02 TRAFFIC CONTROL PLAN

A. The traffic control information provided in the Drawings and Specifications are guidelines for the CONTRACTOR. The CONTRACTOR shall prepare and submit its own Traffic Control Plan for review and approval by the ENGINEER prior to construction.

B. If the CONTRACTOR's Traffic Control Plan deviates from the Contract Documents' traffic control plans and specifications and/or the CA MUTCD or 2010 State Standard Plans and Specifications, traffic control manuals and plans, the CONTRACTOR's Traffic Control Plan shall be prepared by a California Registered Civil Engineer.

C. The CONTRACTOR shall submit 8 copies of its Traffic Control Plan to the ENGINEER for review a minimum of 14 days prior to construction.

D. The ENGINEER shall observe the execution of the approved Traffic Control Plan during construction and may request changes as field conditions warrant. Said changes shall be performed at no additional cost/time to the Contract.

1.03 STREET DESIGNATIONS

A. Streets within the Project are designated as arterial, collector, and minor as follows:
   1. Arterial Streets:
      a. Los Osos Valley Road.

2. Collector Streets:
   a. None.
3. Minor Streets:
   a. All remaining streets not designated as arterial streets or collector streets.

B. Business Street Segments. In addition to the above designations, the following street segments shall be identified as business street segments:
   1. None.

1.04 STREET RESTRICTIONS

A. Arterial Streets:
   1. Two lanes of through traffic shall be maintained at all times in all arterial streets.
   2. Only one construction activity at a single location shall be allowed on all arterial streets at any given time.

B. Collector Streets:
   1. Two lanes of through traffic, or a single lane of through traffic with flagpersons, shall be maintained at all times on collector streets.
   2. Only one construction activity at a single location shall be allowed in one east-west collector street and in one north-south collector street at any given time.

C. Minor Streets:
   1. A minor street segment, limited to the distance between two adjacent street intersections, may be closed to through traffic for the Area construction of various pipelines during working hours.
   2. The CONTRACTOR shall maintain at least one minimum 11-foot-wide lane for local traffic to accommodate residents, visitors, and deliveries to properties in the subject segment and for emergency vehicles during the working hours.

D. Business Street Segments:
   1. The CONTRACTOR shall maintain vehicular access to business driveways and parking areas for business customers at all times.
   2. Where compliance with the above is not possible, and with the ENGINEER's approval, access may be interrupted for a period not to exceed four hours per day for a maximum of two days per business.
   3. The CONTRACTOR shall provide temporary signs to advise potential customers that the subject business remains open during construction and indicates the location of the alternative access.

E. Street Intersections:
   1. Street intersection traffic control shall be performed in accordance with the traffic control typical details included in the Drawings.

F. Traffic Restoration. All streets shall be restored through traffic at the close of working hours by backfilling and compacting the excavation (including providing temporary or permanent pavement) and/or covering with steel plates, as specified herein. Likewise, access shall be restored to all residence and business driveways at the end of each day.

1.05 CONSTRUCTION LIMITATIONS

A. No equipment or material shall be parked or stored within any traffic lanes or within 8 feet from the edge of traveled way at any time of day or night, including holidays and weekends, without an approved lane or road closure unless otherwise approved by the County of San Luis Obispo. Road closures and detours will be authorized only in special circumstances and must be approved by the County of San Luis Obispo a minimum of 2 weeks in advance.

B. Working Hours:
   1. Working hours for arterial streets shall be limited from 8:30 a.m. until 3:00 p.m., Monday through Friday. With a minimum of 48 hours advance notification by the CONTRACTOR, Saturday work may be approved by the ENGINEER on a case-by-case basis. With a minimum of two weeks advance notification by the CONTRACTOR, night work on arterial streets or weekend work may be approved by the ENGINEER on a case-by-case basis.
   2. Working hours for collector streets shall be limited from 7:00 a.m. until 6:00 p.m., Monday through Friday.
   3. Construction activities within one block of any school during student drop-off or pick-up hours, which are generally 7:30 a.m. until 8:30 a.m. and 2:30 p.m. until 3:30 p.m. respectively, Monday through Friday, shall be precluded.

C. No activities that interfere with public traffic during the holiday season (defined as the four-day Thanksgiving weekend and December 18 through January 1) shall be conducted on the following streets:
   1. Los Osos Valley Road.

D. Coordinate lane closures on Los Osos Valley Road with lane closures in and around the vicinity by the Collection System Project. Specifically, either Los Osos Valley Road between South Bay Boulevard and Turri Road or South Bay Boulevard north of Los Osos Valley Road shall be open, with no traffic restrictions, at all times.

E. Lane closures on Los Osos Valley Road are not permitted on Friday afternoons preceding 3-day Federal Holiday weekends.

F. No lane closures shall be permitted on Los Osos Valley Road from 7:00 a.m. to 8:30 a.m. or from 3:00 p.m. to 6:00 p.m. on any weekday.

G. Not Used.

H. Not Used.

I. Not Used.

1.06 ACCESS

A. The CONTRACTOR shall provide emergency services access to all residences and businesses at all times. The CONTRACTOR shall have an adequate number of steel traffic plates and equipment to place the plates or shall backfill the trench and make it passable for emergency vehicles.

B. The CONTRACTOR shall be responsible for maintaining local property access and access to existing public cross-streets within the limits of this Contract. CONTRACTOR shall perform road closures on half block increments or alternating streets.

1.07 NOTIFICATION

A. The CONTRACTOR shall provide written notice at least 3 working days in advance of construction work to South Bay Fire Department, County Sheriff Department, California Highway Patrol, and Regional Transit (if applicable) and other emergency services including ambulance/paramedics.

B. The CONTRACTOR shall provide written notification to residences and businesses a minimum of 72 hours in advance of performing any construction work. Notifications shall be by written notice to the resident placed on or near the building entrance or the property access point to be closed.

C. The CONTRACTOR shall provide, place and maintain all construction signage in accordance with the Caltrans standard specifications and plans. The CONTRACTOR shall also provide portable electronic changeable message signs at the beginning and end of widening Los Osos Valley Road to inform the community of the anticipated work duration, that traffic is subject to delays and other pertinent information. The CONTRACTOR's Public Liaison shall coordinate the foregoing with the OWNER's Public Information Program (PIP) Consultant.

D. General advisory signs shall be posted 10 days in advance of construction activities.

E. The CONTRACTOR shall provide 72-hour advance notice with a CMS of lane closures on arterial roads.

F. The CONTRACTOR shall notify all public agencies (post offices, sheriff, California Highway Patrol, ambulance services, mass transit, trash/sanitation, etc.) of all road closures at least three working days in advance of each closure.

PART 2 PRODUCTS

2.01 NOT USED

2.02 FLASHING ARROW BOARDS

A. All trailer-mounted flashing arrow boards shall meet or exceed the physical and operational requirement of the "California Manual on Uniform Traffic Control Devices."

B. The unit shall have been evaluated by the NTPEP.

C. The display housing shall meet the minimum size requirements of a Type C panel with a 15- or 25-lamp configuration.

2.03 NOT USED

PART 3 EXECUTION

3.01 STREET USE

A. Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, alleyway, or parking area during the performance of the Work. The CONTRACTOR shall conduct its operations to prevent interference with the authorized work of utility companies or other agencies in such streets, alleyways, or parking areas.

B. No street shall be closed to the public without first obtaining permission of the ENGINEER.

C. The CONTRACTOR shall maintain two 10-foot or one 11-foot-wide traffic lane(s) at all times. For single-lane traffic provide signage and flagpersons at all times.

3.02 PROTECTION

A. During the CONTRACTOR's operations that require aerial work over vehicle lanes, the CONTRACTOR shall close such lanes to public traffic. Lane closure shall be subject to the restrictions of this Section. The CONTRACTOR may use flagpersons if the work is intermittent.

B. All street traffic plates shall be provided with raised weld bead or non-skid coating. Plates placed on arterial roads shall be recessed to be flush with top of pavement, all plates on other streets shall be pinned, wedged, or otherwise secured. Provide cold or hot mix pavement around the edges of the plate for smooth passage of traffic.

C. Toe boards shall be provided to retain excavated material if required by the ENGINEER or the OWNER.

D. Fire hydrants on or adjacent to the Work shall be kept accessible to firefighting equipment at all times.

E. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks and the proper functioning of all gutters, drain inlets, and other drainage facilities.

F. The CONTRACTOR shall install and maintain temporary Type K railing and/or fencing around the construction areas.

G. At the conclusion of each workday, all paved traveled-way surfaces shall be restored to an all-weather, traversable condition. There shall not be a drop-off along the edge of traveled way greater than 0.15 foot. "Low Shoulder" signs shall be placed along the traveled way where there is any drop-off. Drop-offs greater than 0.15 foot shall require either:
   1. Backfilling the drop-off to a minimum 4:1 slope.
   2. Providing appropriate steel plates over excavation.
   3. Providing temporary concrete railing along the work zone in conformance with the 2010 State Standard Plans and Specifications.

H. The CONTRACTOR shall provide temporary crash cushion modules for end treatments as shown on the Drawings in accordance with this Specification.

I. All flaggers shall hold current certifications. As defined under Cal OSHA Construction Safety Order Section 1599, all flaggers on the roadway shall be trained by qualified and experienced personnel to the aspects noted in Section 1599. The CONTRACTOR shall use trained personnel only. All workers within the roadway shall wear Type 2 CAL-OSHA high-visibility vests.

3.03 TRAFFIC CONTROL

A. For the protection of traffic in public or private streets and ways, the CONTRACTOR shall provide, place and maintain all necessary barricades, traffic cones, warning signs, lights and other safety devices in accordance with the requirements of the CONTRACTOR's Traffic Control Plan and "California Manual on Uniform Traffic Control Devices" or the Standard Plans.

B. Construction area signs shall be furnished, installed, maintained, and removed when no longer required in accordance with Section 12 of the State Standard Specifications.

C. Prior to initiating work, the CONTRACTOR shall install all required traffic control devices. In addition to these signs, the CONTRACTOR shall install barricades with steady burn flashers at 200 feet O.C. minimum and post-delineators at 50 feet O.C. minimum.

D. Attention is directed to Section 7-1.08 "Public Convenience," Section 7-1.09 "Public Safety," Section 12-3.04 "Portable Delineators" of the State Standard Specifications.

E. The CONTRACTOR shall cooperate with local authorities relative to handling traffic through the area and shall make arrangements relative to keeping the work area clear of parked vehicles.

F. All trenches shall be protected during the hours work is not in progress so that no person or animal could fall into or be injured by an open trench.

G. The CONTRACTOR shall take all necessary precautions for the protection of the Work and the safety of the public. All barricades and obstructions shall be illuminated at night and all lights shall be turned on from sunset until sunrise. The CONTRACTOR shall station such guards or flagpersons and shall conform to such special safety regulations relating to traffic control as may be required by the public authorities within their respective jurisdictions. All signs, signals, and barricades shall conform to the requirements of CAL-OSHA and Sub-part B, Part 1926, of the OSHA Safety and Health Standards for Construction.

H. Traffic control devices shall be placed and maintained at all times during and after working hours of each day until the next phase of construction traffic control is being placed. At the end of the construction, all signing and striping shall be restored to the existing conditions, except that existing thermoplastic striping and payment markings shall be replaced with painted striping and markings. The roadway is defined as "that area of the highway used for vehicular, pedestrian, and bicycle travel."

3.04 PEDESTRIAN REQUIREMENTS

A. The CONTRACTOR shall maintain pedestrian access at all times. Where sidewalks or shoulder areas are closed by construction, an alternate route shall be provided. The alternate route shall consist of a smooth surface a minimum of 48 inches in clear width. The surface may consist of asphalt concrete, aggregate base, or compacted earth. Signs and barricades shall be installed at the limit of construction to direct pedestrians to the alternate route.

B. Fences or railings shall be placed adjacent to areas utilized by pedestrians when a vertical difference in excess of 6 inches exists between the elevation of the pedestrian walkway and the elevation any excavation adjacent to the walkway.

C. The CONTRACTOR shall provide access to bus stops at all times or provide temporary bus stop location and signage. When access to existing bus stops is not practical due to construction activities, the CONTRACTOR shall provide a nearby temporary bus stop location until the existing location is accessible. The CONTRACTOR shall verify location of existing bus stops, confirm the current bus schedule, and coordinate the location of temporary bus stop location with the Transit Authority and School District. The CONTRACTOR shall provide signage at the existing bus stop and at the temporary bus stop.

D. The CONTRACTOR shall not close a bike lane unless approved by the ENGINEER or Public Works Director.

3.05 DRIVEWAY ACCESS

A. Except as provided below, the CONTRACTOR shall maintain access to all driveways. All materials and equipment shall be stored in such a manner as to not block access or egress to any driveway.

B. The CONTRACTOR shall notify the property owner or occupant (if not property owner-occupied) of the pending closure of any driveway for more than one 8-hour work day at least three working days in advance of such closure. The CONTRACTOR shall minimize the inconvenience and the time period that the driveway will be closed. The CONTRACTOR will fully explain to the property owner or occupant the start and duration of the closure.

C. Arrangement for access to the construction site over private property shall be mutually agreed upon by the CONTRACTOR and the property owner before start of construction. CONTRACTOR shall provide the property owner with a copy of the written arrangement or agreement.

3.06 PAVEMENT RESTORATION

A. The CONTRACTOR shall provide and maintain roadway until permanent pavement is installed.

B. Temporary pavement or all-weather surface is limited to a maximum of 45 days prior to final pavement repair.

3.07 COORDINATION WITH PROJECT LIAISON

A. It is understood and agreed that proper traffic control is necessary to minimize public impacts and to ensure their safety. The CONTRACTOR shall, on a daily basis, communicate all traffic control notifications to the ENGINEER including necessary changes in anticipated traffic control measures.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Product requirements; product selection; product options and substitutions; quality assurance; delivery, handling, and storage; and manufacturer's instructions.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 00700 - General Conditions.
      b. Section 01660 - Testing, Training, and Commissioning.
      c. Section 09960 - High-Performance Coatings.

1.02 DEFINITIONS

A. Execution: Inclusive of performance, workmanship, installation, erection, application, field fabrication, field quality control, and protection of installed products.

B. Products: Inclusive of material, equipment, systems, shop fabrications, mixing, source quality control.

1.03 PRODUCT REQUIREMENTS

A. This Project is funded in whole or in part using funds from the American Recovery and Reinvestment Act (ARRA). Section 1605 of the ARRA prohibits the use of these funds unless all iron, steel, and manufactured goods are produced in the United States. All iron and steel manufacturing processes must take place in the United States, except for metallurgical processes involving refinement of steel additives. There is no requirement for the origin of components and subcomponents of manufactured goods. Products listed at 48 CFR 25.104(a) have been determined to be unavailable in the United States and, if required for the Project, may be purchased from foreign sources. No unauthorized use of foreign iron, steel, and/or manufactured goods will be allowed on this Project.

B. Comply with Specifications and referenced standards as minimum requirements.

C. Provide products by same manufacturer when products are of similar nature, unless otherwise specified.

D. Provide identical products when products are required in quantity.

E. Provide products with interchangeable parts whenever possible.

F. Require each equipment manufacturer to have maintenance facilities meeting the following requirements:
   1. Minimum 3 years operational experience.
   2. Location in continental United States.
   3. Equipment and tools capable of making repairs.
   4. Staff qualified to make repairs.
   5. Inventory of maintenance spare parts.

1.04 PRODUCT SELECTION

A. When products are specified by standard or specification designations of technical societies, organizations, or associations only, provide products that meet or exceed reference standard and Specifications.

B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide:
   1. Products by one of named manufacturers that meet or exceed Specifications.
   2. Accepted or equal.

C. When products are specified with names of manufacturers and model numbers or catalog designations, provide:
   1. Products with model numbers or catalog designations by one of named manufacturers.
   2. Accepted or equal.

D. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
   1. Products specified by brand or trade name, model number, or catalog designation.
   2. Products by one of named manufacturers proven in accordance with requirements for or equals to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.
   3. Accepted or equal.

E. When Products are specified with only one manufacturer followed by "or Equal," provide:
   1. Products meeting or exceeding Specifications by specified manufacturer.
   2. Accepted or equal.

1.05 PRODUCT OPTIONS AND SUBSTITUTIONS

A. General: Whenever a product is specified using a name of a particular manufacturer or supplier, the specific item cited shall be understood as establishing type, function, dimension, appearance, and quality desired.

B. Formal substitution request procedure.
   1. Submit a written formal substitution request to Engineer for each proposed substitution within 30 days of effective date of Agreement.
   2. Engineer will return initial opinion and request for additional information within 30 days.
   3. Engineer will notify Contractor in writing of decision to accept or reject the substitution request within 30 days of receiving required information.

C. Formal substitution request contents:
   1. Manufacturer's literature including:
      a. Manufacturer's name and address.
      b. Product name.
      c. Product description.
      d. Reference standards.
      e. Certified performance and test data.
      f. Operation and maintenance data.
   2. Samples, if applicable.
   3. Shop drawings, if applicable.
   4. Reference projects where the product has been successfully used.
      a. Name and address of project.
      b. Point of contact name and phone number.
   5. Itemized comparison of the proposed substitution with product specified including a list of significant variations.
      a. Design features.
      b. Design dimensions.
      c. Installation requirements.
      d. Operations and maintenance requirements.
   6. Define impacts.
      a. Impacts to construction schedule.
      b. Impacts to other contracts.
      c. Impacts to other work or products.
      d. Impact to Contract Sum.
         1) Do not include costs under separate contracts.
         2) Do not include Engineer's costs for redesign or revision of Contract Documents.
         3) Required license fees or royalties.
      e. Availability of maintenance services and sources of replacement materials.
   7. Contractor represents the following:
      a. Contractor bears the burden of proof of the equivalency of the proposed substitution.
      b. Proposed substitution does not change the design intent and will have equal performance to the specified product.
      c. Proposed substitution is equal or superior to the specified product.
      d. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed substitution.
      e. Contractor will coordinate installation of accepted substitution into the Work and will be responsible for the costs to make changes as required to the Work.
      f. Contractor waives rights to claim additional costs caused by proposed substitution which may subsequently become apparent.

D. Substitutions will not be considered for acceptance under the following conditions:
   1. No formal substitution request is made.
   2. The substitution is simply implied or indicated on shop drawings or product data submittals.
   3. The formal substitution request is submitted by a subcontractor or supplier.

E. Substitution requests submitted after the deadline will not be considered unless the following evidence is submitted to the Engineer:
   1. Proof that the specified product is unavailable for reasons beyond the control of the Contractor.
      a. Reasons may include manufacturing discontinued, bankruptcy, labor strikes, or acts of God.
      b. Contractor placed or attempted to place orders for the specified products within 10 days after the effective date of the Agreement.
      c. The formal substitution request is submitted to Engineer within 10 days of the Contractor discovering the specified product cannot be obtained.

F. Engineer's decision on a substitution requests will be final and binding.
   1. Accepted substitutions will be incorporated into the Contract Documents with a Change Order.
   2. Requests for time extensions and additional costs based on submission of, acceptance of, or rejection of substitutions will not be allowed.

1.06 QUALITY ASSURANCE

A. Employ entities that meet or exceed specified qualifications to execute the Work.

B. Inspect conditions before executing subsequent portions of the Work. Accept responsibility for correcting unsatisfactory conditions upon executing subsequent portions of the Work.

C. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.07 DELIVERY, HANDLING, STORAGE, AND PROTECTION

A. Prepare products for shipment by:
   1. Applying grease and lubricating oil to bearings and similar items.
   2. Separately packing or otherwise suitably protecting bearings.
   3. Tagging or marking products to agree with delivery schedule or shop drawings.
   4. Including complete packing lists and bills of material with each shipment.
   5. Packaging products to facilitate handling and protection against damage during transit, handling, and storage.

B. Transport products by methods that avoid product damage. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

C. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

D. Upon delivery, promptly inspect shipments.
   1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
   2. Immediately store and protect products and materials until installed in Work.

E. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for all mechanical equipment, valves, architectural items, electrical and instrumentation equipment and special equipment to be incorporated into this project.
   1. Storage of equipment shall be in strict accordance with the “instructions for storage” of each equipment supplier and manufacturer including connection of heaters, placing of storage lubricants in equipment, etc.
   2. The Contractor shall furnish a copy of the manufacturer’s instructions for storage to the Engineer prior to storage of all equipment and materials.
   3. Corroded, damaged, or deteriorated equipment and parts shall be replaced before acceptance of the project.
   4. Equipment and materials not properly stored will not be included in an application for payment.

F. Store products with seals and legible labels intact.

G. Store moisture sensitive products in weathertight enclosures.

H. Maintain products within temperature and humidity ranges required or recommended by manufacturer.

I. Maintain storage areas at ambient temperatures recommended by manufacturer.

J. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Repaint damaged painted surfaces.

K. Exterior storage of fabricated products:
   1. Place on aboveground supports that allow for drainage.
   2. Cover products subject to deterioration with impervious sheet covering.
   3. Provide ventilation to prevent condensation under covering.

L. Store loose granular materials on solid surfaces in well-drained area. Prevent materials mixing with foreign matter.

M. Provide access for inspection.

N. Maintain equipment per the manufacturer’s recommendation and industry standards, including oil changes, rotation, etc. Provide a log of equipment maintenance to the Engineer on a monthly basis.
   1. Rotation log shall include, as a minimum, the equipment identification, date stored, date removed from storage, copy of manufacturer’s recommended storage guidelines, date of rotation of equipment, and signature of party performing rotation.

O. Protection after installation:
   1. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove covering when no longer needed.

1.08 MANUFACTURER'S INSTRUCTIONS

A. Deliver, handle, store, install, erect, or apply products in accordance with manufacturer's instructions, Contract Documents, and industry standards.

B. Periodically inspect to assure products are undamaged and maintained under required conditions.

1.09 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. Provide spare parts, maintenance products, and special tools as required by Specifications.

B. Box, tag, and clearly mark items.

C. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
   1. Contractor is responsible for spare parts and special tools until acceptance by Owner.
   2. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.

PART 2 PRODUCTS

2.01 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts and special tools inventory list, see Appendix A:
   1. Equipment tag number.
   2. Equipment manufacturer.
   3. Subassembly component, if appropriate.
   4. Quantity.
   5. Storage location.

B. Large items:
   1. Weight: Greater than 50 pounds.
   2. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
   3. Stored individually.
   4. Clearly labeled:
      a. Equipment tag number.
      b. Equipment manufacturer.
      c. Subassembly component, if appropriate.

C. Smaller items:
   1. Weight: Less than 50 pounds.
   2. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
   3. Stored in spare parts box.
   4. Clearly labeled:
      a. Equipment tag number.
      b. Equipment manufacturer.
      c. Subassembly component, if appropriate.

D. Spare parts and special tools box:
   1. Wooden box:
      a. Size: 24 inches wide by 18 inches high by 36 inches long.
   2. Hinged wooden cover
      a. Strap type hinges.
      b. Locking hasp.
      c. Spare parts inventory list taped to underside of cover.
   3. Coating: As specified in Section 09960.
   4. Clearly labeled:
      a. The words “Spare Parts and/or Special Tools.”
      b. Equipment tag number.
      c. Equipment manufacturer.

PART 3 EXECUTION

3.01 CLOSEOUT ACTIVITIES

A. Owner may request advanced delivery of spare parts and special tools.
   1. Deduct the delivered items from inventory and provide transmittal documentation.

B. Immediately prior to the completion date of the Testing Phase defined in Section 01660, arrange to deliver spare parts and special tools to Owner at a location on site chosen by the Owner.
   1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
   2. Owner and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

3.02 ATTACHMENTS

A. Appendix A - Spare Parts and Special Tools Inventory List.

B. Appendix B - Sample Substitution Request Form.

END OF SECTION

APPENDIX A
SPARE PARTS AND SPECIAL TOOLS INVENTORY LIST

[Specification Number and Title]				
[Equipment Tag Number]				
[Equipment Manufacturer]				
Quantity	**Subassembly Component**	**Description**	**Manufacturer's Part Number**	**Storage Location**

Project: _____ Substitution Request Number:

_____ From: _____

To: _____ Date: _____

_____ Engineer Project Number: _____

Re: _____ Contract For: _____

Specification Title: _____ Description: _____

Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Address: _____ Phone: _____

Trade Name: _____ Model No.: _____

Installer: _____ Address: _____ Phone: _____

History: ☐ New product ☐ 2-5 years old ☐ 5-10 yrs old ☐ More than 10 years old

Differences between proposed substitution and specified product: _____

_____

_____

☐ Point-by-point comparative data attached - REQUIRED BY ENGINEER

Reason for not providing specified item: _____

_____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain _____

_____

Savings to Owner for accepting substitution: _____ ($ _____).

Proposed substitution changes Contract Time: ☐ No ☐ Yes [Add] [Deduct] _____days.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ _____

The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including Engineer design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by: _____

Signed by: _____

Firm: _____

Address: _____

_____

Telephone: _____

Attachments: _____

_____

_____

_____

ENGINEER's REVIEW AND ACTION

☐ Substitution accepted - Make submittals in accordance with Specification Section 01330.
☐ Substitution accepted as noted - Make submittals in accordance with Specification Section 01330
☐ Substitution rejected - Use specified materials.
☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments: ☐ Contractor ☐ Subcontractor ☐ Supplier ☐ Manufacturer ☐ Engineer ☐ _____

_____

_____

_____

_____

_____

_____

_____

SECTION 01610

PROJECT DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Project design criteria such as temperature and site elevation.

1.02 PROJECT DESIGN CRITERIA

A. All equipment and materials for the project are to be suitable for performance in wastewater treatment plant environment and under following conditions:
   1. Design temperatures are:
      a. Outdoor temperatures: 30 to 100 degrees Fahrenheit.
      b. Indoor temperatures for the following buildings:
         1) Process areas: 60 to 104 degrees Fahrenheit.
         2) Electrical rooms: 60 to 90 degrees Fahrenheit.
         3) Administration Building: 70 to 76 degrees Fahrenheit
         4) Other: 60 to 104 degrees Fahrenheit.
   2. Moisture conditions: Defined in individual equipment sections.
   3. Site elevation: Approximately 85 feet above mean sea level.
   4. Marine environment with coastal fog and sea salt spray.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01612

SEISMIC DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Seismic design criteria for the following:
   1. Anchorage of mechanical and electrical equipment.
   2. Seismic design and design of anchorage for small tanks fabricated off site and shipped to the Project site.
   3. Other structures or items as specified or indicated on the Drawings.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Code Requirements.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. 7-05 - Minimum Design Loads for Buildings and Other Structures.

1.03 SYSTEM DESCRIPTION

A. Design requirements:
   1. Design in accordance with the requirements of the building code as specified in Section 01410:
      a. Design spectral acceleration at short period, S_{DS}: 0.97g.
      b. Component amplification factor, a_p: In accordance with ASCE 7-05, Tables 13.5-1 and 13.6-1.
      c. Component response modification factor, R_p: In accordance with ASCE 7-05, Tables 13.5-1 and 13.6-1.
      d. Component importance factor, I_p: 1.25
   2. Do not use friction to resist sliding due to seismic forces.
   3. Do not use more than 60 percent of the weight of the mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.
   4. Do not use more than 60 percent of the weight of the tank for resisting overturning due to seismic forces.
   5. Use anchor bolts, bolts, or welded studs for anchors for resisting seismic forces. Anchor bolts used to resist seismic forces shall have a standard hex

bolt head embedded in the concrete. Do not use anchor bolts fabricated from rod stock with an L or J shape.

6. Do not use chemical anchors, concrete anchors, flush shells, powder actuated fasteners, sleeve anchors, or other types of anchors unless indicated on the Drawings or accepted in writing by the Engineer.
7. Seismic forces must be resisted by direct bearing on the fasteners used to resist seismic forces. Do not use connections that use friction to resist seismic forces.

1.04 SUBMITTALS

A. Shop drawings and calculations: Where specified in individual Specifications Sections, complete shop drawings and seismic calculations.

B. Calculations shall be signed and stamped by a civil or structural engineer licensed in the State of California.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01614

WIND DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Wind design criteria.

B. Related section:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.

1.02 SYSTEM DESCRIPTION

A. Design requirements:
   1. Building code criteria: Design for wind in accordance with building code as specified in Section 01410:
      a. Occupancy category: IV.
      b. Basic wind speed: 85 miles per hour.
      c. Exposure category: C.
      d. Topographic factor, K_{zt}: 1.00.
      e. Wind importance factor, I_w: 1.15.
   2. Use anchor bolts, bolts, or welded studs for anchors for resisting wind forces. Anchor bolts used to resist wind forces shall have a standard hex bolt head embedded in the concrete. Do not use anchor bolts fabricated from rod stock with an L or J shape:
      a. Do not use concrete anchors, sleeve anchors, flush shells, chemical anchors, powder actuated fasteners, or other types of anchor unless indicated on the Drawings or accepted in writing by the Engineer.
      b. Wind forces must be resisted by direct bearing on the anchors used to resist wind forces. Do not use connections that use friction to resist wind forces.

1.03 SUBMITTALS

A. Shop drawings and calculations: Where specified in individual specification sections, complete shop drawings, and wind design calculations.

B. Calculations shall be signed and stamped by a civil or structural engineer licensed in the state where the Project is located.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01660

TESTING, TRAINING, AND COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

A. This Section specifies the requirements for achieving, verifying, and documenting the working condition of the Facility, according to its intended function, operation, and performance, including the training of Owner's personnel. This process includes, but is not limited to, documentation and procedures, testing phase, work during start-up phase, commissioning, and possession and use by the OWNER. The process is applicable to mechanical, electrical, and instrumentation systems and completed portions of the Work, functioning as integrated systems of a completed operational Facility.

B. Provide water, power, fuel, chemicals, and all other necessary items and personnel required to complete the tests and inspections specified herein, unless otherwise specified.

C. If, under test, a portion of the Work fails to meet the Contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion, in conjunction with other portions of the work affected, shall be repeated within a reasonable time and in accordance with the specified conditions.

D. Test results to be within the tolerances set forth in the Specifications. If no tolerances have been specified, conform to tolerances established by recognized industry practice.

E. Where, in the case of an otherwise satisfactory result of a test conducted in full compliance with the Contract Documents, doubt or dispute arises between the ENGINEER and the CONTRACTOR regarding the test results or the methods or equipment used in the performance of such test, then the ENGINEER may require the test to be repeated. The repeat test using such modified methods or equipment will be paid per the following:
   1. If the test results confirm the prior, satisfactory results, costs for the repeat test will be paid by the OWNER.
   2. If the test results fail to comply with the Contract requirements, all costs associated with the repeat tests and equipment necessary to achieve the Contract requirements will be at the CONTRACTOR's expense.

F. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to

excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 00700 - General Conditions.
b. Section 01140 - Work Restrictions.
c. Section 01210 - Allowances.
d. Section 01292 - Schedule of Values.
e. Section 01330 - Submittal Procedures.
f. Section 01324A - Progress Schedules and Reports.
g. Section 01500 - Temporary Facilities.
h. Section 01759 - Water Leakage Testing for Concrete Structures.
i. Section 01782 - Operation and Maintenance Data.
j. Section 15958 - Mechanical Equipment Testing.
k. Section 16950 - Field Electrical Acceptance Tests.
l. Section 17050 - Common Work Results for Process and Instrumentation Systems.
m. Section 17950 - Testing, Calibration, and Commissioning.
n. Section 17100 - Control Strategies.
o. Section 17101 - Specific Control Strategies.
p. Appendix B - Waste Discharge Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. It is a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.
   1. ASTM American Society for Testing and Materials.
   2. IEEE Institute of Electrical and Electronics Engineers.
   3. ISA Instrument Society of America.
   4. NETA InterNational Electrical Testing Association.

B. Testing equipment and apparatus shall be installed by personnel trained in the trades and professions required to assure competent workmanship.

C. Supervise the installation of devices and items for specific equipment testing including those that are specified to be installed by factory-trained or manufacturer-certified personnel.

D. Document the skills, experience, and training of workers engaged in the testing furnished by the CONTRACTOR.

1.03 SUBMITTALS

A. Procedures: Section 01330.

B. 60 days after Notice to Proceed, a listing of all individual component and system testing to be performed.

C. 60 days after Notice to Proceed, qualifications of Test Engineer.
   1. Including description of previous experience as a Test Engineer on similar projects and a list of references including phone numbers for OWNER review and approval.

D. Testing Phase Submittals: Separate submittals for each phase.
   1. Preoperational tests.
   2. Component tests.
   3. System tests.
   4. Operational Test: An update of System Test Packages with Operational Test results and evaluations as related to other Systems, facilities, or contracts.
   5. Commissioning: Completed System Test Package documentation.

E. Testing Reports:
   1. By component.
   2. By system.

F. Training Program:
   1. Listing of all individual equipment and systems.
   2. Training content.
   3. Documentation of training performed.

1.04 TEST ENGINEER QUALIFICATIONS AND RESPONSIBILITIES

A. Submit for approval information documenting qualifications of Test Engineer.
   1. Minimum Qualifications:
      a. Have a minimum of five years' experience in operations and commissioning of wastewater treatment facilities, electrical switchgear, and facility control systems of similar size, type, and capacity as this project.
      b. Experienced in activities related to operational testing and trouble-shooting.

B. General Responsibilities of the Test Engineer:
   1. Plan, schedule, and execute the work to complete the provisions of this Section.
   2. Be regularly engaged in all aspects of Testing Phase, Start-up Phase and Commissioning Phase.
   3. Lead CONTRACTOR's efforts and provide oversight during Testing, Start-Up, and Commissioning.
   4. Provide assistance to the OWNER during the Start-Up Phase.
   5. Assist in trouble-shooting and optimization of the treatment processes during Commissioning Phase.

C. Provide primary interface with ENGINEER and OWNER for efforts relating to testing, start-up, and commissioning of project facilities. Carefully review the testing requirements that are specified in the Contract Documents and coordinate with requirements specified in this Section.Specific Responsibilities of the Test Engineer:
   1. Develop schedules for all testing, integrate testing into the master construction activity schedule, and coordinate all required testing.
   2. 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 reflect actual procedures to be used. The test procedures shall be appropriately documented to permit validation of test results by third party.

3. Review and approve all functional and performance tests, results, and documentation for all equipment and systems.
4. Coordinate with subcontractor and manufacturers specific to their responsibilities and contractual obligations.
5. Coordinate all cross system testing. Examples include process controls, HVAC, fire alarm, and life safety.
6. Document any inconsistencies or deficiencies in system operations and ensure system compliance or recommend modifications that will achieve compliance with performance requirements.
7. Coordinate the participation in the required testing and approve procedures, after verifying that pretests have been satisfactorily conducted and the systems are ready for final tests.
8. Review, verify, and approve as-built data provided by subcontractors and manufacturers.
9. Obtain all documentation of equipment and systems' tests and assemble a final test report, following the completion of the Operational Testing and that of the Final Acceptance Testing.

D. Test Engineer On Site:
1. Prior to Testing Phase: As needed to plan, scope, coordinate, and schedule future activities with the ENGINEER.
2. Testing Phase: Full time.
3. Start-Up Phase: Minimum 3 days a week.
4. Commissioning Phase: Full time.

1.05 DEFINITIONS

A. Facility: The Los Osos Water Recycling Facility (LOWRF) and associated infrastructure and facilities, some of which may be located outside of the plant boundaries (e.g., Collection System facilities).

B. Minimum Plant Design Flow Rate of 100,000 Gallons per Day: The minimum daily average influent flow rate at which the LOWRF is designed to operate its biological processes on a continuous basis and produce secondary effluent that may be either discharged offsite in accordance with the LOWRF's permit requirements or be temporarily stored on-site and retreated prior to being discharged offsite in accordance with the permit requirements.

C. Equipment: An assembly of component(s) and devices(s) that requires installation or functional testing. (Examples: Effluent Pump (pump, motor, VFD) and UV Disinfection System).

D. System:
1. A grouping of subsystems, equipment, components, and devices that perform a definable function.
2. Specific systems include, but are not limited to, the following:
   a. Screens and screenings compactors.
   b. Aerators and Mixers.
   c. Secondary Clarifiers.
   d. Tertiary Filtration System.
   e. UV Disinfection System.
   f. Chemical Feed Systems.

g. Dewatering System.
h. Effluent Pump System.
i. Miscellaneous Pumping Facilities.
j. SCADA System.
k. Administration Building Systems.
l. Sludge Storage System.
m. Emergency Generator.
n. Potable/Fire Water System.

E. Component: A basic building block of equipment, subsystems, and systems that requires installation or functional testing but does not have an electrical connection or internal electronics. (Examples: filter effluent piping and manual isolation valves).

F. System Test Package: Comprehensive package of test procedures and results for each system listed. Package shall include items listed in the paragraphs above. Individual package shall be prepared for each system listed.

G. Preoperational Tests:
1. Factory testing as specified in individual Specification Sections.
2. Standard factory tests of manufacturer and standard industry practice.
3. Equipment inspection and acceptance upon delivery to site.

H. Component Tests: Installed component tests and inspections.

I. System Tests: Complete Systems tests and evaluations.

J. Testing Phase: A series of testing of Equipment, Systems, and the Facility that includes and concludes with Operational Testing of the Facility using non-wastewater. Its objective is to substantiate that all systems and processes operate to defined design/performance criteria with non-wastewater for a specific duration.

K. Completion Date for Testing Phase: The date on which the certificate of successful Operational Testing is approved by the ENGINEER.

L. Start-Up Phase: The period during which the influent wastewater flow is below the Minimum Plant Design Flow Rate. Consequently, Interim Measures are required to handle the wastewater flows during this phase. The influent flow rates will gradually increase over time during this period.

M. Interim Measures: Temporary equipment, systems, processes, and/or procedures required to treat, store, handle, and dispose of the wastewater flows in a manner consistent with the LOWRF's permit requirements.

N. Commissioning: The initiation of the entire Facility operation by OWNER personnel, in accordance with the design intent, with the influent flow rate equaling or exceeding the Minimum Plant Design Flow Rate. The Facility is required to treat the entire influent wastewater flows during this period without any Interim Measures. Further, the effluent discharged from the LOWRF during this period is required to meet the water quality requirements for leach field discharge, which are listed in the Waste Discharge Requirements (Appendix B).

O. Final Acceptance Test: The operation of the Facility by OWNER's personnel for a specified duration during Commissioning Phase to document the Project has

successfully met the Contractual requirements and the Facility is operationally ready for achieving Substantial Completion.

1.06 TESTING PHASE

A. General Requirements for Test Submittals:
   1. Complete description and schedule of all testing to be completed at each test stage.
   2. Submit for approval minimum 30 days prior to initiating test stage, except as follows.
      a. Complete test procedure schedule, procedures, forms, and other documentation and submit for approval six months prior to starting any testing required by DIVISION 17.

B. Submit the following prior to testing and in accordance with Section 01330:
   1. Preoperational Tests:
      a. Description of procedures for and results of factory tests specified in individual Specifications.
      b. Other standard factory test results available from manufacturer.
   2. Component Tests:
      a. Written test procedures for Systems Test Package for each item of Equipment for approval prior to testing.
      b. Schedule indicating the order in which various tests, activities, and training will occur.
      c. Completed forms, which include:
         1) Recorded data from preoperational inspection.
         2) Verification of proper checkout, alignment, adjustment, and calibration.
         3) All test information and results including specified operational parameters.
         4) Use form for each piece of Equipment installed.
         5) Use form that includes all test information including specified operational parameters.
         6) Initials of Equipment manufacturer's representatives, the CONTRACTOR's representative, and the ENGINEER.
         7) Record of relevant performance data for the original testing and not less than 3 retests.
         8) Format acceptable to ENGINEER.
   3. System Tests:
      a. System Test package prior to testing a System. Include the following:
         1) Identification of the System with a description of operating parameters.
         2) Process and instrumentation diagrams detailing System.
         3) Equipment list pertaining to the System with cross-references to the appropriate Specifications. Reference Systems as defined above.
         4) Written procedures detailing the CONTRACTOR's Component Tests and System Tests proposed to verify Equipment compliance with the Specifications and operating parameters.
         5) Submittals from Preoperational Test and delivery acceptance tests and inspections for each Component Test of the System.
         6) Submittals from Component Tests Phase for each component of the System.

b. Update System Test Package with results of System Tests.
c. Complete System Test results and performance evaluations.

C. Testing Report:
1. Following completion of System testing, submit Form 01660-A for each equipment item.

1.07 COMMISSIONING PHASE TESTING

A. Within 14 days of the completion of the Final Acceptance Testing, submit a final test report.

1.08 TRAINING

A. Submit per Section 01330.

B. Procedure:
1. Master training schedule for operations and maintenance:
a. Submit 30 days prior to start of System Testing for first training presentation.
b. Schedule to include:
1) Target date and time for each operating and maintenance training presentation for each System, both field and classroom.
a) Include all training sessions including those that are repeated during Commissioning Phase.
2) Target date for initiation of Commissioning period.
3) Do not schedule training on weekends or holidays observed by OWNER.
4) Coordinate training scheduling with applicable OWNER staff work schedule.
2. After each training, submit completed Form 01660-B and Form 01660-C.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 MATERIALS AND EQUIPMENT

A. Comply with the requirements of this Contract and the recommendations of the Equipment manufacturers.

B. Provide temporary pumps, piping, valving, and/or other appurtenances to conduct all required testing during the Testing Phase.

C. Provide test gauges, meters, recorders and monitors as required to supplement or augment the instrumentation System provided under this Contract to properly demonstrate that Equipment fully satisfies the specified requirements. Specifically select devices employed for the purpose of measuring the performance of the

Facility's Equipment and Systems to be consistent with the variables to be monitored. Instruments to be recently calibrated.

D. Demonstrate through re-calibration the accuracy of instruments employed for testing purposes.

E. Calibration procedures are in accordance with applicable standards of ASTM, ISA, IEEE, and NETA. The adequacy and calibration of gauges, meters, recorders, and monitors.

F. Furnish and install materials and equipment that would collectively constitute the Interim Measure(s) during the Start-Up Phase in accordance with OWNER's specific request.

3.02 INSTALLATION

A. Install Equipment in accordance with the details shown and specified in full compliance with manufacturer's requirements. Notify the Engineer of conflict between a manufacturer's installation recommendations and specific requirements of the Contract Documents.

3.03 TESTING PHASE

A. General requirements:
   1. Test and inspect Equipment and partially completed or fully completed portions of the Work to prove compliance with the Contract requirements.
   2. Unless otherwise noted, pay all costs of testing, including temporary facilities, utilities, and connections.
   3. Test the Following:
      a. Leakage testing for concrete structures designed to hold water as specified in Section 01759.
      b. Equipment with one or more moving parts or devices requiring an electrical, pneumatic, or hydraulic connection.
      c. Leakage tests and other piping tests as specified in DIVISION 15.
      d. Testing and balance for heating, ventilation, and air conditioning Systems as specified in accordance with DIVISION 15.
      e. Electrical devices and Systems as specified in accordance with DIVISION 16.
      f. Instrumentation devices and Systems as specified in accordance with DIVISION 17, including but not limited to the following:
         1) SCADA system work for the Collection System facilities.
         2) Control loop tuning.
         3) Global process control systems testing.
   4. Coordinate with the Fire Inspection Compliance Check. Take necessary corrective action prior to commencing Operational Testing.
   5. Receive ENGINEER approval for application of all tests only after ENGINEER inspection of Equipment for conformance with Specifications.
   6. Tests and inspections, unless otherwise specified or accepted, are in accordance with the recognized standards of the industry. Allow for up to two additional setpoint changes during testing.

B. Procedures:
   1. Design testing procedures to duplicate, as nearly as possible, operation conditions while ensuring Equipment is not damaged. Once testing procedures have been reviewed and approved by ENGINEER, organize by System into test packages and include proper checkout, alignment, adjustment, and calibration signoff forms for each item of Equipment and System.
   2. Jointly use forms with ENGINEER to ensure that documentation for each electrical, mechanical, and instrumentation Equipment item has been properly recorded for installation and testing. Failure to follow ENGINEER-approved procedure will result in non-acceptance of Equipment.
   3. Fulfillment of test and inspection requirements are by either of the following:
      a. Tests and inspections carried out in ENGINEER's presence, or:
      b. Certificates or reports of tests and inspections carried out by ENGINEER-approved persons or organizations.
   4. Maintain the Systems test packages, 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. Tests:
   1. Preoperational Tests:
      a. Test items at the place of manufacture during or on completion of manufacture. Tests are comprised of hydraulic pressure tests, electric and instrumentation subsystem tests, performance and operating tests, and inspections.
      b. Perform in accordance with the relevant standards of the industry if not specified in the Contract Documents.
      c. When the items are delivered to site and when requested by ENGINEER, remove all coverings, containers, or crates in order to permit ENGINEER to conduct inspection to determine if items are of specified quality and workmanship, and are visually in good order and condition at the time of delivery. Should ENGINEER find, in its opinion, indication of damage or deficient quality of workmanship, provide necessary documentation or conduct such tests to demonstrate compliance.
   2. Component Tests:
      a. General:
         1) Equipment to be tested to the specified requirements before a System is placed into operation.
         2) Incorporate Specification 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.
         3) Perform all changes, adjustments, or replacements required to make the Equipment operate.
      b. Component testing procedures include, but are not limited to:
         1) Piping System pressure testing and cleaning as specified in DIVISION 15.
         2) Electrical System testing as specified in DIVISION 16.
         3) Instrumentation System testing as specified in DIVISION 17.
         4) Provide and complete a checklist to verify discrete and analog inputs from field devices update PLC memory registers.

5) Provide and complete a checklist to verify PLC discrete and analog outputs are connected to field devices.
6) Testing, Checking and Correcting Deficiencies of:
   a) Power, control, and monitoring circuits for continuity prior to connection to power source.
   b) Voltage of all circuits.
   c) Phase sequence.
   d) Cleanliness of connecting piping Systems.
   e) Alignment of connected machinery.
   f) Vacuum and pressure of all closed Systems.
   g) Lubrication.
   h) Valve orientation and position status for manual operating mode.
   i) Tankage integrity using clean water.
   j) Instrumentation and control signal generation, transmission, reception, and response.
   k) Tagging and identification Systems.
   l) Proper connections, alignment, calibration, and adjustment.
7) Calibrate all safety equipment.
8) Manually rotate or move moving parts to ensure freedom of movement.
9) Bump electric motors to verify power and direction of rotation.
10) Perform other tests, checks, and activities required to make component ready for System Testing.

c. Obtain approval of operation and maintenance information per Section 01782 prior to any testing.

3. System Tests:
   a. General:
      1) Once ENGINEER has approved Equipment required for Component Test and has not found deficiencies in that portion of Work, test and operate all individual Systems under operating conditions to determine as comprehensively as possible whether Equipment and System meet Specification requirements. See specific System testing procedures below.
      2) Use potable water in the testing of W1 and W2 water systems including water storage tanks. For all other Systems use non-wastewater. ENGINEER to approve test media disposal methods.
      3) When testing requires use of auxiliary Systems such as seal water, electrical power, natural gas, or instrumentation that have not yet been placed in service, provide acceptable substitute sources, capable of meeting requirements of the machine, device or System. ENGINEER may require a repeat of the test when the auxiliary system becomes available.
      4) Maintain temporary facilities until permanent services are in service.
      5) Following System Testing:
         a) Recheck machines for proper alignment; realign if necessary and dowel in place.
         b) Check Equipment for loose connections, unusual movement, or other indications of improper operating characteristics.
         c) Correct deficiencies to the requirements of the ENGINEER.
         d) Disassemble and inspect equipment that exhibits unusual or unacceptable operating characteristics. Repair or remove from

site and replace with new. Test until Equipment meets Specification requirements.

b. Field Testing to Verify Performance Requirements:
   1) As part of System Tests, completely field test each Equipment item specified in DIVISIONs 11 through 15 over entire range of operating conditions.
   2) Record flow, suction pressure, and discharge pressure in field testing report.
   3) Perform vibration tests where specified in individual equipment specification. Vibration tests shall be in accordance with Hydraulic Institute Standards and Section 15958.
   4) Provide necessary pressure and flow measuring equipment. Calibrate prior to use.
   5) Provide a complete field testing report on each Equipment item and include in System Test Package.

c. System Test Procedures Include, But are Not Limited to:
   1) Provide and complete a checklist to demonstrate discrete and analog points are displayed on graphic screens at main control.
   2) Provide and complete a checklist to demonstrate operator entries via operator interface are communicated to PLC memory.
   3) Provide and complete a checklist to demonstrate entries via operator interface control the Equipment and Systems as described in Sections 17100 and 17101.
   4) Provide and complete a checklist to verify discrete and analog inputs from field devices update PLC operator interface panel.
   5) Provide and complete a checklist to demonstrate operator entries via PLC interface panel control as described in the Control Strategy.
   6) Actuate all alarms from field devices by physically changing state of field device to cause alarm. Do not simulate conditions. Provide and complete a checklist to demonstrate that all alarms are received on annunciators, PLC interface, and displays.
   7) Test Systems to ENGINEER requirements prior to proceeding to Operational Tests.

d. Complete Manufacturer's certificate of proper installation following all testing.

4. Operational Testing:
   a. General:
      1) Provide 2-week notice to ENGINEER prior to starting Operational Test in order that OWNER staff may be coordinated to provide support as needed.
      2) Conduct an Operational Test Coordination Meeting 1 week prior to initiating the Operational Tests. Coordinate with OWNER.
      3) After completion of System Testing and approval by ENGINEER that systems and equipment comply with Specification requirements, configure all systems for complete automatic operation as required by Sections 17100 and 17101.
      4) Supply operational manpower for testing requiring 24-hour operations.
      5) Submit Operational Testing results within 14 days of completion of this testing phase.
      6) Upon successful completion of Testing Phase, submit a certificate to ENGINEER for written approval.

b. Testing:
   1) Test the operation of the entire Facility (the liquid and solids handling processes and associated auxiliary systems) with non-wastewater.
   2) Conduct Operational Test for a continuous 10-day period. Unless otherwise noted, Facility shall perform through its complete design range for a period of 10 consecutive 24-hour days. Operational Test shall be sequenced in coordination with the criteria specified in Section 01140 and this Section.
   3) Test water flow shall be recirculated from one REW pond to one of the two 10-inch tees in the Influent Meter Vault, identified on Sheet 10M01. Use of Effluent Pumps and Out-of-Compliance Return (OOCR) line for this purpose is permissible. OOCR pipe is designed to discharge into the Influent Splitter Box of the Oxidation Ditches, and is provided with a tee outside of the Influent Splitter Box. CONTRACTOR shall assess its feasibility, provide all required temporary pumps, piping, pipe plugs, and other appurtenances, and take full responsibility for conducting the Operational Test. Minimum pumping capacity shall be 2.75 mgd.
   4) Do not allow overflows.
      a) Submit an emergency spill/overflow response procedure for approval, prior to Operational Test.
      b) Provide a plant alignment schematic. Schematic shall show at minimum; flow path, valve alignment identifying open or close, equipment in operation, equipment in "not ready status", pump(s) in lead/lag status, and monitored overflow points.
   5) Operate Equipment and Systems during operational testing phase, to the greatest extent practical, at conditions that represent the full range of operating parameters as defined in Contract Documents.
   6) Bring process units to full operating conditions, including temperature, pressure, and flow.
   7) Test in a step-by-step method, in accordance with CONTRACTOR's approved written testing procedures. Accomplish testing work in an orderly, systematic testing of Equipment, Systems, structures, and the complete Facility as a unit. ENGINEER to witness each individual step in the procedures.
   8) Operational Testing shall be considered complete when, in ENGINEER's opinion, Facility under test has operated properly for the entire test duration without significant interruption.
      a) "Significant interruption" during Operational Testing may include any of the following events:
         (1) Failure of a system (process, controls, etc.) that is not permanently corrected within 6 hours after such failure occurs.
         (2) Failure of a process equipment unit (mechanical, electrical, instruments, etc.) that is not permanently corrected within 8 hours after such failure occurs.
      b) "Permanently corrected" means without a repeat failure during the remaining duration of the Testing Phase and shall consist of all of the following:
         (1) Work repaired and replaced to conform with specified requirements.

(2) Parts and components replaced as recommended by original manufacturer, without impacting the warranty, and conforming with reviewed submittals.
(3) Piping and valves properly installed and connected.
(4) Wiring properly terminated.
(5) Accessories, including spare parts and lubricants, furnished as specified.
(6) The facility is back on line and operating within normal operating parameters.

9) Occurrence of a significant interruption shall require testing then in-progress to be stopped and restarted at time equals zero (begin at Day 1 again) after permanent corrections are made.

10) During Operational Testing, any condition that affects the ability of Equipment or Systems to operate as specified, or which would significantly increase operating or maintenance costs shall be considered unsatisfactory. It is the intent to confirm that each part of the project is capable of performing satisfactorily. The performance of all other elements of the project necessary for this test shall also be considered.

11) Unless otherwise directed by ENGINEER, any malfunction of Equipment or Systems observed during the test shall be corrected when observed.
    a) Where the malfunction is of a minor nature, as determined by ENGINEER, the test may be interrupted for a short period to correct the malfunction. Period of test will then be increased by the duration of the actual period or periods of such stoppages.
    b) Where the malfunction is of a major nature and results in an unscheduled shutdown (of the process or equipment being tested), or a shutdown for an extended period or is considered unsatisfactory as defined above, all as determined by the ENGINEER, the test will be deemed to have failed. After the malfunction has been corrected, the test shall be restarted and repeated until successfully performed.

3.04 START-UP PHASE

A. After completion of Testing Phase and its certification by ENGINEER, OWNER will allow the LOWRF's collection system to be operational and allow wastewater to flow into plant. This marks the beginning of the Start-Up Phase. During this period, OWNER will be operating the LOWRF with the assistance of the CONTRACTOR's work.

B. Provide assistance to OWNER in accordance with OWNER's specific requests in writing.
   1. CONTRACTOR's work under this period is being covered with a bid allowance. Refer to Sections 00700 and 01210.
   2. For planning and contractual purposes, the Start-Up Phase shall be considered to be 180 days in duration.

C. By definition, influent flows during this period would be less than the Minimum Plant Design Flow Rate. Consequently, some Interim Measures must be implemented in order to treat and handle influent wastewater in a manner consistent with the Waste

Discharge Requirements of the LOWRF. The following provides a brief summary of several alternatives for such Interim Measures that may be considered by OWNER. As such, they describe the potential assistance that the CONTRACTOR will be required to provide.

1. Alternative No. 1 - Preliminary Treatment followed by On-site Storage and Offsite Trucking:
    a. Once influent wastewater is metered and screened at the Headworks, it would be conveyed, by gravity, to the Storm Water Retention Pond via the overflow box at the Headworks and the 14-inch SI piping.
    b. An inflatable plug would need to be installed in the 18-inch SI piping, which would otherwise convey screened effluent to the Oxidation Ditches.
    c. Wastewater stored in the Storm Water Retention Pond would be pumped into trucks to be provided by CONTRACTOR, using the Storm Water Pumps. Trucks would haul wastewater to a nearby wastewater treatment plant to be designated by OWNER for the duration of this phase.
2. Alternative No. 2 - Preliminary Treatment followed by On-site Storage and Package Treatment System:
    a. Influent wastewater would be metered and screened at the Headworks, and then conveyed to the Storm Water Retention Pond similar to Alternative No. 1.
    b. Wastewater stored in the Storm Water Retention Pond would be treated by a package treatment system to be furnished, installed, and maintained by the CONTRACTOR. The Storm Water Pumps would be used to deliver a steady feed into the package treatment system.
    c. The effluent from the package treatment system would flow by gravity into the Filter Influent Pump Station, which in turn would pump to the Tertiary Filters. Downstream of the Filters, the flow would pass through the UV facility, with or without operating the UV system, to one of the two REW ponds. If the UV system is not used, sodium hypochlorite may be added to the flow at the UV common effluent channel.
    d. Water stored in the REW pond may be either discharged to leach fields in accordance with the Waste Discharge permit or be pumped to the oxidation ditch for further treatment.
3. Alternative No. 3 – Preliminary Treatment followed by Temporary Floating Aerators:
    a. Influent wastewater would be metered and screened at the Headworks and then conveyed to the Oxidation Ditches. One ditch, equipped with temporary floating surface aerators that would be capable of operating with varying side water depths, would be placed in service.
    b. CONTRACTOR would truck waste activated sludge from a nearby wastewater treatment plant for seeding the oxidation ditch to be placed in service.
    c. Additional source of biological oxidation demand (BOD) may need to be added in order to maintain an appropriate ratio of food to microorganisms in the ditch.
    d. Effluent gates for the ditch would be set to allow storage of flow in the ditch. With the rising level in the ditch, additional floating aerators may be installed and turned on. Alternatively, one or both permanent aerators in the ditch may be used if level in the ditch enables such operation.
    e. Aerators would need to be cycled on/off periodically to achieve denitrification in the ditch.

f. Ditch effluent would flow downstream as designed, except that the UV system may or may not be operated. If the UV system is not used, sodium hypochlorite may be used for disinfection.
g. Water stored in the REW pond may be either discharged to leach fields in accordance with the Waste Discharge permit or be pumped back to the oxidation ditch for additional treatment.

D. The Start-Up Phase shall continue until the influent flow rate reaches the Minimum Plant Design Flow Rate under Alternatives No. 1 or 2, OR when the biological process stabilizes without the need of any temporary equipment or BOD supplementation under Alternative No. 3.

3.05 COMMISSIONING

A. The OWNER will provide written notice of the completion of the Start-Up Phase and the commencement of the Commissioning Phase.
   1. Prior to start of Commissioning activities, remove temporary system, piping, plugs, and other apparatus that would no longer be used.

B. Final Acceptance Test
   1. Initiate the Final Acceptance Test for the entire Facility, during which the Facility shall be made fully operational, capable of accepting design flows, and performing all functions as designed.
   2. Duration: 14 consecutive days.
   3. OWNER or OWNER's operations and maintenance personnel will operate the LOWRF or portion thereof.
   4. CONTRACTOR shall:
      a. Provide required labor and assistance to support the OWNER to ensure the Facility attains and maintains its fully operational mode.
      b. Be responsible for all costs of necessary repairs or replacements required to keep the Facility operational. Failures of equipment will require restart of Final Acceptance Test.
      c. Be available to provide immediate assistance 24 hours per day, seven days per week, in case of failure of a portion of the System being operated.
   5. Successful operation of the Facility for the duration specified above shall be a pre-requisite for completing the Commissioning Phase.

C. Other Responsibilities of CONTRACTOR:
   1. Participate and assist the OWNER in trouble-shooting and process optimization. Make available technical and knowledgeable personnel capable of resolving issues promptly. Make such personnel available onsite.
   2. Provide additional training of OWNER's staff during Commissioning.

3.06 TRAINING

A. Provide training of OWNER's personnel during Testing Phase, and repeat the training during Commissioning Phase as described below.

B. Testing Phase Training:
   1. Conduct personnel training after completion of Component Test for the Equipment for which training is being conducted, but no later than 5 days after

System Testing begins except for vendor package systems. Personnel training for vendor package systems shall be conducted during Operational Testing.

a. Personnel training on individual Equipment or System will not be considered completed unless:
    1) All training deliverables are received and approved before commencement of training on the individual Equipment or System.
    2) All provisions of field and classroom training are met.

2. Training on variable frequency drive and custom-engineered equipment shall occur prior to testing of the component.
3. Field and Classroom Training Requirements:
    a. Hold classroom training on site.
    b. Training instructor: Factory trained and familiar with giving both classroom and hands-on instructions.
    c. Session beginning and ending times to be coordinated with ENGINEER and indicated on master schedule. Normal time lengths for class periods can vary, but brief rest breaks shall be scheduled and taken.
    d. When requested by OWNER, organize training into separate maintenance and operation sessions and identify on schedule.
    e. Plan for minimum class attendance of 6 people at each session and provide sufficient classroom materials, samples, and handouts for those in attendance.
    f. Instructors to have a typed agenda and well prepared instruction material. The use of visual aids, e.g., films, pictures, and slides, is recommended for use during the classroom training programs.
    g. Provide Equipment required for presentation of films, slides, and other visual aids.
    h. Maintain a log of classroom training including: instructors, topics, dates, time, and attendance.
4. Make available experienced factory-trained representatives of manufacturers of the various pieces of Equipment to train OWNER's personnel in operation and maintenance thereof. The time required for this training is as specified for each piece of Equipment and as specified in this Section.
5. Notify ENGINEER of the training time at least 10 days prior to the training day.

C. Commissioning Phase Training:
    1. Due to the extended duration of the Testing Phase and the Start-Up Phase, during commissioning, repeat all training sessions that have been conducted during the Testing Phase.

3.07 TRAINING PRESENTATION CONTENTS

A. Train 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 (PM):
    a. Pass out the PM list, including reference material, and daily, monthly, quarterly, semi-annual, and annual PM tasks.
    b. Demonstrate how to perform PM tasks.
    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 days prior to first anticipated training presentation.

C. Provide a status report and schedule-to-complete for requirements prerequisite to training presentation.

D. Provide training content for each training presentation a minimum of 14 days prior to the training presentation.

E. Document personnel who has received training.

3.08 SCHEDULING

A. Identify time frames for the Facility integration activities identified and developed in this Section in the construction schedule per the requirements in Section 01324A.

B. Update as the Facility integration process occurs.

C. Use hourly scheduling when required by the tasks to be completed and coordinated.

3.09 PAYMENT

A. Payment for the work for the Commissioning and Training shall be reflected in the Schedule of Values and paid monthly as the work in this Section is completed. The Schedule of Values is specified in Section 01292.

END OF SECTION

01660-A Equipment Test Report Form

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. The example is furnished, as a means of illustrating the level of detail required for the preparation of equipment test report forms.

Equipment Name: _____

Equipment Number: _____

Specification Reference: _____

Location: _____

PREOPERATIONAL CHECKLIST

MECHANICAL

	Contractor		Vendor		Project Rep	
	Verified	**Date**	**Verified**	**Date**	**Verified**	**Date**
Lubrication						
Alignment						
Anchor Bolts						
Seal Water System Operational						
Equipment Rotates Freely						
Safety Guards						
Valves Operational						
O&M Manual Information Complete						
Manufacturer's Installation Certificate Complete						

ELECTRICAL (Circuit Ring-Out and High-Pot Tests)

	Contractor		Vendor		Project Rep	
	Verified	**Date**	**Verified**	**Date**	**Verified**	**Date**
Circuits:						
Power to MCC						
Control to HOA						
Indicators at MCC:						
Red (Running)						
Green (Power)						
Amber (Auto)						
Indicators at Local Control Panel						
Wiring Labels Complete						
Nameplates:						
MCC						
Control Station						
Control Panel						
Equipment Bumped for Rotation						

SAMPLE

PIPING SYSTEMS

	Contractor		Vendor		Project Rep	
	Verified	**Date**	**Verified**	**Date**	**Verified**	**Date**
Cleaned and Flushed:						
Suction						
Discharge						
Pressure Tests						
Temporary Piping Systems in Place						

INSTRUMENTATION AND CONTROLS

	Contractor		Vendor		Project Rep	
	Verified	**Date**	**Verified**	**Date**	**Verified**	**Date**
Flowmeter Calibration:						
Calibration Report No.						
Flow Recorder Calibrated:						
Against Transmitter						
VFD Speed Indicator Calibrated Against:						
Independent Reference						
Discharge Over-Pressure Shutdown:						
Switch Calibration						
Simulate Discharge Over-pressure:						
Shutdown						

INITIAL OPERATION

MECHANICAL

	Contractor		Vendor		Project Rep	
	Verified	**Date**	**Verified**	**Date**	**Verified**	**Date**
Motor Operation Temperature Satisfactory						
Pump Operating Temperature Satisfactory						
Unusual Noise, Etc.						
Pump Operation:						
Measurement:						
Flow						
Pressure						
Test Gauge Number						
Alignment Hot						
Doweled In						

Remarks: _____

_____

SAMPLE

ELECTRICAL

	Contractor		Vendor		Project Rep	
	Verified	**Date**	**Verified**	**Date**	**Verified**	**Date**
Local Switch Function:						
Runs in HAND						
No Control Power in OFF						
Timer Control in AUTO						
Overpressure Protection Switch:						
Functional in both HAND and AUTO						
Overpressure Protection Switch Set at 75 psig						
PLC Set at 24 Hour Cycle, 25 Minutes ON						

OPERATIONAL TEST

Pump cycles as specified, indicators functional, controls functional, pump maintains capacity, over pressure protection remains functional, hour meter functional.

_____

_____

_____

_____

_____

_____

_____

_____

RECOMMENDED

_____ _____

Contractor Representative Date

ACCEPTED

_____ _____

Project Representative Date

SAMPLE

01660-B Training Attendance Form

Contract Name: _____

Contract No: _____ Date: _____

TRAINING PROCEDURES FOR _____

Trainer: _____ Company: _____ Phone No.: _____

Name	Company	Phone No.

SAMPLE

01660-C Training Procedure Documentation

Contract Name: _____

Contract No: _____ Date: _____

TRAINING PROCEDURES FOR _____

Trainer: _____ Company: _____

TOPIC	DISCUSSION
Familiarization	
Safety	
Operations	
Preventative Maintenance	
Repairs	
Parts	
Contacts	
Guarantees	

SAMPLE

SECTION 01710

CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Execute cleaning, during progress of the work, and at completion of the WORK, as required by Section 00700 - General Conditions.

1.02 DISPOSAL AND CLEANING

A. Conduct cleaning and disposal operations to comply with codes, ordinances, regulations, permits, and anti-pollution laws.

PART 2 PRODUCTS

2.01 MATERIALS

A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.01 DURING CONSTRUCTION

A. Execute periodic cleaning to keep the work, the site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris, resulting from construction operations.

B. Provide on-site containers for the collection of waste materials, debris, and rubbish.

C. Remove waste materials, debris, and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

3.02 FINAL CLEANING

A. Employ skilled workmen for final cleaning.

B. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.

C. Prior to substantial completion, conduct an inspection of all work areas, to verify that the entire WORK is clean.

END OF SECTION

SECTION 01722

FIELD ENGINEERING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Field engineering to establish lines and grades for the Work.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01770 - Closeout Procedures.

1.02 QUALITY ASSURANCE

A. Qualifications of surveyor or ENGINEER: Registered civil engineer or land surveyor in state where Project is located.

B. Accuracy of stakes, alignments, and grades may be checked randomly by ENGINEER:
   1. Notice of when checking will be conducted will be given.
   2. When notice of checking is given, postpone parts of the Work affected by stakes, alignments, or grades to be checked until checked.
   3. Do not assume that ENGINEER's check substitutes or complements required field quality control procedures.

1.03 CONSTRUCTION STAKES, LINES, AND GRADES

A. Execute the Work in accordance with the lines and grades indicated.

B. Make distances and measurements on horizontal planes, except elevations and structural dimensions.

1.04 SURVEY REFERENCE POINTS

A. Basic reference line, a beginning point on basic reference line, and a benchmark located outside of the project site will be provided by OWNER.

B. From these reference points, establish other control and reference points as required to properly lay out the Work.

C. Locate and protect control points prior to starting site work, and preserve permanent reference points during construction:
   1. Make no changes or relocations without prior written notice.
   2. Replace Project control point, when lost or destroyed, in accordance with original survey control.

D. Set monuments for principal control points and protect them from being disturbed and displaced;
   1. Re-establish disturbed monuments.
   2. When disturbed, postpone parts of the Work that are governed by disturbed monuments until such monuments are re-established.

1.05 PROJECT SURVEY REQUIREMENTS

A. Establish a permanent survey monument on site referenced to data established by survey control points. Provide a brass disc in the concrete at the Oxidation Ditch as indicated on the Drawings. The survey monument shall indicate final surveyed elevation.

B. Record survey monument location with horizontal and vertical data on Project Record Documents.

C. Assume responsibility for accuracy of stakes, alignments, and grades by performing verifications and checking in accordance with standard surveying practice.

1.06 RECORD DOCUMENTS

A. Prepare and submit Record Documents as specified in Section 01770.

B. Maintain complete, accurate log of control points and survey.

C. Affix civil engineer's or land surveyor's signature and registration number to record drawing to certify accuracy of information shown.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01732

CUTTING AND PATCHING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Cutting and patching new construction.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.

1.02 SUBMITTALS

A. Submit as specified in Section 01330.

B. Cutting and patching plan:
   1. Submit details of proposed construction before cutting and patching construction commences affecting:
      a. Work of Owner or of others.
      b. Structural integrity of element of Project.
   2. Cutting and patching plan shall include the following:
      a. Identification of Work.
      b. Description of affected construction.
      c. Necessity for cutting, patching, alteration, or excavation.
      d. Description of proposed construction.
      e. Scope of cutting, patching, alteration, or excavation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Comply with specifications and standards for products involved.

PART 3 EXECUTION

3.01 PREPARATION

A. Provide adequate temporary support as necessary to ensure structural integrity of affected portion of Work.

B. Provide devices and methods to protect other portions of Project from damage and persons from injury.

C. Provide protection from elements for that portion of Project which may be exposed by cutting and patching, and maintain excavations free from water.

3.02 CUTTING AND PATCHING

A. Cut, fit, and patch when required to:
   1. Make its several parts fit together properly.
   2. Remove and replace construction not conforming to Contract Documents.
   3. Remove samples of installed construction as specified for testing.
   4. Provide routine penetrations of nonstructural surfaces for installation of piping and electrical conduit.

B. Execute cutting and demolition by methods which will prevent damage and will provide proper surfaces to receive installation of repairs.

C. Openings in existing concrete and masonry:
   1. Create openings by:
      a. Saw cutting completely through concrete or masonry.
      b. Scoring edges of opening with saw to at least 1-inch depth on both surfaces (when accessible) and removing concrete or masonry by chipping.
   2. Do not allow saw cuts to extend beyond limits of opening.
   3. Make corners square and true by combination of core drilling and grinding or chipping.
   4. Prevent debris from falling into adjacent tanks or channels in service or from damaging existing equipment and other facilities.

D. Sizing of openings in existing concrete or masonry:
   1. Make openings sufficiently large to permit final alignment of pipe and fittings without deflections.
   2. Allow adequate space for packing around pipes and conduit to ensure watertightness.

E. Grouting pipes in place:
   1. Sandblast concrete surfaces and thoroughly clean sand and other foreign material from surfaces prior to placing grout.
   2. Grout pipes, sleeves, castings, and conduits in place by pouring grout under a head of at least 4 inches. Vibrate grout into place. Completely fill the spaces occupied by pipes, sleeves, castings, and conduits.
   3. Water cure the grout.

F. Connections to existing pipes:
   1. Cut existing pipe square.
   2. Properly prepare the ends for the connection indicated on the Drawings.
   3. Repair any damage to existing lining and coating.

END OF SECTION

SECTION 01734

WORK WITHIN PUBLIC RIGHT-OF-WAY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for maintenance, support, protection, relocation, reconstruction and adjusting-to-grade, restoration, construction of temporary and new facilities, and abandonment of existing utilities affected by construction work within the public right-of-way.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01571 - Traffic Control.

1.02 DEFINITIONS

A. Utility: For purpose of this Section, utility means any public or private service, such as electric light and power systems; gas distribution systems; telephone, telegraph, cable television and other communication services; water distribution; storm drain and sanitary sewer services; police and fire communication systems; street lighting and traffic signs and signals; parking meters; and steam distribution systems.

B. Trenching:
   1. Open trench:
      a. General: Includes excavation, pipe laying, backfilling, and pavement replacement.
   2. Any excavated areas shall be considered as "open trench" until all pavement replacement has been made or until all trenches outside of pavement replacement areas have been backfilled and compacted in accordance with these Contract Documents.

1.03 DESIGN REQUIREMENTS

A. Trenching:
   1. Except where otherwise specified, indicated on the Drawings, or accepted in writing by ENGINEER, maximum open trench length, where construction is in any stage of completion, shall not exceed linear footage as set forth below. Descriptions under area designations are general in nature and may be amended in writing by ENGINEER due to particular or peculiar field conditions:
      a. Commercial Areas maximum 400 linear feet: Industrial, shopping centers, churches, schools, hotels, motels, markets, gas stations, government and private office buildings, hospitals, fire and police stations, and nursing homes.
      b. Undeveloped Areas maximum 1,000 linear feet: Parks, golf courses, farms, undeveloped subdivided land.
   2. Completely backfill trenches across streets and install temporary or permanent pavement as soon as possible after pipe laying.

B. Site conditions:
   1. Use substantial steel plates with adequate trench bracing to bridge across trenches at street and alley crossings, commercial driveways, and residential driveways where trench backfill and temporary patch have not been completed during regular working hours.
   2. Provide safe and convenient passage for pedestrians.
   3. Maintain access to fire stations, fire hydrant, and hospitals at all times.
   4. Provide traffic control devices, barricades, and signage as required by the regulating agency.

1.04 SUBMITTALS

A. Traffic control plan: Submit detailed traffic control plan for acceptance by jurisdictional agency and as specified in Section 01571.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01740

WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

A. Refer to Section 00700 (General Conditions), Article 6 for additional warranty requirements.

B. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.

1.03 SUBMITTALS

A. Submit written warranties to the ENGINEER for approval prior to the date that the warranties are set to take effect.

B. When a designated portion of the work is completed and occupied or used by the OWNER, by separate agreement with the CONTRACTOR during the construction period, submit properly executed warranties to the ENGINEER within 15 days of completion of that designated portion of the WORK.

C. When a special warranty is required to be executed by the CONTRACTOR, or the CONTRACTOR and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the ENGINEER for approval prior to final execution.

D. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.

E. Prior to the completion date for the Testing Phase, compile two copies of each required warranty and bond properly executed by the CONTRACTOR, or by the CONTRACTOR, subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1.04 WARRANTY DURATION

A. All warranties shall commence from the completion date of the Testing Phase, specified in Section 01660. Warranty duration shall be at least two years, unless a longer duration is specified in individual specifications. Warranty shall cover materials and workmanship.

1.05 WARRANTY REQUIREMENT

A. Related Damages and Losses: 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 provide access for correction of warranted work.

B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The CONTRACTOR is responsible for the cost of replacing or rebuilding defective work regardless of whether the OWNER has benefited from use of the work through a portion of its anticipated useful service life.

D. OWNER's Recourse: 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.

E. Rejection of Warranties: 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.

F. 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.

G. Disclaimers and Limitations: 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 required to countersign special warranties with the CONTRACTOR.

1.06 MANUFACTURERS CERTIFICATIONS

A. Where required, the CONTRACTOR shall supply evidence, satisfactory to the ENGINEER, that the CONTRACTOR can obtain manufacturers’ certifications as to the CONTRACTOR’s installation of equipment.

1.07 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 warranties or to provide greater rights for the OWNER.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01757

DISINFECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Cleaning and disinfection requirements for new facilities affected by the Work.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C651 - Disinfecting Water Mains.
   2. C652 - Disinfection of Water Storage Facilities.
   3. C653 - Disinfection of Water Treatment Plants.

B. U.S. Environmental Protection Agency (EPA):
   1. Method 524.2 Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry.
   2. Safe Drinking Water Act (SDWA).

1.03 SUBMITTALS

A. Submit disinfection test plan which details procedure to be utilized to disinfect the facilities including:
   1. Method and locations of disinfectant application.
   2. Locations of sampling points.
   3. Method of flushing and location of flushing ports (as appropriate for method of chlorination).
   4. Method of dechlorination (as appropriate for method of chlorination).
   5. Disposal location for chlorinated water (as appropriate for method of chlorination).

B. Submit disinfection reports and include the following:
   1. Date issued.
   2. Project name and location.
   3. Treatment subcontractor's name, address, and phone number.
   4. Type and form of disinfectant used.
   5. Time and date of disinfectant injection start.
   6. Time and date of disinfectant injection completion.
   7. Test locations.
   8. Initial and 24-hour disinfectant residuals in milligrams per liter for each outlet tested.
   9. Time and date of flushing start.
   10. Time and date of flushing completion.
   11. Disinfectant residual after flushing in milligrams per liter for each outlet tested.

C. 5-day volatile organic carbon (VOCs) report:
   1. Date tested.
   2. Project name and location.
   3. Contractor/Subcontractor’s name, address, and phone number.
   4. Test duration.
   5. VOCs test report from a state certified laboratory.
   6. Certification that water samples meet all state and federal requirements for VOCs in drinking water.

D. Submit bacteriological reports and include the following:
   1. Date issued.
   2. Project name and location.
   3. Laboratory's name, certification number, address, and phone number.
   4. Time and date of water sample collection.
   5. Name of person collecting samples.
   6. Test locations.
   7. Time and date of laboratory test start.
   8. Coliform bacteria test results for each outlet tested.
   9. Certification that water conforms or fails to conform to bacterial standards of SDWA.
   10. Bacteriologist's signature and bacteriological laboratory's evidence of certification.

1.04 QUALITY ASSURANCE

A. Bacteriological and physical chemistry laboratory: Certified by state in which Project is located.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect chlorine and bacteriological samples against damage and contamination.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60 degrees Fahrenheit and 80 degrees Fahrenheit.

1.06 PROTECTION

A. Provide necessary signs, barricades, and notices to prevent persons from accidentally consuming water or disturbing system being treated.

PART 2 PRODUCTS

2.01 MATERIALS

A. Disinfectant: Free chlorine in liquid, powder, tablet, or gas form in accordance with AWWA C653.

B. Dechlorination agent: Sulfur dioxide, sodium bisulfate, sodium sulfite, or sodium thiosulfite in accordance with AWWA C653.

PART 3 EXECUTION

3.01 PRELIMINARY CLEANING

A. Complete hydrostatic/leakage tests prior to disinfection.

B. Clean all newly constructed facilities, including water storage and conveyance facilities, in accordance with AWWA C653 and the following:
   1. Remove all debris and material not associated with the structure or process prior to disinfection.
   2. Clean all wall, floor, ceiling, and attached surfaces by use of high-pressure water jet, sweeping, scrubbing, or equally effective means.
   3. Remove all water, paint flakes, sediment, dirt, and foreign material accumulated during cleaning.
   4. Remove by flushing or other means: soil and debris from water pipes and channels in accordance with AWWA C651.
   5. Protect surfaces from adverse environmental exposure between the preliminary cleaning and the disinfection stages.

C. Prior to chlorination, clean all newly constructed and/or modified facilities to be disinfected in accordance with AWWA C651, C652, or C653, as applicable.

3.02 SURFACES TO BE DISINFECTED

A. Groundwater wells.

B. Water storage tanks (both temporary and permanent).

C. All wetted surfaces associated with conveyance elements, such as pipes and water treatment equipment.

D. Piping systems that are used to convey water, solutions, or chemicals to potable water facilities.

E. Recycled water pipelines.

3.03 DISINFECTION OF WATER AND RECYCLED WATER LINES

A. Cleaning:
   1. Remove by flushing or other means: soil and debris from the water tanks in accordance with AWWA C652 prior to chlorination.

B. Inspection:
   1. Verify that water system is completed and cleaned of soil and debris prior to chlorination.
   2. Start disinfection when conditions are satisfactory.
   3. After the disinfection test, clean the interior of the tank and perform the following 5-day VOC test:
      a. Fill the up entire reservoir with potable water.
      b. Let the water sit undisturbed for 5 days.
      c. Sample the water in the reservoir in accordance with EPA Method 524.2.
      d. Verify that all VOC levels in the reservoirs are below all federal and state maximum contaminant levels prior to disinfection of the reservoir.

C. System treatment:
   1. Perform disinfection of water lines and structures in accordance with AWWA C651, C652, and C653, and as specified in this Section.
   2. Starting at outlet closest to water source, bleed water from each outlet until water produces odor of disinfectant. Repeat process at each outlet throughout system.
   3. Test for disinfectant residual at each of following locations and other locations in accordance with submitted disinfection test plan:
      a. Ends of piping runs.
      b. Remote outlets.
      c. Tanks.
      d. At least 2 outlets on each building floor where directed.
      e. Drain lines.
      f. Filters and effluent channels and piping.
   4. Maintain disinfectant in system for appropriate 6-hour or 24-hour interval in accordance with AWWA C652.
   5. When disinfectant residual is less than 10 milligrams per liter after 24 hours, repeat system treatment.
   6. Stainless steel piping:
      a. Modify procedures for disinfection of stainless steel piping and appurtenances as necessary to avoid causing corrosion, pitting, or attack of stainless steel materials.
         1) Take steps to eliminate chlorinated water trapped in crevices and under gaskets through the following procedures:
            a) Pressurize stainless steel piping systems so that all gaskets and O-rings are seated before introducing chlorinated water into the system.
            b) Flush to displace a minimum of 3 pipe volumes at the conclusion of the disinfection procedure.
            c) Use the continuous-feed method to fill the stainless steel piping system with the minimum chlorine concentration required to provide a 10 milligrams per liter residual after 24 hours of contact time in accordance with AWWA C651.

3.04 DISINFECTION OF WATER TANKS AND RESERVOIRS

A. Perform disinfection of water tank in accordance with AWWA C652 and as specified in this Section.

B. Test for disinfectant residual at locations as specified in Disinfection Test Plan.
   1. Inlet and outlet piping.
   2. Drain line.

C. Maintain disinfectant in system for appropriate 6-hour or 24-hour interval in accordance with AWWA C652.

D. When disinfectant residual is less than 2 parts per million after 24 hours, repeat system treatment.

E. After the disinfection test, clean the interior of the tank and perform the following 5-day VOC test:
   1. Fill the up entire reservoir with potable water.

2. Let the water sit undisturbed for 5 days.
3. Sample the water in the reservoir in accordance with EPA Method 524.2.
4. Verify that all VOC levels in the reservoirs are below all federal and state maximum contaminant levels prior to disinfection of the reservoir.

3.05 REPAIRS OR CONNECTIONS TO EXISTING LINES

A. Clean and sterilize the interior surfaces of new piping, fittings, equipment, and appurtenances to be installed in an existing potable water system or connected to an existing system.

B. Clean and sterilize the existing pipe or facilities for a minimum distance of 3 pipe diameters back from the ends of the pipe. Plug the ends of the line when work is not being performed on the pipe.

C. Perform sterilization by swabbing each item with a concentrated chlorine solution.
   1. Each piece is to be disinfected prior to being assembled for installation in the existing pipe.
   2. Disinfect each piece just prior to assembly to help prevent recontamination.
   3. Plug the ends of the assembly until a new item is to be added to the assembly.
   4. Store disinfected materials on blocks to prevent contact with the ground.

3.06 FLUSHING

A. Remove disinfection water from the facilities as appropriate for the type of disinfectant and method used for disinfection.

B. Flush facilities with potable water containing no more disinfectant residual than the active distribution system or 1.0 milligrams per liter, whichever is greater (as appropriate for method of chlorination).

C. Continue flushing until water at designated flushing ports contains disinfectant residual equal to concentration specified above.

3.07 DISPOSAL OF CHLORINATED WATER

A. Dispose of chlorinated water in accordance with the submitted disinfection test plan and applicable requirements of federal, state, county, and city having jurisdiction over disposal of hazardous wastes in location of the Project and disposal site.

B. Chlorinated water may only be disposed of in a sanitary sewer system with the written permission of the OWNER. If allowed, discharge the chlorinated water at a low rate so it does not surcharge the sewer line.

3.08 BACTERIOLOGICAL TEST

A. Instruct bacteriological laboratory to collect water samples no sooner than 24 hours after start of disinfection of each facility.

B. A minimum of 24 hours after flushing system and within 24 hours before the water main is placed in service, collect bacteriological quality samples at each of following locations and other locations in accordance with the submitted disinfection test plan and Standard Methods for the Examination of Water and Wastewater:
   1. Where water enters system.
   2. Inlet piping.
   3. Ends of piping runs.
   4. Drain lines.
   5. Remote outlets.
   6. Tanks.
   7. At least 2 outlets on each building floor.

C. Analyze water samples in accordance with Standard Methods for Examination of Water and Wastewater.

D. When bacteriological test proves water quality to be unacceptable, repeat disinfection treatment process until water meets quality standards for disinfection.

END OF SECTION

SECTION 01759

WATER LEAKAGE TEST FOR CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydrostatic leakage test for concrete water-holding structures.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01500 - Temporary Facilities and Controls.
      c. Section 02300 - Earthwork.
      d. Section 02553 - In Plant Temporary Pumping.
      e. Section 03300 - Cast-in-Place Concrete.

1.02 REFERENCES

A. Definitions.
   1. Damp spots: Surfaces where visible moisture can be picked up by a dry hand.
   2. Containment structure, lined: Liquid-containing structure with barrier coating or membrane applied to the inside surfaces to prevent leaking of contents to the outside.
   3. Containment structure, unlined: Liquid containing structure where only the concrete structure itself is used to prevent leaking of contents to the outside.

1.03 SUBMITTALS

A. Shop drawings:
   1. Description and details of each evaporation/precipitation measuring device anticipated for use during the test.

B. Tests and evaluation reports:
   1. Results of water leakage test for each structure and for each portion of a structure designated for testing.

C. Special procedure submittals:
   1. Testing plan for each structure, or portion thereof, required to be tested.
      a. Describe methods of obtaining water for testing and of controlling water released for disposal, including provisions for dechlorination if required.

b. Include plans showing locations where measurements will be made and locations of evaporation/precipitation measuring device.
c. Indicate plans for filling and draining structure(s).
d. Include schedule showing duration of test for each structure or cell to be tested, date and time for start of each test; dates and times of observations and measurements during the test; dates and times for closeout of testing procedures, and date for submittal of final results.

2. Proposed procedures and products for repair of leaks.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 GENERAL

A. Test structures and portions of structures listed in the following paragraphs for water leakage.
   1. Tests shall be made for all portions of a structure that are intended to retain water, unless otherwise specified by the ENGINEER.
   2. Unless otherwise specified, the CONTRACTOR shall:
      a. Obtain all required permits for discharging testing water.
      b. Provide dechlorination of such water if required by the permits.
      c. Prepare and fill the structures.
      d. Provide access and equipment required for testing and for recording test results.
      e. Take measurements and make observations required for testing.
   3. At all times during testing, the ENGINEER shall have access to observe measurements by others or to make independent measurements.

B. Test the concrete structures and portions thereof for water leakage at the following facilities. Where specified, structures shall be tested separately and non-concurrently with adjacent portions of the same facility:
   1. Area 4 - Storm Water Pump Station
   2. Area 4 – Plant Drain Pump Station
   3. Area 10 – Headworks.
   4. Area 20 – Oxidation Ditch.
      a. Oxidation Ditch No. 1 (test separately and non-concurrently).
      b. Oxidation Ditch No. 2 (test separately and non-concurrently).
      c. Oxidation Ditches may be leak tested prior to placing the top slab.
   5. Area 21 – Secondary Clarifiers.
      a. Secondary Clarifier No. 1.
      b. Secondary Clarifier No. 2.
   6. Area 23 – Scum Pump Station.
   7. Area 28 – Filter Influent Pump Station.
   8. Area 31 – UV Facility.
   9. Area 50 – Sludge Storage Tank.
      a. Sludge Storage Tank No. 1 (test separately and non-concurrently).
      b. Sludge Storage Tank No. 2 (test separately and non-concurrently).

C. Required preparation for testing is designated in this Section. Waiver of, or failure to complete preparations shall not change the testing criteria or acceptance criteria for the areas tested.

D. Re-test structures and portions of structures until the evaluation criteria are satisfied.

3.02 TEST WATER SOURCE AND DISPOSAL

A. For use during construction, OWNER will provide non-potable water up to a volume, and in a manner, specified in Sections 01500 and 01140. This water is intended for the first filling of the Headworks and Oxidation Ditch. Provide, and pay for, temporary pumps and piping to move this water from one basin to another as needed to conduct the water leakage tests and to proceed with additional work in the basin, in accordance with Section 02553.
   1. After all leakage testing is complete, CONTRACTOR shall dispose of water as specified in Section 01500.

3.03 PREPARATION

A. For each structure to be tested, prepare and submit a plan showing schedule and sequence of activities, method of filling, and methods of disposing of test water.

B. Sequencing requirements:
   1. Complete construction of concrete structure and cure concrete to obtain minimum specified 28-day compressive strength as specified in Section 03300.
      a. Do not begin tests until all portions of structure are complete and have reached their minimum specified 28-day compressive strength.
      b. Do not begin tests until at least 14 days have passed since completion of the last concrete placement.
   2. Complete tests before:
      a. Covering any surface of the structure with materials that might mask the location of leaks or obscure damp concrete surfaces. Such coverings include, but are not limited to basin bottom grout, masonry veneer, stucco, plaster, and other coatings.
      b. Installation of equipment, unless otherwise accepted by the ENGINEER.
      c. Backfilling structures to elevations above the limits indicated in the following paragraphs.
   3. Liners and coatings.
      a. Install liners that are mechanically locked to the concrete surface during placement of plastic concrete and before leakage testing.
         1) Examine liners for pinholes, tears, and partially fused splices, complete all required liner integrity testing, and make required repairs before commencing leakage testing.
      b. Unless otherwise specified, do not install surface applied protective or decorative coatings and linings until leakage tests have been completed.

C. Weather requirements:
   1. Tests on structures with tops open to the atmosphere shall not be scheduled for periods when the 10-day weather forecast indicates a substantial change in weather patterns.

2. Measurements of water surface levels in the structure shall not be scheduled for periods when the weather forecast indicates a difference of more than 35 degrees Fahrenheit between the ambient temperature readings at the times of initial and final measurements.
3. Tests shall not be scheduled for periods when the 10-day weather forecast indicates that the water surface may freeze before the test is complete.

D. Groundwater requirements:
1. Bring groundwater to a level below the low point of the drain system and maintain at that level for the duration of the test.

E. Clean interior of structure:
1. Remove dirt, contaminants, and construction debris.
2. Flush floors and sumps to provide clean surfaces.
3. Remove standing water that would interfere with examination of surfaces, cracks, or joints.

F. Observe the structure, or portions of the structure being tested, for potential leak locations
1. Give particular attention to cracks, open joints, voids, and honeycombed and repaired surfaces.
2. Visually observe openings, fitting, and pipe penetrations in the structure at both faces if possible.
3. Repair potential leak locations in accordance with these Specifications and as accepted by the ENGINEER.
4. Backfill excavations to the top of the structure foundation. Do not place backfill against water-bearing walls or over footings unless accepted in advance by the ENGINEER.
   a. If requesting backfilling of walls before testing, include a description of methods that will be used to detect leakage in the backfilled areas.
   b. ENGINEER's acceptance of backfilling before testing shall not relieve CONTRACTOR of the responsibility to conduct leakage tests, to satisfy the leakage acceptance criteria for the structure, or to repair leaking portions of the structure, including those portions below or behind the backfill.
5. See Drawings and Section 02300 for requirements to provide wall stability before backfilling.

G. Inlets to/outlets from the structure:
1. Make inlets to and outlets from the structure watertight.
   a. Include valves; stop gates, stop, sluice, and slide gates; and temporary bulkheads as required.
   b. Inlets and outlets not required to be operable may be temporarily sealed before testing of the compartments to which they open.
   c. Secure inlets used to fill the structure for testing to ensure that no water is entering or leaving the structure once it has been filled to the test level.
2. Adjustments to measured leakage at inlets and outlets based on manufacturer's or CONTRACTOR's estimates will not be allowed.
   a. Adjustments to measured leakage may be permitted by the ENGINEER, and at his/her discretion, only when the CONTRACTOR makes specific measurements of leakage at each individual inlet and outlet using methods acceptable to the ENGINEER.

3.04 HYDROSTATIC LEAKAGE TEST FOR OPEN OR COVERED CONTAINMENT STRUCTURES (“HST-100”)

A. Isolate sections of water holding structures that can be isolated in actual operation. Fill and test sections for leakage separately.
   1. Fill structures and sections of structures scheduled for testing to the high operating water level indicated on the Hydraulic Profile indicated on the Drawings.

B. The filling rate for structures shall not exceed 4 feet per hour.

C. HST-100 testing includes 2 parts, “Qualitative Testing”, and “Quantitative Testing,” as described in the following paragraphs.
   1. HST-100, Part 1 - Qualitative Testing.
      a. During the first 24 hours after structures are filled, examine exposed concrete surfaces for damp spots, or flowing water.
         1) Make observations in early morning, at mid-day, and in late afternoon.
         2) Continue observations through the duration of the Quantitative Testing period.
         3) Pay particular attention to conditions at joints, honeycombed areas, cracks, and repaired portions of the structure.
      b. Evaluation criteria.
         1) The structure shall be considered to have failed these Qualitative Testing requirements, if any of the following conditions are observed.
            a) Water droplets or moist areas on an outside surface that could only have originated inside the structure.
            b) Water is flowing or seeping from joints, cracks, or surfaces.
               (1) Exception: Dampness or wetness on top of a footing, in the absence of flowing water, shall not be considered as failure to meet this criterion.
            c) Moisture can be transferred to a dry hand from the outside surfaces of the filled area.
      c. Repairs and re-testing.
         1) Where damp spots or flowing water as described in the preceding paragraphs are observed, mark locations, provide repairs, and re-test the structure as specified in subsequent paragraphs.
   2. HST-100 - Part 2: Quantitative Testing.
      a. If accepted by the ENGINEER, Quantitative Testing may begin before repairs to areas failing Part 1 of this test; however:
         1) Adjustments to volume loss calculations of Quantitative Testing based on observed leakage will not be permitted, and
         2) All defects identified for repair during Qualitative Testing shall be repaired to the satisfaction of the ENGINEER before acceptance of the structure.
      b. Report the results of Quantitative Testing on “Leakage Test Report” included as Figure A at the end of this Section, or similar form prepared by the CONTRACTOR and containing at least the information included in Figure A.
      c. Unlined concrete structures:
         1) Fill to the designated water surface elevation. Maintain that level for at least 72 hours before recording initial water levels for leakage test.

2) Duration of test:
   a) Theoretical time required to lower the water surface in the structure by 3/8 inch when leakage is occurring at the maximum allowable rate specified in subsequent paragraphs of this Section.
   b) The duration ("D") of the test in days is determined by the following equation:

$$D = \frac{0.375 \text{ inches}}{(0.005 \text{ in/in/day} \times H \text{ ft} \times 12 \text{ in/ft})}$$

Where: H = maximum liquid depth

      (1) Round results upward to the next full 24-hour period (day).
      (2) Minimum duration of test: 24 hours (1 day).
      (3) Maximum duration of test: 120 hours (5 days).

d. Lined concrete structures and secondary containment areas:
   1) Fill to the designated water surface elevation. Recording of water levels for leakage tests may begin as soon as the designated water surface level is reached and the water surface is calm.
   2) Duration of test: 72 hours (3 days).

e. Measurements: Water level:
   1) Record water levels at 24-hour intervals for the full duration of the test period.
   2) Measure water levels at not less than 2 locations on opposite ends of the structure, and preferably at 4 locations spaced equally around the structure. Mark locations on the structure, and take measurements at the same locations throughout the duration of the test.
   3) Measure, to an accuracy of 1/16 inch, the vertical distance to the water surface from a fixed point on the structure above.

f. Measurements: Temperatures:
   1) As part of the first and last sets of level measurements, record water temperature at a depth of 18 inches below the water surface. Measure temperature at the same locations where level measurements are taken.
   2) Record ambient temperature at the time of each water level measurement.

g. Measurements: Evaporation and precipitation:
   1) Measure evaporation and precipitation by floating pans inside the structures during testing.
      a) For uncovered structures, measure both evaporation and precipitation.
      b) For covered structures that are well ventilated, measure evaporation.
   2) Measure using specially constructed clear containers.
      a) Provide clear plastic, calibrated, open-top containers not less than 18 inches in diameter and 18 inches deep.

b) Partially fill containers with water and float inside the structure. Make provisions to hold containers in place at each measurement location, but away from structure walls and items passing overhead, such as beams or pipes.

c) Measure initial depth of water in each device. Measure changes in water level in each device at the same time measurements of the water level inside the structure are taken.

h. Re-start of test:

1) The ENGINEER may order a re-start of the test when, in the ENGINEER's opinion, measurements have become unreliable due to unusual precipitation or other factors.

2) If measurements or observed leakage during the testing period indicate that the allowable leakage requirements will be exceeded, the test may be terminated before completion of the full test period. Take appropriate actions to correct problems before re-starting the test.

i. Calculations of leakage test results:

1) For each section of the structure tested, use water surface level records, to calculate average loss of volume per 24-hour interval.

a) For each 24-hour interval during the test, calculate the average of all measured drops in water level around the structure.

b) Use the average drop thus determined to calculate an average loss of volume for each 24-hour interval.

2) Adjustments to leakage calculations:

a) For uncovered basins, calculations shall be corrected for precipitation added to the structure.

b) Calculations may be corrected for evaporation and water temperature.

j. Evaluation criteria:

1) Unless otherwise specified, the average loss of volume during <u>any</u> 24-hour interval shall not exceed the limits shown in Table.

Table – Loss of Volume Criteria for Leakage Tests

Structure Type	Maximum Loss of Water Volume
• Structure fully lined prior to leakage test • Secondary containment areas	No measurable loss over 72 hour test period
• Structure with monolithically placed membrane floor slab	0.0125 percent volume per 24-hour period
• Concrete paved canals, drying beds, lagoons, and similar structures	0.100 percent volume per 24-hour period
• Other containment structures	0.050 percent volume per 24-hour period

k. Repairs and re-testing:

1) Structures and portions of structures that have satisfied the qualitative requirements of HST-100, but have failed to satisfy the quantitative requirements of HST-100 may be immediately re-tested for volume loss.

a) If the structure fails the second test for volume loss, the structure shall be drained and the CONTRACTOR shall observe the interior for probable areas of leakage.

b) The structure shall not be re-tested until repairs to the probable areas of leakage are complete.

3.05 REPAIRS FOR RETESTING

A. Locations showing damp spots or flowing water:
   1. Mark locations of visible leaks and damp spots.
   2. Drain structures for repair.
   3. Repair defects causing damp spots and flowing water using methods specified in Section 03300 and acceptable to the ENGINEER.
      a. Both interior and exterior surfaces and make structures watertight.
      b. Submit proposed repair products and procedures for ENGINEER's review.
      c. Re-fill structures for re-testing.
   4. Repeat filling, observations, and repairs until no leaks or damp spots appear.

B. Structures for which loss of water volume loss exceeds the limits specified after adjustments for evaporation, and precipitation:
   1. Determine cause of volume loss.
   2. Drain structures of water.
   3. Repair defects causing loss of water volume using methods specified in Section 03300 and acceptable to the ENGINEER.
      a. Submit proposed repair products and procedures for ENGINEER's review.
   4. Re-fill water-holding structures.
   5. Repeat testing and repairs until volume loss does not exceed specified limits.

END OF SECTION

FIGURE A

WATERTIGHTNESS TEST REPORT

PROJECT:	_____	SUBMITTED BY:	_____
STRUCTURE:	_____	WITNESSED BY:	_____
AREA:	_____	TEST DATES:	_____
TEST DURATION:		TEST DURATION:	

Surface area of structure tested:	_____	(square feet)
Volume of structure tested:	_____	(cubic feet)
Volume of structure tested:	_____	(gallons)
Measured loss through gates, etc:	_____	(gallons / day)
Allowable loss of water volume:	_____	(per day)
Allowable loss of water volume:	_____	(% in 24 hours)
Allowable Measured Loss Over Test Duration (inches):	_____	
Measured loss of water:	_____	(gallons / day – From E below)
Measured loss of water volume (%)	_____	(in 24 hours – From E below)

Water temperature: Start of test: ^{o}F End of test: ^{o}F

			Water Surface Elevation (Top of structure to top of water)				
			Location #1	Location #2	Location #3	Location #4	Initials**
Day	Date	Time	(inches)	(inches)	(inches)	(inches)	
1							
2							
3							
4							
5							
Changes in Level:							

A. Average change in level (feet) _____ (Average of total charges for all locations)

B. Correction for Precipitation: _____ (Measured from pan)

C. Correction for Evaporation: _____ (Measured from pan)

D. Corrected change in level (CL) _____

E. Total days tested: _____

F. Avg Measured % water loss in 24 hrs: _____ = $\frac{\text{(CL) x (surface area) x 100}}{\text{(initial water volume)x(number of test days)}}$

Notes and field observations**

** Place date and initials at the beginning of each entry

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Contract closeout requirements including:
   1. Final cleaning.
   2. Waste disposal.
   3. Touch-up and repair.
   4. Disinfection of systems.
   5. Preparation and submittal of closeout documents.
   6. Final completion certification.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01324A - Progress Schedules and Reports.
      b. Section 01660 - Testing, Training, and Commissioning.
      c. Section 01710 - Cleaning.
      d. Section 01722 - Field Engineering.

1.02 REFERENCES

A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

A. Perform final cleaning prior to inspections for Substantial Completion.

B. Employ skilled workers who are experienced in cleaning operations.

C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.

D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.

E. Clean roofs, gutters, downspouts, and drainage systems.

F. Broom clean exterior paved surfaces and rake clean other surfaces of site work:
   1. Police yards and grounds to keep clean.

G. Remove dust, cobwebs, and traces of insects and dirt.

H. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.

I. Remove non-permanent protection and labels.

J. Polish waxed woodwork and finish hardware.

K. Wash tile.

L. Wax and buff hard floors, as applicable.

M. Wash and polish glass, inside and outside.

N. Wash and shine mirrors.

O. Polish glossy surfaces to clear shine.

P. Vacuum carpeted and soft surfaces.

Q. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.

R. Clean ducts, blowers and coils when units were operated without filters during construction.

S. Clean light fixtures and replace burned-out or dim lamps.

T. Refer to Section 01710 for additional requirements.

1.04 WASTE DISPOSAL

A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
   1. Prior to making disposal on private property, obtain written permission from Owner of such property.

B. Do not fill ditches, wales, or drainage ways which may create drainage problems.

C. Do not create unsightly or unsanitary nuisances during disposal operations.

D. Maintain disposal site in safe condition and good appearance.

E. Complete leveling and cleanup prior to final acceptance of the Work.

1.05 TOUCH-UP AND REPAIR

A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.

B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF PLANT FACILITIES

A. Clean channels, pipe, water treatment equipment, reservoirs, and tanks before running of 7-day test, or before facility goes on stream when 7-day test is not required.

B. Wash, wherever practicable, or broom sweep channels, pipe, basins, reservoirs, and tanks.

C. Disinfect reservoirs, tanks, channels, and piping intended to carry potable water as follows or in accordance with AWWA Standards.

D. Provide ample sampling outlets in pipe for testing.

E. Fill pipe and other plant facilities with chlorine solution of sufficient strength to retain residual of not less than 10 parts per million at end of 24 hours.

F. When reservoirs and basins are too large to be economically disinfected by filling with chlorine solution, spray reservoirs and basins with solution containing 100 parts per million of chlorine.

G. After disinfection, rinse entire potable water system with potable water sufficient to reduce chlorine residual to not more than 0.6 parts per million throughout system before system is put into service.

1.07 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF POTABLE WATER AND RECYCLED WATER MAINS

A. Clean interior of pipe and fittings.

B. When pipe contains dirt that cannot be removed by flushing, swab pipe interiors with solution containing not less than 500 parts per million of chlorine until clean.

C. Flush 12-inch diameter and smaller pipe as thoroughly as available water sources will permit.

D. Fill pipe with chlorine solution of sufficient strength to provide 10 parts per million chlorine residual at end of 24 hours.

E. Flush pipes with potable water until chlorine residual is less than 0.6 parts per million before pipe are put into service.

1.08 CLOSEOUT DOCUMENTS

A. Submit following upon the completion of the Testing Phase, specified in Section 01660:
   1. Evidence of Compliance with Requirements of Governing Authorities.
   2. Operation and Maintenance Manuals.
   3. Warranties and Bonds.
   4. Keys and Keying Schedule.
   5. Survey Record Documents as specified in Section 01722.

B. Submit following Closeout Submittals upon Substantial Completion and at least 7 days prior to submitting Application for Final Payment:
   1. Project Record Documents.
   2. Evidence of Payment and Release of Liens as outlined in Conditions of the Contract.
   3. Release of claims as outlined in Conditions of the Contract.
   4. Certificate of Final Completion.

1.09 EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES

A. Submit the following:
   1. Certificate of Occupancy.
   2. Certificates of Inspection:
      a. Elevators.
      b. Mechanical:
         1) Certificates for monorails and hoists.
         2) Form U-1 "Manufacturer's Data Report for Unfired Pressure Vessels" for each pressure vessel furnished and installed.

1.10 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to Owner and Engineer, 1 copy of the Contract Documents, shop drawings, and other submittals in good order:
   1. Mark and record field changes and detailed information contained in submittals and change orders.
   2. Record actual depths, horizontal and vertical location of underground pipes, duct banks, and other buried utilities. Reference dimensions to permanent surface features.
   3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.
   4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits and filled conduits.
   5. Provide schedules, lists, layout drawings, and wiring diagrams.
   6. Make annotations with erasable colored pencil conforming to the following color code:

Additions:	Red
Deletions:	Green
Comments	Blue
Dimensions:	Graphite

B. Maintain documents separate from those used for construction:
   1. Label documents "RECORD DOCUMENTS."

C. Keep documents current:
   1. Record required information at the time the material and equipment is installed and before permanently concealing.

D. Deliver record documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

E. Record documents will be reviewed monthly to determine the percent complete for the monthly pay application.

F. During progress meetings, record documents will be reviewed to ascertain that changes have been recorded.

G. Final Schedule Submittal as specified in Section 01324A.

1.11 WARRANTIES AND BONDS

A. Provide executed Warranty or Guaranty Form as required by Contract Documents.

B. Provide specified additional warranties, guarantees, and bonds from manufacturers and suppliers.

1.12 CERTIFICATE OF FINAL COMPLETION

A. When the Commissioning Phase specified in Section 01660 has been successfully completed, Engineer will certify that new facilities are operationally complete. Engineer will submit a list of known items (punch list) still to be completed or corrected prior to contract completion.

B. List of items to be completed or corrected will be amended as items are resolved by Contractor.

C. When all items have been completed or corrected, submit written certification that the entire work is complete in accordance with the Contract Documents and request final inspection.

D. Upon completion of final inspection, Engineer will either prepare a written acceptance of the entire work or advise Contractor of work not complete. If necessary, inspection procedures will be repeated.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01782

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preparation and submittal of Operation and Maintenance Manuals.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 15958 - Mechanical Equipment Testing.

1.02 SUBMITTALS

A. Submit Operation and Maintenance Manuals before field quality control testing and before training of each piece of equipment or system.

B. Submit 2 hardcopy manuals for each piece of equipment or system.

C. Submit 1 electronic copy of manuals for each piece of equipment or system, in CD-ROM. Unless specifically approved by the Engineer, other means of electronic submittal will not be accepted.

D. Make manuals available at project site for use by construction personnel and Engineer.

E. Make additions and revisions to the manuals in accordance with Engineer's review comments.

1.03 OPERATION AND MAINTENANCE MANUALS

A. Preparation:
   1. Provide hardcopy Operations and Maintenance Manuals in 3-ring binders with rigid covers. Utilize numbered tab sheets to organize information.
   2. Provide electronic copy Operations and Maintenance Manuals in PDF. Minimum requirements include:
      a. Adobe Acrobat PDF Version 9.0 or higher.
      b. Images scanned at 300 dpi or higher.
      c. Word searches of the PDF document must operate successfully.

d. Create bookmarks in the navigation frame.
e. PDF documents shall open in the "Fast Web View" mode.

3. Provide original and clear text on reproducible non-colored paper.
4. Provide all dimensions in English units.

B. Contents of Operation and Maintenance Manuals:

1. Cover page:
   a. Equipment name, equipment tag number, project name, Owner's name, appropriate date.
2. Table of Contents:
   a. General description of information provided within each tab section.
3. Equipment Summary Form:
   a. Completed form in the format shown in Appendix A.
   b. The manufacturer's standard form will not be acceptable.
4. Lubrication information:
   a. Required lubricants and lubrication schedules.
5. Control diagrams:
   a. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
   b. Complete set of 11-inch by 17-inch drawings of the control system.
   c. Complete set of control schematics.
6. Programming:
   a. Copies of all Contractor furnished programming.
7. Testing procedures:
   a. Recommendations for installation, adjustment, calibration, and troubleshooting.
8. Operating procedures:
   a. Step-by-step procedures for starting, operating, and stopping equipment under specified modes of operation.
   b. Include safety precautions and emergency operating shutdown instructions.
9. Preventative maintenance procedures:
   a. Recommended tasks, steps, and frequency for maintaining equipment.
10. Overhaul instructions:
    a. Directions for disassembly, inspection, repair, and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
11. Parts list:
    a. Complete parts list for all equipment being provided, including part number, name, and quantity.
    b. Catalog data for all products or equipment furnished including generic title and identification number of each component part of equipment.
       1) Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
12. Spare parts list:
    a. Recommended number of parts to be stored at the site and special storage precautions.
13. Drawings:
    a. Exploded view or plan and section views with detailed callouts.

b. Complete set of 11-inch by 17-inch drawings of equipment.
c. Provide electrical and instrumentation schematic record drawings.

14. Source (factory) quality control test results:
    a. Provide copies of factory test reports as specified in Sections 15958 or the equipment section.
15. Field quality control test results:
    a. After field-testing is completed, insert field test reports as specified in Sections 15958 or the equipment section.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

APPENDIX A
EQUIPMENT SUMMARY FORM

1. SPECIFICATION SECTION _____

2. EQUIPMENT ITEM_____

3. MANUFACTURER _____

4. EQUIPMENT IDENTIFICATION NUMBER(S)_____
(maps equipment number)

5. LOCATION OF EQUIPMENT_____

6. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)_____

_____

_____

_____

7. NAMEPLATE DATA
   - Horsepower_____
   - Amperage_____
   - Voltage_____
   - Service Factor (S.F.)_____
   - Speed_____
   - ENC Type_____
   - Capacity_____
   - Other_____

8. MANUFACTURER'S LOCAL REPRESENTATIVE

   Name_____

   Address_____

   Telephone Number_____

9. MAINTENANCE REQUIREMENTS_____

_____

_____

10. LUBRICANT LIST_____

_____

11. SPARE PARTS (recommendations)_____

_____

12. COMMENTS_____

SECTION 02050

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Aggregate Base Course.
   2. Class 2 Permeable.
   3. Drain Rock.
   4. Gravel.
   5. Imported Fill.
   6. Native Material.
   7. Sand.
   8. Select Material.
   9. Stabilization Material.
   10. Coarse Aggregate for Trench Stabilization.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
   2. C 131 - Standard Test Method for Resistance to Degradation of Small-Size Course Aggregate by Abrasion and Impact in the Los Angeles Machine.
   3. C 136 - Standard Test Method for Sieve Analysis of Fine and Course Aggregates.
   4. D 422 - Standard Test Method for Particle-Size Analysis of Soils.
   5. D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   6. D 4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   7. D 4829 - Standard Test Method for Expansion Index for Soils.

B. California Department of Transportation:
   1. Standard Specifications.
   2. California Test 205.
   3. California Test 211.
   4. California Test 217.
   5. California Test 229.
   6. California Test 301.

1.03 SUBMITTALS

A. Product data:
   1. Material source.
   2. Gradation.
   3. Testing data.

B. Quality control for aggregate base course:
   1. Test reports: Reports for tests required by Sections of Standard Specifications, State of California, Department of Transportation, Latest edition.
   2. Certificates of Compliance: Certificates as required by Sections of Standard Specifications, State of California, Department of Transportation, Latest edition.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:
   1. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.
   2. Materials derived from processing demolished or removed asphalt concrete are not acceptable.

B. Aggregate base course:
   1. Class 2, conforming to Section 26-1.02A of the Standard Specifications, 3/4-inch maximum aggregate size free from organic matter and other deleterious substances, and of such nature that aggregate can be compacted readily under watering and rolling to form a firm, stable base.
   2. Aggregate base course for structures:
      a. Consist of crushed or fragmented particles.
      b. Coarse aggregate material retained in Number 4 sieve shall consist of material of which at least 25 percent by weight shall be crushed particles when tested in accordance with California Test 205.
   3. Aggregate shall not be treated with lime, cement, or other chemical material.
   4. Durability index: Not less than 35 when tested in accordance with California Test 229.
   5. Aggregate grading and sand equivalent tests shall be performed to represent not more than 500 cubic yards or 1 day's production of material, whichever is smaller.
   6. Sand equivalent: Not less than 25 when tested in accordance with California Test 217.
   7. Resistance (R-value): Not less than 78 when tested in accordance with California Test 301.
   8. Conform to size and grade within the limits as follows when tested in accordance with ASTM C 117 and ASTM C 136:

Sieve Sizes (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90-100
Number 4	35-60

Sieve Sizes (Square Openings)	Percent by Weight Passing Sieve
Number 30	10-30
Number 200	2-9

C. Class 2 permeable:
   1. Durability index: Not less than 40 when tested in accordance with California Test 229.
   2. Conform to Standard Specifications Section 68-2.02F.
   3. Consist of hard, durable particles of stone or gravel, screened or crushed to the specified size and gradation.
   4. Provide free of organic matter, lumps or balls of clay, and other deleterious matter.
   5. Sand equivalent: Not less than 75 when tested in accordance with ASTM D 2419.
   6. Conform to size and grade within the limits as follows when tested in accordance with ASTM C 117 and C 136:

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90-100
3/8 inch	40-100
Number 4	25-40
Number 8	18-33
Number 30	5-15
Number 50	0-7
Number 200	0-3

D. Drain rock:
   1. Durability index: Not less than 40 when tested in accordance with California Test 229.
   2. Consist of hard, durable particles of stone or gravel, screened or crushed to specified size and gradation.
   3. Free from organic matter, lumps or balls of clay, or other deleterious matter.
   4. Crush or waste coarse material and waste fine material as required to meet gradation requirements.
   5. Conform to size and grade within the limits as follows when tested in accordance with ASTM C 117 and C 136:

Sieve Size (Square Openings)	Percent By Weight Passing Sieve
2 inch	100
1-1/2 inch	95-100
3/4 inch	50-100
3/8 inch	15-55
Number 200	0-2

E. Gravel:
   1. Consist of hard, durable particles of stone or gravel, screened or crushed to the specified sizes and gradations.
   2. Free of organic matter, lumps or balls of clay, and other deleterious matter.
   3. Crush or waste coarse material, and add or waste fine material in order to meet the specified gradations.
   4. Fraction of material passing number 40 sieve: Material having plasticity index not greater than 5 when tested in accordance with ASTM D 4318.
   5. Durability percentage of wear not greater than 40 percent when tested in accordance with California Test 211.
   6. Conform to sizes and grade within the limits as follows when tested in accordance with ASTM C 117 and C 136:

Sieve Size (Square Openings)	**Percent by Weight Passing Sieve**		
	Type A	**Type B**	**Type C**
2 inch	100	-	-
1-1/2 inch	95-100	100	-
3/4 inch	35-60	55-85	100
3/8 inch	15-40	35-65	50-100
Number 4	0-25	20-35	30-45
Number 30	-	5-15	10-20
Number 200	0-5	2-9	2-9

F. Imported material for structural and retaining wall backfill:
   1. Any imported material is to be tested and approved by the OWNER's Geotechnical Engineer.
   2. Sound, earthen material passing 1-inch sieve.
   3. Expansion index less than 20 when tested in accordance with ASTM D 4829.
   4. Caltrans Standard Specification for Structure Backfill, Section 19-3.02B or approved onsite sandy soil having a sand equivalent greater than 20.

G. Native material (on-site soil):
   1. Free of organics, oversize rock (greater than 3 inches), trash, debris, corrosive, and other deleterious materials.
   2. Percent of material by weight passing Number 4 sieve shall be at least 75 when tested in accordance with ASTM D 422.
   3. When placed within 3 feet of finished grade in pavement areas shall meet the design R-value for that area. Design R-values for pavements are as follows:
      a. Los Osos Valley Road: 18.
      b. Plant Entrance Road: 5.
      c. In-plant Roads: 5.

H. Sand:
   1. Clean, coarse, natural sand.
   2. Non-plastic when tested in accordance with ASTM D 4318.
   3. One hundred percent shall pass a 1/2-inch screen.
   4. No more than 20 percent shall pass a Number 200 sieve.

I. Select material:
   1. Sound earthen material for which sum of plasticity index when tested in accordance with ASTM D 4318 and the percent of material by weight passing Number 200 sieve shall not exceed 23 when tested in accordance with ASTM D 422.
   2. Organic content shall not be greater than 3 percent by volume.

J. Stabilization material:
   1. Durability percentage of wear not greater than 40 percent when tested in accordance with California Test 211.
   2. Consist of clean, hard, durable particles of crushed rock or gravel screened or crushed to the specified sizes and gradations.
   3. Shall be free of any detrimental quantity of soft, friable, thin, elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.
   4. Shall be free of slaking or decomposition under the action of alternate wetting and drying.
   5. The portion of material retained on the 3/8-inch sieve shall contain at least 50 percent of particles having three or more fractured faces. Not over 5 percent shall be pieces that show no such faces resulting from crushing. Of the portion that passes the 3/8-inch sieve, but is retained on the No. 4 sieve, not more than 10 percent shall be pieces that show no faces resulting from crushing.
   6. Conform to size and grade when tested in accordance with ASTM C 117 and ASTM C 136.

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90-100
Number 4	0-10
Number 200	0-2

K. Course Aggregate for Trench Stabilization:
   1. Consist of hard, durable particles of stone or gravel, screened or crushed to the specified sizes and gradations.
   2. Free of organic matter, lumps or balls of clay, and other deleterious matter.
   3. Conforming to ASTM C33 No. 8 Coarse Aggregate or Section 90-1.02C(4)(b) of the Standard Specifications.
   4. One hundred percent shall pass a 1-1/2-inch screen.

2.02 SOURCE QUALITY CONTROL

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02084

UTILITY STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Onsite utility structures:
   1. Precast concrete manholes.
   2. Precast drainage inlets.
   3. Standpipes for irrigation or drainage pipes.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 02318 - Trenching.
      b. Section 03300 - Cast-in-Place Concrete.
      c. Section 05500 - Metal Fabrications.
      d. Section 07900 - Joint Sealants.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
   2. C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
   3. C 857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   4. C 858 - Standard Specification for Underground Precast Concrete Utility Structures.

1.03 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Manholes and appurtenances: Manholes and appurtenances shall be watertight and free from infiltration or exfiltration.

1.04 SUBMITTALS

A. Shop drawings: Submit shop drawings for precast utility structures.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Precast concrete manholes:
   1. Construct precast concrete manholes in accordance with design, size, shape, form, details, and at locations indicated on the Drawings and specified.
   2. Construct manholes of precast eccentric or concentric manhole units in accordance with the requirements indicated on the Drawings and specified.
   3. Provide precast, cylinder units, taper sections, and eccentric flat top sections meeting strength requirements in accordance with ASTM C 478.
   4. Base design and manufacture to A-16 (HS 20-44) loading in accordance with ASTM C 857.

B. Precast drainage inlets:
   1. Construct precast concrete drainage inlets in accordance with the size, shape, form, details, and at locations indicated on the Drawings and specified.
   2. Base design and manufacture to A-16 (HS 20-44) loading in accordance with ASTM C 857.
   3. In accordance with ASTM C 858.

C. Standpipes for irrigation or drainage pipes:
   1. Pipe may be used in lieu of cast-in-place structures, as indicated on the Drawings.
   2. Use concrete pipe in accordance with ASTM C 361.

2.02 ACCESSORIES

A. Standpipes for irrigation or drainage pipes:
   1. Covers: As indicated on the Drawings.

B. Precast concrete manholes:
   1. Joint sealant: Use precast concrete joint sealant as specified in Section 07900.
   2. Manhole frames and cover sets: Type, size, and quality as specified in Section 05500 or as indicated on the Drawings.
   3. Drop manhole fittings:
      a. Drop tee and other fittings: Vitrified clay pipe or as otherwise specified or indicated on the Drawings.
   4. Piping penetrations through cylinder units:
      a. Install Kor-N-Seal, or equivalent, rubber gasket boots with steel clamps.
      b. Piping connections to the manhole bases shall be as indicated on the Drawings.

C. Precast drainage inlets:
   1. Covers: As indicated on the Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Standpipes for irrigation or drainage pipes:
   1. Excavation and backfill: As specified in Section 02318.

B. Concrete manholes:
   1. Excavation and backfill: As specified in Section 02318.
   2. Precast concrete manholes:
      a. Manhole bases:
         1) Form and place concrete on undisturbed soil and/or on aggregate base course compacted to 95 percent of maximum density.
         2) Form that portion of base above invert elevation of sewer pipe to provide smooth channel section as indicated on the Drawings.
         3) Check forms for accuracy of dimensions and relative smoothness prior to placing concrete for base. Channels shall vary uniformly in size and shape from inlet to outlet if required.
         4) Construct of Class A concrete as specified in Section 03300 to form and dimensions indicated on the Drawings.
         5) Place base concrete as monolith.
      b. Manhole sections:
         1) Set each manhole section plumb.
         2) Use sections of various heights and adjustment rings to bring top of manhole ring and cover to required elevation.
      c. Joints:
         1) Seal joints with precast concrete joint sealant as specified in Section 07900 unless otherwise indicated on the Drawings.
         2) Clean joints with brush and prime.
         3) Apply precast concrete joint sealant as follows, except where instructions differ from manufacturer's printed instructions. Where these instructions differ from manufacturer's instructions, install precast concrete joint sealant in accordance with manufacturer's written instructions:
            a) Remove silicon treated protective paper from one side of preformed rope and lay preformed rope, paper side up, on cleaned joint surface. Press surface firmly end-to-end around entire joint, making minimum 1-inch laps where necessary.
            b) Remove protective paper from preformed rope and lower next section into place.
         4) Seal joints watertight.
      d. Manhole frame and cover sets:
         1) Install manhole frames and cover sets at locations indicated on the Drawings.
         2) Setting:
            a) Set manhole frames and covers at elevations and requirements indicated on the Drawings.
               (1) Set manhole covers flush with paving.
               (2) Where no paving exists, set manhole cover 6 inches above surrounding grade.
            b) Where structure is outside limits of traveled shoulder but not in roadside ditch, place structure 1/10 foot or more above existing ground surface.
            c) Where cover is in existing pavement or in traveled way of existing road shoulder, place cover flush with existing surface.
            d) Where manhole cover falls in existing roadside ditch or right of way, place manhole cover approximately 1-1/2 feet above existing ground surface.

e) Set manhole frames at required grade and securely attach to top of precast manhole shaft unit or on adjustment rings, using cement mortar.

f) Setting covers:

(1) After frames are securely set in place in accordance with requirements specified, install covers and perform necessary cleaning and scraping of foreign materials from frames and covers as required to accomplish and to assure proper fit.

(2) Any frame and cover that creates noise when passed over by traffic shall be replaced.

3. Drop manholes:

a. Construct drop manholes at locations and in accordance with details indicated on the Drawings.

b. Provide inside diameter of drop inlet pipe the same as intercepted sewer unless otherwise indicated on the Drawings or specified in this Section.

c. Furnish and set fittings as indicated on the Drawings.

4. Pipe stubs:

a. Provide pipe stubs at manhole locations and in conformance with details indicated on the Drawings and as specified.

b. Plugging stubs:

1) Plug stubs with vitrified clay stopper or brick plug as indicated on the Drawings.

2) Unless otherwise indicated on the Drawings, comply with following:

a) Stubs up to and including 21 inches: Vitrified clay stoppers.

b) Stubs greater than 21 inches: Brick plugs.

C. Precast drainage inlets:

1. Excavation and backfill: As specified in Section 02318.

3.02 FIELD QUALITY CONTROL

A. Tests:

1. Sanitary sewer manholes: Vacuum test all sanitary sewer manholes. Use following vacuum test procedures and requirements:

a. After completion of the manhole barrels but prior to backfilling and grade ring installation, seal all openings in the manhole with plugs and a rubber ring "donut" type plug inserted inside the opening of the cone.

b. Attach a small vacuum pump to a hose connected to the plug and apply 4 psi of vacuum.

1) Allow vacuum to stabilize at 3.5 psi for 1 minute, then begin the test.

2) The manhole must maintain vacuum such that no greater than 0.5 psi of vacuum is lost during the specified test period.

c. The specified test period is as follows:

Manhole Depth (Feet)	Minimum Test Period (Minutes)
0-5	4.5
5-10	5.5
10-15	6.0
Greater than 15	6.5

d. Patch as required and retest manholes that fail the test.
e. Provide a vacuum regulator on the vacuum pump such that no greater than 4 psi can be applied to the manhole during the test.
f. Repair all manholes that do not meet the leakage test, or are unsatisfactory from visual inspection.
    1) Retest after repair is completed.

END OF SECTION

SECTION 02200

SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Clearing, grubbing, and stripping project site.

1.02 REFERENCES

A. San Luis Obispo County 2011 Public Improvement Standards.

1.03 DEFINITIONS

A. Clearing: Consists of removal of natural obstructions and existing foundations, buildings, fences, lumber, walls, stumps, brush, weeds, rubbish, trees, boulders, utility lines, and any other items that interfere with construction operations or are designated for removal.

B. Grubbing: Consists of removal and disposal of wood or root matter below ground surface remaining after clearing and includes stumps, trunks, roots, or root systems greater than 1-inch diameter or thickness to a 6-inch depth below ground surface.

C. Stripping: Includes removal and disposal of all organic sod, topsoil, grass and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped. The depth of stripping is estimated to be 3 feet, but the required depth of stripping will be determined by the ENGINEER.

1.04 QUALITY ASSURANCE

A. Regulatory requirements: Verify and comply with applicable regulations regarding those governing noise, dust, nuisance, drainage and runoff, fire protection, and disposal.

B. Pre-construction conference: Meet with ENGINEER to discuss order and method of work.

1.05 PROJECT CONDITIONS

A. Environmental requirements:
   1. For suspected hazardous materials found, notify ENGINEER immediately.

1.06 SEQUENCING AND SCHEDULING

A. Clearing and grubbing: Perform clearing and grubbing in advance of grading operations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine site and verify existing conditions for beginning work.

3.02 PREPARATION

A. Protect existing improvements from damage by site preparation work.

3.03 INSTALLATION

A. Clearing:
   1. Clear areas where construction is to be performed and other areas as indicated on the Drawings, or specified in this Section, of fences, lumber, walls, stumps, brush, roots, weeds, trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with proper performance or completion of the work, would impair its subsequent use, or form obstructions.
   2. All tree impacts and removal shall be made in accordance with Appendix E of the San Luis Obispo County 2011, Department of Public Works, Public Improvement Standards.
   3. Do not incorporate organic material from clearing and grubbing operations in fills and backfills.
   4. CONTRACTOR's temporary construction facilities: Fill or remove pits, fill, and other earthwork required for erection of facilities, upon completion of the work, and level to meet existing contours of adjacent ground.

B. Grubbing:
   1. From excavated areas: Grub stumps, roots, and other obstructions 3 inches or over in diameter to depth of not less than 18 inches below finish grade.
   2. In embankment areas or other areas to be cleared outside construction area: Do not leave stumps, roots, and other obstructions higher than the following requirements:

Height of Embankment over Stump	Depth of Clearing and Grubbing
0 feet to 2 feet	Grub stumps or roots 3 inches or over in diameter to 18 inches below original grade. Cut others flush with ground.
2 feet to 3 feet	Grub stumps 1 foot and over in diameter to 18 inches below original grade. Cut others flush with ground.
Over 3 feet	Leave no stumps higher than stump top diameter, and in no case more than 18 inches.

   3. Backfill and compact cavities left below subgrade elevation by removal of stumps or roots to density of adjacent undisturbed soil.

C. Stripping:
   1. Remove soil material to depth of 3 feet throughout the entire plant site .
   2. Deposit stripped material in accordance with following requirements:
      a. At locations acceptable to ENGINEER.
      b. Use accepted material in top 6 inches of areas to be used for future planting.
   3. Replace topsoil where indicated on the Drawings.

END OF SECTION

SECTION 02240

DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Installation and maintenance of dewatering systems.
   2. Disposal of water entering excavation or other parts of the work.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03300 - Cast-in-Place Concrete.
      b. Section 03600 - Grouting.

1.02 SYSTEM DESCRIPTION

A. Design requirements:
   1. Keep excavations reasonably free from water. Draw down the static water level to a minimum of 3 feet below the bottom of excavations.
   2. Analysis includes the following: Evaluation of the anticipated subsurface conditions, required well spacing, diameter of wells, depth screen interval, backfill and filter pack, pump size, drawdown duration, drawdown and steady state flow rates, desilting tank, and settlements.
   3. Include water drawdown curves in dewatering calculations.
   4. Coordinate dewatering design with excavation and shoring design. Recognize the changes in groundwater conditions and earth pressures in the shoring and excavation design.
   5. Do not place concrete or masonry foundations or floors in water, nor allow water to rise over them until concrete or mortar has set at least 24 hours.
   6. Maintain operation of the dewatering system until the complete structure including walls, slabs, beams, struts, and all other structural elements have been constructed and the concrete has attained specified strength, and backfill has been completed to finish grade.
   7. Provide standby power to ensure continuous dewatering in case of power failure.

B. Secure written permission from the ENGINEER before locating wells, well points, or drain lines for purposes of dewatering within limits of structure foundation.

C. Locate dewatering facilities where they will not interfere with utilities and construction work to be performed by others.

D. Open manholes will not be allowed for discharge piping. Obtain approval of each discharge location from the ENGINEER.

1.03 SUBMITTALS

A. Dewatering plan:
   1. Arrangement, location, depths of system components.
   2. Type and sizes of filters.
   3. Required permits.

B. Well construction logs which include:
   1. Descriptions of actual materials encountered in accordance with Unified Soil Classification System.
   2. Construction details.
   3. Well development procedures and results.
   4. Deviations from original design.

C. Laboratory test results.

D. Qualifications:
   1. Dewatering Contractor.
   2. Dewatering Design Engineer.
   3. Testing laboratory.

1.04 QUALITY ASSURANCE

A. Qualifications of a dewatering design engineer:
   1. Dewatering plan and dewatering system analysis:
      a. Prepared by a registered Civil Engineer, registered in the state where the Project is located. The Civil Engineer must have at least 8 years of experience in designing similar systems.
      b. Submit qualifications of the Dewatering Contractor, the Dewatering Design Engineer, sampling service, and testing laboratory.

B. Regulatory requirements:
   1. Assume responsibility for obtaining water discharge permits that are required.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide and maintain during construction: Ample means and devices with which to promptly remove and properly dispose of water entering excavation or other parts of the work, whether water is surface water or underground water.

B. Intercept and divert precipitation and surface water away from excavations through the use of dikes, curb walls, ditches, pipes, sumps, or other means.

C. Disposing of water:
   1. Dispose of water from the work in suitable manner without damage to adjacent property.
   2. Do not drain water into work built or under construction.
   3. Dispose of water in such manner as not to be menace to public health.

D. Wells, well points, and drain lines for dewatering:
   1. Locate after receiving ENGINEER's written permission.
   2. Fill dewatering wells, pipes, and french drains to be left in place within structure foundation limits with Class “C” concrete as specified in Section 03300 or grout as specified in Section 03600.

3.02 CONSTRUCTION

A. Interface with other work:
   1. Prior to release of groundwater to its static level:
      a. All groundwater pressure relief devices for the structure are fully operational.
      b. Construction of structure complete and the concrete has reached specified strength.
      c. Backfill of structure is complete.
      d. Control release of groundwater to its static level to prevent disturbance of the natural foundation soils or compacted backfills and fills and to prevent flotation or movement of structures or pipelines.

END OF SECTION

SECTION 02260

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for designing, furnishing and installing, maintaining, and removing excavation support and protection.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.

1.02 REFERENCES

A. American Institute of Steel Construction, Inc. (AISC):
   1. Steel Construction Manual.

B. American Society of Civil Engineers (ASCE):
   1. Guidelines of Engineering Practice for Braced and Tied-Back Excavations.

C. California Code of Regulations (CCR):
   1. Title 8 - Industrial Relations.
      a. Chapter 3.2. California Occupational Safety and Health Regulations (CAL/OSHA).

D. California Labor Code (CLC).

E. Department of the Navy Naval Facilities Engineering Command (NAVFAC):
   1. Design Manual 7.2 - Foundations and Earth Structures.
   2. Design Manual 7.3 - Soil Dynamics and Special Design Aspects

F. State of California Department of Transportation (Caltrans):
   1. Caltrans California Trenching and Shoring Manual.

G. United States Steel Corporation (USS):
   1. Steel Sheet Piling Design Manual.

1.03 DEFINITIONS

A. General Engineering Design Practice: General engineering design practice in area of the Project, performed in accordance with recent engineering literature on subject of shoring and stability of excavations.

B. Shoring: A temporary structural system designed to support vertical faces, or nearly vertical faces, of soil or rock for purposes of excavation. Shoring includes cantilevered sheet piling, internally braced sheet piling, slurry walls, soldier piles and lagging, and other similar shoring systems. Sloping of the soil is not shoring.

1.04 SYSTEM DESCRIPTION

A. Where General Engineering Design Practice is specified, provide drawings and signed calculations and have design performed by civil or structural engineer registered in State where the Project is located:
   1. Provide design calculations that clearly disclose assumptions made, criteria followed, and stress values used for the materials being used.
   2. Furnish references acceptable to ENGINEER substantiating appropriateness of design assumptions, criteria, and stress values.

B. Design requirements:
   1. General:
      a. Design means for safe and stable excavations in accordance with general engineering design practice:
         1) The preceding requirement shall not apply to trench excavation support conforming to standards set forth in CCR Title 8, Chapter 3.2.
      b. Design steel members in accordance with the building code as specified in Section 01410 and the AISC Manual of Steel Design.
      c. Design shoring involving materials other than steel in accordance with building code as specified in Section 01410.
      d. Perform design in accordance with soil characteristics and design recommendations contained in a written geotechnical report issued and signed by a geotechnical engineer hired by the CONTRACTOR. Geotechnical engineer shall be registered in the state where the Project is located:
         1) Make copy of geotechnical report available at project site for ENGINEER's review.
         2) Retain and pay for geotechnical engineer's services.
         3) Obtain report based on soil samples, field and laboratory tests, and borings performed for the geotechnical report for the design of stability of excavations by the geotechnical engineer hired by CONTRACTOR.
      e. When electing to design with material stresses for temporary construction higher than allowable stresses prescribed in the AISC Steel Construction Manual and the building code as specified in Section 01410, increase in such stresses shall not exceed 10 percent of value of prescribed stresses.
      f. Minimum safety factor used for design shall not be less than 1.5.
      g. The calculated minimum depth of penetration of shoring below the bottom of the excavation shall be increased not less than 30 percent if the full value of passive pressure is used in the design.

h. The maximum height of cantilever shoring above the bottom of excavation shall not exceed 15 feet.
    1) Use braced shoring when the height of shoring above the bottom of excavation exceeds 15 feet.
i. The location of the point of fixity for shoring shall not be less than half the calculated minimum embedment depth below the bottom of the excavation.
j. Generally acceptable references for the design of shoring and excavations are as follows:
    1) Caltrans California Trenching and Shoring Manual.
    2) NAVFAC Design Manual 7.2.
    3) NAVFAC Design Manual 7.3.
    4) USS Steel Sheet Piling Design Manual.
    5) ASCE Guidelines of Engineering Practice for Braced and Tied-Back Excavations.

2. Soldier piles and lagging:
    a. Provide lagging over the full face of the excavation. Joints between pieces of lagging shall be tight to prevent loss of soil.
    b. Provide full face lagging all around penetrations through the lagging.
    c. If the soldier piles are installed in predrilled holes, the predrilled holes shall be filled with control density backfill after the soldier piles are installed.
    d. The effective width of driven soldier piles for passive soil resistance shall not exceed 2 times the width of the pile.
        1) The effective width of concrete encased soldier piles for passive soil resistance shall not exceed 2 times the width of the concrete encasement.
    e. Fill voids behind lagging with gravel or other material acceptable to the ENGINEER.
    f. Apply loads from tie back soil, rock, or deadman anchors concentrically to soldier piles or wales spanning between soldier piles.
        1) Wales shall be back-to-back double channels or other members acceptable to the ENGINEER.
        2) Eccentrically loaded with section soldier piles or wales are not acceptable.
    g. Design soldier piles for downward loads including vertical loads from tie back anchors.

3. Soil anchors, rock anchors, and deadmen anchors:
    a. Design tie back anchors for a safety factor of not less than 2 times the calculated load from the shoring.
    b. Proof load all production anchors to not less than 150 percent of the calculated load from the shoring.
        1) Lock off anchors at the calculated anchor load.
    c. The length of soil anchors used to calculate resistance to load from the shoring shall not include any length within the potential active pressure soil failure zone behind the face of shoring.
    d. Design tie rods for anchors for 130 percent of the calculated load from the shoring.
    e. Design tie rods for anchors for 150 percent of the calculated load from the shoring when tie rod couplers are used and for other conditions where stress concentrations can develop.

C. Performance requirements:
   1. General:
      a. Support faces of excavations and protect structures and improvements in vicinity of excavations from damage and loss of function due to settlement or movement of soils, alterations in ground water level caused by such excavations, and related operations.
      b. Specified provisions:
         1) Complement, but do not substitute or diminish, obligations of CONTRACTOR for the furnishing of a safe place of work pursuant to provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for protection of the Work, structures, and other improvements.
         2) Represent minimum requirement for:
            a) Number and types of means needed to maintain soil stability.
            b) Strength of such required means.
            c) Methods and frequency of maintenance and observation of means used for maintaining soil stability.
   2. Provide safe and stable excavations by means of sheeting, shoring, bracing, sloping, and other means and procedures, such as draining and recharging groundwater and routing and disposing of surface runoff, required to maintain the stability of soils and rock.
   3. Provide support for trench excavations for protection of workers from hazard of caving ground.
   4. Provide shoring:
      a. Where, as result of excavation work and analysis performed pursuant to general engineering design practice, as defined in this Section:
         1) Excavated face or surrounding soil mass may be subject to slides, caving, or other types of failures.
         2) Stability and integrity of structures and other improvements may be compromised by settlement or movement of soils, or changes in soil load on structures and other improvements.
      b. For trenches 5 feet and deeper.
      c. For trenches less than 5 feet in depth, when there is a potential for cave-in.
      d. Where indicated on the Drawings.
   5. For safe and stable excavations, use appropriate design and procedures for construction and maintenance to minimize settlement of supported ground and to prevent damage to structures and other improvements, including:
      a. Using stiff support systems.
      b. Following appropriate construction sequence.
      c. Preventing soil loss through or under support system:
         1) Provide support system that is tight enough to prevent loss of soil and extend deep enough to prevent heave or flow of soils from supported soil mass into the excavation.
      d. Providing surface runoff routing and discharge away from excavations.
      e. Where dewatering is necessary, recharge groundwater as necessary to prevent settlement in area surrounding excavation.
      f. Where sheet piling is used, use interlocking type sheets.
         1) The sheet piles shall be continuous and driven in interlock.
         2) If the bottom of the excavation is located below the water table, use "thumb and finger" type interlock.
      g. Not applying shoring loads to existing structures and other improvements.

h. Not changing existing soil loading on existing structures and other improvements.
i. Provide welded steel packing between soil retaining members such as sheet piles and wales and similar members when the gap exceeds 1/2 inch before the wales are loaded.

1.05 SUBMITTALS

A. Shop drawings and calculations:
1. In accordance with requirements in CLC for trench excavations 5 feet or more in depth and for trenches less than 5 feet in depth when there is potential for cave-in. Submit in advance of excavation work, detailed drawings showing means for safe and stable excavations:
a. Where such drawings vary from excavation support standards set forth in California Code of Regulations Title 8 - Construction Safety Orders, submit design calculations pursuant to general engineering design practice.
b. Provide means for safe and stable excavations that are not less effective than required in CCR Title 8 - Construction Safety Orders.
2. For excavations other than trenches, submit, in advance of excavation work, design calculations as performed pursuant to general engineering design practice, as specified in this Section, and detailed drawing showing means for safe and stable excavations. In design calculations and detailed drawing, cover, as a minimum:
a. Excavations adjacent to structures and other improvements.
b. Excavations 5 feet or more in depth, or less than 5 feet in depth when there is potential for cave-in, at other locations.
3. Submit the following:
a. Provide calculations for the different load, support, and other conditions that occur during the sequence of installation of shoring, construction of facilities protected by the shoring, and sequence of removal of shoring.
b. Provide sketches showing the condition at various stages of installation and removal of shoring.
c. Show structures, pipelines, and other improvements located near the shoring, and the shoring on a plan.
d. When utilities penetrate the shoring, submit an elevation of all sides of the shoring showing the locations of the penetrations.
1) Submit details on ground support and sealing around utility penetrations.

B. Written geotechnical report on soil characteristics and design recommendations, as specified in this Section.

C. Control points and schedule of measurements:
1. Submit location and details of control points and method and schedule of measurements in accordance with requirements of this Section.
2. Promptly upon constructing control points and making measurements at such control points, as specified in this Section, submit copy of field notes with such measurements.
a. The field notes shall show the current measurement and the change in measurement from the first measurement taken.

D. Detailed sequence of installation and removal of shoring:
   1. Consider effects of ground settlement in the sequence of installation and removal of shoring.
   2. Provide sketches showing the conditions at various stages in the sequence of installation and removal of shoring.

E. Submit submittals for stability of excavations as a complete package and include all items required in this Section.
   1. Incomplete submittals will not be reviewed and will be returned for resubmittal as a complete package.

1.06 SEQUENCING AND SCHEDULING

A. When required to meet with the overall project schedule, implement additional shoring as necessary.

B. Do not begin work on excavations, trenches, and means for providing stability of excavation and trenches until submittals have been accepted by ENGINEER and until materials necessary for installation are on site.

C. Submit submittals a minimum of 30 days prior to the scheduled date to begin excavation work.

D. Do not begin construction of any shoring or excavation operations until:
   1. Control points as specified in this Section and as indicated on the Drawings on existing structures and other improvements have been established and surveyed to document initial elevations and locations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 INSTALLATION AND REMOVAL

A. Install means for providing safe and stable excavations as indicated in the submittals.

B. Except for concrete encased soldier piles, slurry walls, and similar shoring systems, remove shoring by completion of the Work.
   1. Select shoring system and method of removal, which will minimize soil that sticks to shoring from creating large voids and causing settlement.
   2. To prevent settlement caused by pulling shoring, fill voids with sand, pea gravel, or pressure injected grout.
   3. The methods used shall prevent settlement.
   4. Pressure preservative treated wood lagging may be left in place when acceptable to the ENGINEER.

3.02 MAINTENANCE

A. Where loss of soil occurs, plug gap in shoring and replace lost soil with fill material acceptable to ENGINEER.

B. Where measurements and observations indicate possibility of failure or excessive movement of excavation support, determined in accordance with general engineering design practice, take appropriate action immediately.

3.03 CONTROL POINTS

A. Establish control points on shoring and on structures and other improvements in vicinity of excavation for measurement of horizontal and vertical movement:
   1. Set control points on shoring support system:
      a. Set points at distances not exceeding 25 feet at each support level.
      b. Support levels shall be levels of tie-backs, wales, bottom of excavation, and other types of supports.
   2. Set control points on curbs, manholes, and other improvements indicated on the Drawings.

B. Provide plumb bobs with horizontal targets indicating original position of plumb bobs in relation to shoring at control points located on shoring.

C. Perform horizontal and vertical survey and measurement of control points at least once every week.

END OF SECTION

SECTION 02280

SUBSURFACE UTILITY ENGINEERING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for subsurface utility engineering (SUE) as part of the WORK for new pipelines.

B. Related section:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. 38-02 Standard Guideline for the Collection and Depiction of Existing and Subsurface Utility Data.

1.03 DEFINITIONS

A. General: Definitions used in this Section are in accordance with ASCE 38 02.

1.04 REQUIREMENTS

A. Existing utilities indicated on the Drawings are approximately only and are provided based on the best information available.

B. Existing utilities are shown for the convenience of CONTRACTOR only.
   1. It is the CONTRACTOR's responsibility to field verify the vertical and horizontal location of all utilities including those not indicated or incorrectly indicated on the Drawings.

C. CONTRACTOR is responsible to review all geotechnical reports, record drawings, and Contract Documents.

D. Coordinate with utility locator, such as CALL BEFORE YOU DIG, and other affected entities.

E. CONTRACTOR is responsible for protecting all utilities encountered.
   1. Before any excavation, follow requirements of Section 01140.
   2. If a conflict exists between what is indicated on the Drawings and what exists in the field, CONTRACTOR shall notify ENGINEER immediately.

F. Where scheduled, provide subsurface utility engineering services by a Civil Engineer registered in the state of California in accordance with ASCE 38-02.

G. Requirements: The SUE shall entail the following at a minimum:
   1. Review of existing record drawings.
   2. Geophysical methods such as ground penetrating radar.
   3. Soft excavation to locate known utilities along the proposed pipeline alignment.
   4. Open trench excavation to locate unknown utilities along the proposed pipeline alignment.
   5. Utilization of field survey by a Professional Land Survey licensed in the state of California in for determination of vertical and horizontal locations.

1.05 QUALIFICATIONS

A. General: CONTRACTOR shall utilize the services of a qualified subconsultant for SUE services with minimum qualifications that include but are not limited to:
   1. Minimum of 5 years of SUE experience in the state of California where providing vertical and horizontal locations of utilities in accordance with ASCE 38-02 utility quality level A was required.
   2. Completion of 5 SUE projects of equal or greater magnitude within the past 5 years.

1.06 SUBMITTALS

A. Shop Drawings:
   1. CONTRACTOR shall submit all SUE information as follows:
      a. Plan drawings that clearly illustrate vertical and horizontal location of known and unknown utilities.
         1) Horizontal location shall include northing and easting coordinates.
      b. Identifies size and material and service for known utilities.
      c. Identify size and material for unknown utilities.
   2. Review of shop drawings and calculations by ENGINEER and OWNER are for record only.
   3. Drawings shall be performed, stamped, and endorsed by a Civil Engineer registered in the state of California.
   4. Field survey information shall be performed, stamped, and endorsed by a Surveyor registered in the state of California.

B. Detailed sequence of SUE:
   1. Submit a schedule for all SUE events that shows start, end, and intermediate milestones.
   2. Provide sketches showing the conditions at various stages in the sequence of SUE.

C. Submit submittals for stability of excavations as a complete package and include all items required in this Section.
   1. Incomplete submittals will not be reviewed and will be returned for resubmittal as a complete package.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate all WORK with restrictions provided in Section 01140.

B. Do not begin WORK until submittals have been accepted by ENGINEER and until equipment and materials necessary for installation are on site.

C. Submit submittals a minimum of 30 days prior to the scheduled date to begin excavation work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 SUE SCHEDULE

A. Provide SUE services for the following pipelines and utilities.

Description	Reference Drawings
2-Inch High Pressure Natural Gas	01C10
Power Connection	ESC02
Telephone Connection	ESC02
Fiber Optic Connection	ESC02

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Loosening, excavating, filling, grading, borrow, hauling, preparing subgrade, compacting in final location, wetting and drying, and operations pertaining to site grading for buildings, basins, reservoirs, boxes, roads, and other facilities.
   2. Backfilling and compacting under and around structures.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01060 - Regulatory Agency and Utility Requirements.
      b. Section 01570 - Stormwater Pollution Prevention Plan.
      c. Section 02050 - Soils and Aggregates for Earthwork.
      d. Section 02240 - Dewatering.
      e. Section 02312 - Controlled Low Strength Materials (CLSM).
      f. Section 02620 - Filter Fabric.
      g. Section 02621 - Stabilization Fabric.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   2. D 1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN m/m^3)).
   3. D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 DEFINITIONS

A. Backfill adjacent to structure: Backfill within volume bounded by the exterior surfaces of structure, the surface of undisturbed soil in the excavation around structure, and finish grade around structure.

B. Embankments: Dikes, levees, berms, and similar facilities.

C. Excavation: Consists of loosening, removing, loading, transporting, depositing, and compacting in final location, wet and dry materials, necessary to be removed for purposes of construction of structures, ditches, grading, roads, and such other purposes as are indicated on the Drawings.

1.04 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Where mud or other soft or unstable material is encountered, remove such material and refill space with stabilization material. Wrap stabilization material with stabilization fabric.
   2. Obtain acceptable import material from other sources if surplus obtained within Project site do not conform to specified requirements or are not sufficient in quantity.
   3. No extra compensation will be made for hauling of fill materials or for water required for compaction.
   4. Remove surplus soil from project site.

1.05 SUBMITTALS

A. Copy of Property OWNER's Agreement allowing placement of surplus soil material on their property.

B. Excavation plan.

1.06 QUALITY ASSURANCE

A. Initial compaction demonstration:
   1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
      a. 50 cubic yards of backfill adjacent to structures.
      b. 100 cubic yards of embankment work.
      c. 100 cubic yards of fill.
      d. 50 cubic yards of roadway base material.
      e. 100 cubic yards of road fill.
   2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
   3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

B. CONTRACTOR shall perform all work related to this Section in accordance with the approved Stormwater Pollution Prevention Plan (SWPPP) and as specified in Section 01570.

1.07 SEQUENCING AND SCHEDULING

A. Schedule earthwork operations to meet requirements specified in this Section for excavation and uses of excavated material.

B. If necessary, stockpile excavated material in order to use it at specified locations.

C. Excavation, backfilling, and filling: Perform excavation, backfilling, and filling during construction in manner and sequence that provides drainage at all times.

PART 2 PRODUCTS

2.01 MATERIALS

A. Water for compacting: Use water from source acceptable to ENGINEER.

B. Soil and rock materials:
   1. General:
      a. Provide aggregate base course, Class 2 permeable, controlled low strength material, drain rock, gravel, native material, sand, select material, and stabilization material where specified or indicated on the Drawings.
      b. If suitable surplus materials are available, obtain native material and select material from cut sections or excavations or imported materials.
   2. Aggregate base course materials: As specified in Section 02050.
   3. Class 2 permeable: As specified in Section 02050.
   4. Drain rock: As specified in Section 02050.
   5. Gravel: As specified in Section 02050.
   6. Native material: As specified in Section 02050.
   7. Sand: As specified in Section 02050.
   8. Select material: As specified in Section 02050.
   9. Stabilization material: As specified in Section 02050.

C. Controlled low strength material: As specified in Section 02312.

D. Geotextile fabrics:
   1. Filter fabric: As specified in Section 02620.
   2. Stabilization fabric: As specified in Section 02621.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Character and quantity of material:
      a. Verify character and quantity of rock, gravel, sand, silt, water, and other inorganic or organic materials to be encountered in work to be performed.
      b. Determine gradation and shrinkage, and swelling of soil, and suitability of material for use intended in work to be performed.
      c. Determine quantity of material, and cost thereof, required for construction of backfills, cuts, embankments, excavations, fills, and roadway fills, whether from onsite excavations, or imported materials. Include in cost of work to be performed.
      d. Include wasting of excess material, if required, in cost of work to be performed.

3.02 PREPARATION

A. Backfills:
   1. After clearing and excavation are completed, scarify entire areas that underlie backfills or structures to a depth indicated on the Drawings and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified before placing backfill material or concrete.
   3. Do not place backfill against walls until:
      a. Walls have been cast full height of structure and concrete has reached the specified strength.
         Connecting slabs and beams have been cast and concrete has reached the specified strength.
   4. Prior to backfilling:
      a. Remove all forms
      b. Clean all trash and debris from the excavation site.
   5. After inspection of foundation, walls, and pipes, place backfill symmetrically around structures to prevent eccentric loading of structures.

B. Embankments:
   1. After clearing is completed, scarify entire areas that underlie embankments to a depth of 9 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for embankments before placing of embankment material.

C. Fills:
   1. After clearing is completed, scarify entire areas that underlie fill sections or structures to a depth of 9 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for compacted fills before placing of fill material or concrete.

D. Roadway fills:
   1. After clearing is completed, scarify entire areas that underlie roadway fills to a depth of 9 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for roadway fills before placing of roadway fill material.

E. Sloped surfaces for fill or foundations:
   1. Foundations for fill having slopes in excess of 1 vertical to 4 horizontal:
      a. Bench or terrace to adequately key existing ground and fill built thereon.
   2. Slopes of original hillsides and old fills: Bench minimum of 10 feet horizontally as fill is placed.
   3. Provision of new benches:
      a. Start new bench wherever vertical cut of next lower bench intersects existing grade.
      b. Recompact material thus cut out along with new embankment material at no additional cost to the OWNER.

F. Erosion control:
   1. Comply with erosion control requirements specified in Sections 01060 and 01570.

3.03 INSTALLATION

A. General:
   1. Dispose of excavated materials that are not required or are unsuitable for fill and backfill in lawful manner.
   2. Dispose of surplus material on private property only when written permission agreement is furnished by owner of property. Submit copies of such agreements.
   3. Rocks, broken concrete, or other solid materials larger than 4 inches in greatest dimension: Remove from project site at no additional cost to OWNER.
   4. Stabilization of subgrade: Provide materials used, or perform work required, to stabilize subgrade so it can withstand loads that may be placed upon it by CONTRACTOR's equipment.

B. Borrow area: There is no designated borrow area on Project site.
   1. When additional material is required, import material from source located off Project site selected by the CONTRACTOR and subject to acceptance by the ENGINEER.
   2. There will be no additional cost to the Contract for use of imported material.

C. Compaction:
   1. Provide specified compaction for backfills, cuts, embankments, fills, roadway fills, and other earthwork.
   2. Perform confirmation tests to verify and confirm that work has complied, and is complying at all times, with compaction requirements specified in this Section for initial compaction demonstration and field quality control testing.
   3. In-place density of compacted backfills, cuts, embankments, fills, and roadway fills determined in accordance with ASTM D 1556, or with ASTM D 6938.
   4. Maximum density obtained in laboratory when tested in accordance with ASTM D 1557.
   5. To prevent damage to structures due to backfilling operations, place backfill with equipment that does not exceed H-20 loading, within a distance from the face of the structure of not less than 1/2 the depth of backfill. The depth of backfill is the distance between the level being compacted and the bottom of the excavation. Outside this distance, heavier compaction equipment may be used.
   6. Maintain moisture content as necessary to achieve the required compaction in each lift of material. Place fill derived from on-site sources with a moisture content of 2 percent above optimum.
   7. Remove fill material that is soft or yielding and replace with properly compacted fill material prior to placing the next lift of material.
   8. Compact to percentage of maximum density as follows:
      a. Backfill adjacent to structures and retaining walls: 90 percent.
      b. Backfilling voids: 95 percent.
      c. Embankments: Compact embankment fill to at least 90-percent relative compaction in non-pavement areas. Compact embankment fill to at least 95 percent relative compaction where fill is placed within 3 feet of finished grade in pavement areas.
      d. Other areas: 90 percent.

e. Under structures:
   1) Aggregate base course: 95 percent.
   2) Scarified, moisture conditioned native material: 90 percent.
f. Under roadways, parking and storage areas, curbs, and sidewalks: 95 percent.
g. Upper 9 inches of cuts: 90 percent.
h. General Fills: 90 percent unless noted otherwise.

D. Dewatering: As specified in Section 02240.

E. Excavation:
1. Blasting: Not permitted.
2. Excavations for structures:
   a. Provide excavations conforming to dimensions and elevations indicated on the Drawings for each structure, including trenching for piping and all work incidental thereto.
   b. After clearing is complete, excavate for the structure, down to the elevation indicated on the Drawings. Unless directed by ENGINEER, do not carry excavations below elevation indicated on the Drawings.
   c. Where soil is encountered having unsuitable bearing value, ENGINEER may direct in writing that excavation be carried to elevations below those indicated on the Drawings.
   d. Where excavations are made below elevations indicated on the Drawings, adjust elevations of excavations in accordance with the following requirements:
      1) Under slabs: Restore to proper elevation in accordance with procedure specified for backfill in this Section.
      2) Under footings: Restore to the proper elevation using one of the following:
         a) Aggregate base-course or
         b) Controlled low strength material.
   e. Excavation width:
      1) Extend excavations at least 5 feet clear from walls and foundations of structures to allow for placing and removal of forms, installation of services, and inspection.
      2) Do not undercut slopes.
   f. Difficulty of excavation: No extra compensation will be made for removal of rock or any other material due to difficulty of excavation.
3. Excavation of lined channels:
   a. Excavations in open cut for lined channels may be made so as to place concrete directly against excavated surfaces providing faces of excavations are:
      1) Firm and unyielding.
      2) Will stand or can be made to stand without sloughing.
   b. Excavations to provide subgrade for lined channel or subdrainage material: Excavate to lines and grades indicated on the Drawings.
4. Excavation of unlined channels and basins:
   a. Excavate to lines and grades indicated on the Drawings.
   b. Perform excavation and grading so that finish surfaces are in uniform planes with no abrupt breaks in surface.

5. Excavation of ditches and gutters:
    a. Cut ditches and gutters accurately to cross sections and grades indicated on the Drawings.
    b. Take care not to excavate ditches and gutters below grades indicated on the Drawings.
    c. Backfill excessive ditch and gutter excavations to grade with suitable material acceptable to ENGINEER that is thoroughly compacted.
    d. Do not deposit any material within 3 feet of edge of ditch unless otherwise indicated on the Drawings.
6. Necessary over excavation:
    a. Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, backfill voids remaining after removal as specified in backfilling of voids below, or as acceptable to the ENGINEER.
    b. Backfill voids with material acceptable to the ENGINEER:
        1) With acceptance of the ENGINEER, backfill with one of the following:
            a) Aggregate base course.
            b) Controlled low strength material.

F. Materials for backfills, embankments, fills, roadway fills:
1. General:
    a. Obtain import material from other sources if surplus materials from cuts and excavations obtained from within Project site do not conform to specified requirements or are not sufficient in quantity for construction of Project.
2. Backfills:
    a. Backfill adjacent to structures, slabs, or walls: As indicated on the Drawings.
    b. Backfill material under concrete structures: Aggregate base course material, except in areas where controlled low strength material or concrete encasement are indicated on the Drawings.
    c. Extend backfill in any area under concrete structures from scarified, recompacted, and moisture conditioned native material to the bottom aggregate base course material layer.
3. Embankments:
    a. Native material unless otherwise specified or indicated on the Drawings.
4. Fills:
    a. Native material, or unless otherwise specified or indicated on the Drawings.
    b. Extend fill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
5. Roadway fills: One of the following, unless otherwise specified or indicated on the Drawings:
    a. Aggregate base course material.

G. Placement:
1. General:
    a. Lines and grades:
        1) Construct backfills, embankments, fills, and road fills, at locations and to lines and grades indicated on the Drawings.
        2) Overbuild all permanent fill slopes by at least 1 foot and then cut to final grade to provide adequate compaction of the remaining fill.

2. Backfills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 2 percent above optimum moisture content before compacting.
    c. Defective compacted backfills: Remove and recompact.
3. Fills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 2 percent above optimum moisture content before compacting.
    c. Defective compacted fills: Remove and recompact.
4. Embankments:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 2 percent above optimum moisture content before compacting.
    c. Defective compacted embankments: Remove and recompact.
5. Roadway fills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction:
    b. Bring each layer to a moisture content between optimum moisture content and 2 percent above optimum moisture content before compacting.
    c. Defective compacted roadway fills: Remove and recompact.

3.04 FIELD QUALITY CONTROL

A. Tests:
1. Compliance tests:
    a. Periodic compliance tests will be made by the ENGINEER to verify that compaction is meeting requirements previously specified.
    b. Remove overburden above level at which the ENGINEER wishes to test. Backfill and recompact excavation after testing is completed.
    c. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:
        1) Remove and replace materials at proper density.
        2) Bring density up to specified level by other means acceptable to the ENGINEER.
    d. Retesting:
        1) CONTRACTOR bears the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.

B. Tolerances:
1. Finish grading of backfills, cuts, embankments, fills, and roadway fills:
    a. Perform fine grading under concrete structures such that finish surfaces are never above the grade or cross section indicated on the Drawings and are never more than 0.10 feet below.
    b. Provide finish surface for areas outside of structures that are within 0.10 feet of grade or cross section indicated on the Drawings.

2. Unlined channels and basins:
    a. In both cut and fill, and levee and access road side slopes in cut: Vertical tolerance of none above and 3 inches below grade indicated on the Drawings on bottom and side slopes.
    b. On top surface of levee and access road in both cut and fill, and levee and access road side slopes in fill: Vertical tolerance of none below and 3 inches above grade indicated on the Drawings.
3. Areas which are not under structures, concrete, asphalt, roads, pavements, sidewalks, dikes, and similar facilities:
    a. Provide finish graded surfaces of either undisturbed soil, or cohesive material not less than 6 inches deep.
    b. Intent of proceeding is to avoid sandy or gravelly areas.
4. Finish grading of surfaces:
    a. Reasonably smooth, compacted, and free from irregular surface changes.
    b. Provide degree of finish that is ordinarily obtainable from blade grader operations, except as otherwise specified.
    c. Uniformly grade areas that are not under concrete.
    d. Finish ditches and gutters so that they drain readily.

3.05 ADJUSTING

A. Finish grades of excavations, backfills, and fills:
    1. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur from action of the elements or any other cause prior to final acceptance.

3.06 PROTECTION

A. Finish grades of backfills, cuts, excavations, and fills:
    1. Protect newly graded areas from erosion and deterioration by action of the elements.

B. Ditches and gutters:
    1. Maintain ditches and gutters free from detrimental quantities of debris that might inhibit drainage until final acceptance.

END OF SECTION

SECTION 02312

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Controlled low strength material (CLSM).

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03300 - Cast-in-Place Concrete.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   2. C 33 - Standard Specification for Concrete Aggregates.
   3. C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   4. C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
   5. C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
   6. C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   7. C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   8. D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3)).

1.03 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Total calculated air content: Not be less than 8.0 percent nor greater than 12.0 percent.
   2. Minimum unconfined compressive strength: Not less than 50 pounds per square inch measured at 28 days.
   3. Maximum unconfined compressive strength: Not greater than 150 pounds per square inch measured at 28 days.
   4. Wet density: No greater than 132 pounds per cubic foot.

1.04 SUBMITTALS

A. Product data: Submit data completely describing products.

B. Sieve analysis: Submit sieve analyses of fine and coarse aggregates being used in triplicate. Resubmit at any time there is a significant change in grading of materials.

C. Mix: Submit full details, including mix design calculations for mix proposed for use.

D. Trial batch test data:
   1. Submit data for each test cylinder.
   2. Submit data that identifies mix and slump for each test cylinder.

E. Cement mill tests: Include alkali content, representative of each shipment of cement for verification of compliance with specified requirements.

F. Pozzolan certificate of compliance: Identify source of pozzolan and certify compliance with requirements of ASTM C 618.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland cement: Type II low alkali portland cement as specified in Section 03300.

B. Fly ash: Class F fly ash in accordance with ASTM C 618.

C. Water: As specified in Section 03300.

D. Admixture: Air entraining admixture in accordance with ASTM C 260.

E. Fine aggregate: Concrete sand that does not need to be in accordance with ASTM C 33. No more than 12 percent of fine aggregate shall pass a No. 200 sieve, and no plastic fines shall be present.

F. Coarse aggregate: Pea gravel no larger than 3/8 inch.

2.02 SOURCE QUALITY CONTROL

A. Trial batch:
   1. After mix design has been accepted by ENGINEER, have trial batch of the accepted mix design prepared by testing laboratory acceptable to ENGINEER.
   2. Prepare trial batches using specified cementitious materials and aggregates proposed to be used for the Work.
   3. Prepare trial batch with sufficient quantity to determine slump, workability, consistency, and to provide sufficient test cylinders.

B. Test cylinders:
   1. Prepare test cylinders in accordance with ASTM C 31 with the following exceptions:
      a. Fill the concrete test cylinders to overflowing and tap sides lightly to settle the mix.

b. Do not rod the concrete mix.
c. Strike off the excess material.

2. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
3. Do not remove the test cylinder from mold until the cylinder is to be capped and tested.
4. The test cylinders may be capped with standard sulfur compound or neoprene pads:
   a. Perform the capping carefully to prevent premature fractures.
   b. Use neoprene pads a minimum of 1/2-inch thick and 1/2-inch larger in diameter than the test cylinders.
   c. Do not perform initial compression test until the cylinders reach a minimum age of 3 days.

C. Compression test 8 test cylinders: Test 4 test cylinders at 3 days and 4 at 28 days in accordance with ASTM C 39 except as modified in this Section:
   1. The compression strength of the 4 test cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.

D. If the trial batch tests do not meet the Specifications for strength or density, revise and resubmit the mix design, and prepare additional trial batch and tests. Repeat until an acceptable trial batch is produced that meets the Specifications.
   1. All the trial batches and acceptability of materials shall be paid by the CONTRACTOR.
   2. After acceptance, do not change the mix design without submitting a new mix design, trail batches, and test information.

E. Determine slump in accordance with ASTM C 143 with the following exceptions:
   1. Do not rod the concrete material.
   2. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.

PART 3 EXECUTION

3.01 INSTALLATION

A. Prior to placement, soils located below controlled low strength material placement shall be scarified to a depth of 9 inches, uniform moisture conditioned to or above the optimum moisture content, and compacted to a minimum of 90 percent relative compaction in accordance with ASTM D 1557.

B. Place controlled low strength material by any method which preserves the quality of the material in terms of compressive strength and density:
   1. Limit lift heights of CLSM placed against structures and other facilities that could be damaged due to the pressure from the CLSM, to 3 feet. Do not place another lift of CLSM until the last lift of CLSM has set and gained sufficient strength to prevent lateral load due to the weight of the next lift of CLSM.
   2. The basic requirement for placement equipment and placement methods is the maintenance of its fluid properties.

3. Transport and place material so that it flows easily around, beneath, or through walls, pipes, conduits, or other structures.
4. Use a slump of the placed material greater than 9 inches, and sufficient to allow the material to flow freely during placement:
   a. After trial batch testing and acceptance, maintain slump developed during testing during construction at all times within plus or minus 1 inch.
5. Use a slump, consistency, workability, flow characteristics, and pumpability (where required) such that when placed, the material is self-compacting, self-densifying, and has sufficient plasticity that compaction or mechanical vibration is not required.

3.02 FIELD QUALITY CONTROL

A. General:
   1. Make provisions for and furnish all material for the test specimens, and provide manual assistance to assist the ENGINEER in preparing said specimens.
   2. Be responsible for the care of and providing curing condition for the test specimens.

B. Tests by OWNER:
   1. During the progress of construction, the OWNER will have tests made to determine whether the controlled low strength material, as being produced, complies with the requirements specified in this Section. Test cylinders will be made and delivered to the laboratory by the ENGINEER and the testing expense will be borne by the OWNER.
   2. Test cylinders:
      a. Prepare test cylinders in accordance with ASTM C 31 with the following exceptions:
         1) Fill the concrete test cylinders to overflowing and tap sides lightly to settle the mix.
         2) Do not rod the concrete mix.
         3) Strike off the excess material.
      b. Place the cylinders in a safe location away from the construction activities. Keep the cylinders moist by covering with wet burlap, or equivalent. Do not sprinkle water directly on the cylinders.
      c. After 2 days, place the cylinders in a protective container for transport to the laboratory for testing. The concrete test cylinders are fragile and shall be handled carefully. The container may be a box with a Styrofoam or similar lining that will limit the jarring and bumping of the cylinders.
      d. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
      e. Do not remove the test cylinder from mold until the cylinder is to be capped and tested.
      f. The test cylinders may be capped with standard sulfur compound or neoprene pads:
         1) Perform the capping carefully to prevent premature fractures.
         2) Use neoprene pads a minimum of 1/2-inch thick and 1/2-inch larger in diameter than the test cylinders.
         3) Do not perform initial compression test until the cylinders reach a minimum age of 3 days.

3. Not less than 3 cylinder specimens will be tested for each 150 cubic yards of controlled low strength material and not less than 3 specimens for each half day's placement:
   a. Test 1 cylinder at 3 days and 2 at 28 days in accordance with ASTM C 39 except as modified in this Section.
   b. The compression strength of the cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.
4. The OWNER will test the air content of the controlled low strength material. Test will be made immediately after discharge from the mixer in accordance with ASTM C 231.

C. Tests by CONTRACTOR:
   1. Test the slump of controlled low strength material using a slump cone in accordance with ASTM C 143 with the following exceptions:
      a. Do not rod the concrete material.
      b. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.
   2. Test the slump at the beginning of each placement, as often as necessary to keep the slump within the specified range, and when requested to do so by the ENGINEER.

END OF SECTION

SECTION 02318

TRENCHING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Trench excavation, fine grading, pipe bedding, backfilling, and compaction for the following, including requirements for ditch crossings:
   1. Pipes.
   2. Direct buried electrical and control conduits.
   3. Electrical and control duct banks.
   4. Manholes, valves, or other accessories.
   5. Potable water pipe appurtenances.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 02050 - Soils and Aggregates for Earthwork.
      b. Section 02240 - Dewatering.
      c. Section 02260 - Excavation Support and Protection.
      d. Section 02300 - Earthwork.
      e. Section 02312 - Controlled Low Strength Material (CLSM).
      f. Section 15956 - Piping Systems Testing.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   2. D 1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   3. D 6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

A. Lab certification.

B. Confirmation test reports.

1.04 QUALITY ASSURANCE

A. Initial compaction demonstration:
   1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
      a. 200 linear feet of trench backfill.
   2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
   3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

PART 2 PRODUCTS

2.01 MATERIALS

A. Soil and rock materials:
   1. Aggregate base course material: As specified in Section 02050.
   2. Gravel: As specified in Section 02050.
   3. Native material: As specified in Section 02050.
   4. Sand: As specified in Section 02050.
   5. Select material: As specified in Section 02050.

B. Controlled low-strength material: As specified in Section 02312.

PART 3 EXECUTION

3.01 PREPARATION

A. General:
   1. Embankment condition:
      a. Exists where width of trench exceeds limits specified in this Section.
      b. Before laying pipes in fill, place fill and compact it to not less than 2 feet above top of pipe.
      c. After placing and compacting fill, excavate pipe trench through fill.

B. Protection: Stabilize trench excavations as specified in Section 02260.

3.02 INSTALLATION

A. Trench excavation:
   1. General requirements:
      a. If, because of soil conditions, safety requirements, or other reasons, trench width at top of pipe is increased beyond width specified in this Section, upgrade laying conditions or install stronger pipe designed in conformance with Specifications for increased trench width, without additional cost to OWNER.
      b. Excavate bottom of trench to depth indicated on the Drawings. The bottom of the trench excavation shall be firm and dry.

2. The trench may be excavated by machinery to the grade indicated on the Drawings provided that the soil material remaining in the bottom of the trench is no more than slightly disturbed.
3. Rock:
    a. Pipe: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of fine grading material. Backfill overcut with aggregate base course material compacted to 95 percent of maximum density up to bottom of fine grading material.
    b. Direct buried electrical and control conduits: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of conduit bedding material. Backfill overcut with aggregate base course material up to bottom of conduit bedding material.
    c. Electrical and control duct banks: If bottom of trench excavation is found to consist of rock or any material that by reason of its hardness cannot be excavated to provide uniform bearing surface, remove such rock or other material to a depth of not less than 4 inches below bottom of concrete duct bank. Backfill overcut with aggregate base course material up to bottom of concrete duct bank.
4. Overcut of trench bottom: Where the bottom of the trench is excavated below the depth indicated on the Drawings, restore trench bottom to proper grade by back filling with aggregate base course material compacted to 95 percent of maximum density, at no additional cost to OWNER.
5. Soft or unstable material:
    a. If bottom of excavation is found to consist of soft or unstable material that is incapable of providing proper support, remove such material to a depth and for the length required, as determined by the ENGINEER. Backfill trench to bottom of fine grading material with coarse aggregate for trench stabilization material. Coarse aggregate shall be encased using stabilization fabric.
6. Trench widths:
    a. Minimum clear width of trench for pipe (measured at top of pipe):
        1) For pipe sizes 4 inches to and including 24 inches: Not less than outside diameter of pipe plus 18 inches.
        2) For pipe sizes larger than 24 inches: Not less than outside diameter of pipe plus 24 inches.
    b. Maximum clear width of trench for pipe (measured at top of pipe):
        1) For pipe sizes 4 inches to and including 24 inches: Not to exceed outside diameter of pipe plus 24 inches.
        2) For pipe sizes larger than 24 inches: Not to exceed outside diameter of pipe plus 36 inches.
7. For manholes, valves, or other accessories:
    a. Provide excavations sufficient to leave at least 12 inches clear between their outer surfaces and sides of trench or shoring.
    b. Backfilling of manhole excavation: Conform to backfilling requirements as specified for trenches in this Section.

c. Backfill under manholes, vaults, tanks, or valves with aggregate base course material. Do not backfill with soil.
d. Fill any unauthorized excess excavation below elevation indicated on the Drawings for foundation of any structure with aggregate base course material at no additional cost to OWNER.

8. Potable water pipe appurtenances:
   a. Lay in trenches separate from those used for sewers.
   b. Unless otherwise specified or indicated on the Drawings, lay in trenches having cover of not less than 3 feet below surface of ground and located at distance of not less than 10 feet from any parallel sewer or Plant Drain trench.
9. At road crossings or existing driveways:
   a. Make provision for trench crossings at these points, either by means of backfills, tunnels, or temporary bridges.

B. Dewatering: As specified in Section 02240.

C. Pipe fine grading:
   1. Schedule fine grading material as specified in this Section.
   2. For pipes 16 inches in nominal diameter and under.
      a. Place 6 inches of fine grading material below bottom of pipe.
      b. Place fine grading material at uniform density, with minimum possible compaction.
   3. For pipe over 16 inches in diameter.
      a. Place 6 inches, or 1/12 the outside diameter of pipe, whichever is greater, of fine grading material below bottom of pipe.
      b. Place fine grading material at uniform density, with minimum possible compaction.
   4. Bell or coupling holes:
      a. Dig holes after trench bottom has been graded.
      b. Provide holes of sufficient width to provide ample room for grouting, banding, or welding.
      c. Excavate holes only as necessary for making joints and to ensure that pipe rests upon prepared trench bottom and not supported by any portion of the joint.
   5. Depressions for joints, other than bell-and-spigot:
      a. Make in accordance with recommendations of joint manufacturer for particular joint used.

D. Pipe bedding:
   1. Schedule bedding material as specified in this Section.
   2. After pipe laid:
      a. Place bedding material under and around pipe in 6-inch maximum lifts of bedding material, to level 12 inches above top of pipe. Compact to 90 percent of maximum density.
   3. Pipe displacement:
      a. Take necessary precautions in placement and compaction of bedding material to prevent displacement of piping.
      b. In event there is movement or floating of the piping, re-excavate, re-lay, and backfill the pipe.

E. Trench backfill above pipe bedding, electrical and control conduit bedding, and electrical and control duct banks:
   1. Under structures:
      a. Backfill trench up to underside of structure with aggregate base course material as specified in Section 02050 compacted to 95 percent of maximum density or controlled low-strength material as specified in Section 02312.
   2. Cuts across roadways and paved streets:
      a. Backfill trench to underside of pavement with aggregate base course material as specified in Section 02050 compacted to 95 percent of maximum density or controlled low-strength material as specified in Section 02312.
   3. Under and parallel to roadways, paved areas, or storage areas:
      a. Backfill trench up to within 2 feet of finish grade with native material compacted to 95 percent of maximum density.
      b. Then backfill from 2 feet below finish grade to finish grade, or underside of aggregate base course or pavement as indicated on the Drawings with aggregate base course material as specified in Section 02050, compacted to 95 percent of maximum density or controlled low-strength material as specified in Section 02312.
   4. In areas outside the improved section of roadways or in open country:
      a. Backfill to finish grade with native material as specified in Section 02050 compacted to 95 percent of maximum density.
   5. Through earth slopes adjacent to, or supporting structures:
      a. Backfill to finish grade with aggregate base course material or select material compacted to 95 percent of maximum density.

F. Under existing intersecting pipes or conduits larger than 3 inches in diameter:
   1. Backfill from bottom of new pipe trench to spring line of intersecting pipe or conduit with aggregate base course material, as specified in Section 02050, compacted to 90 percent of maximum density or controlled low-strength material as specified in Section 02312.
   2. Extend aggregate base course material as specified in Section 02050, or controlled low-strength material as specified in Section 02312, 2 feet on either side of intersecting pipe or conduit to ensure that material remains in place while other backfill is being placed.
   3. Backfill remainder of trench as specified in “Trench backfill above pipe bedding, electrical and control conduit bedding, and electrical and control duct banks” above.

G. Compaction:
   1. In-place density of compacted trench backfill, and bedding determined in accordance with ASTM D 1556, or with ASTM D 6938.
   2. Maximum density obtained in laboratory when tested in accordance with ASTM D 1557.
   3. Consolidation:
      a. Do not use water-settling methods such as flooding, poling, or jetting.

H. Excess material:
   1. Remove excess excavated material from the Project site as specified in Section 02300 and dispose of legally off site.

3.03 FIELD QUALITY CONTROL

A. Tests:
   1. Compliance tests:
      a. Frequency of testing: Periodic compliance tests will be made by the ENGINEER to verify that compaction is meeting requirements previously specified.
      b. If compaction fails to meet specified requirements: Perform remedial work by one of the following methods:
         1) Remove and replace backfill at proper density.
         2) Bring density up to specified level by other means acceptable to the ENGINEER.
   2. Retesting:
      a. Costs of retesting: CONTRACTOR is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
      b. CONTRACTOR's confirmation tests during performance of remedial work:
         1) Performance: Perform tests in manner acceptable to the ENGINEER.
         2) Frequency: Double amount specified for initial confirmation tests.

B. Piping system testing:
   1. As specified in Section 15956.

3.04 SCHEDULES

A. Pipe fine grading materials:
   1. Fine grading material shall be the same as bedding material.

B. Bedding materials:
   1. Pipes:
      a. For pipe less than 16-inch nominal size: Except as otherwise specified, use sand.
      b. For pipe from 16- inch to 48-inch nominal size: Except as otherwise specified, use sand.
      c. For pipe over 48 inches: Aggregate base course material.
      d. For polyvinyl chloride or other plastic pipe less than 2 inches in diameter: Sand.
   2. Direct buried electrical and control conduits: Sand.

END OF SECTION

SECTION 02352

GEOGRID REINFORCEMENT FOR INTERLOCKING BLOCK RETAINING WALL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Synthetic geogrid reinforcement for interlocking block retaining wall, wall fill, and backfill the lines and grades indicated on the Drawings.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.
      b. Section 02836 - Interlocking Block Retaining Wall.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 5261 - Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.
   2. D 6637 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi Rib Tensile Method.

1.03 SUBMITTALS

A. General: Submit as specified in Section 01330.

B. Product data:
   1. Manufacturer's specifications for proposed materials, method of installation, and list of material proposed for use.

C. Shop drawings.

D. Samples:
   1. Samples of all products specified in this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store geogrid at temperatures above minus 20 degrees Fahrenheit.

B. Prevent excessive mud, wet cement, epoxy, and similar materials, which may affix themselves to the gridwork from coming in contact with the geogrid material.

C. Rolled material may be laid flat or stood on end for storage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Huesker, Inc., 35/20-20.
   2. TC Mirafi, Miragrid 5XT.

2.02 MATERIALS

A. Geogrid products shall be high-density polyethylene expanded sheet or polyester woven fiber materials, specifically fabricated for use as soil reinforcement.

B. Concrete retaining wall units are as indicated on the Drawings and specified in Section 02836.

2.03 GEOGRID

A. Geogrid shall have a minimum ultimate strength of twice the long-term strength shown on the Drawings, machine direction, and at least 50 percent of that ultimate strength in the cross direction in accordance with ASTM D 6637.

B. Geogrid shall weigh a minimum of 5.5 ounces per square yard for walls up to 10 feet high maximum, and 9.8 ounces for all higher walls, in accordance with ASTM D 5261.

C. Geogrid shall have an open area between 50 and 90 percent.

D. At the long-term design strength in the machine direction, the maximum strain shall not exceed 5 percent.

E. Geogrid shall be resistant to naturally occurring alkaline and acidic soil conditions and to attack by bacteria.

F. Geogrid shall be stabilized with at least 1 percent carbon black to be resistant to the effects of long-term exposure to ultraviolet rays.

PART 3 EXECUTION

3.01 FOUNDATION SOIL PREPARATION

A. Excavate foundation soil to the lines and grades indicated on the Drawings.

B. Fill over-excavated areas with compacted backfill material.

C. Proof roll foundation soil prior to fill and geogrid placement.

3.02 WALL ERECTION

A. Wall erection shall be as specified under Section 02836.

3.03 GEOGRID INSTALLATION

A. The geogrid soil reinforcement shall be laid horizontally on compacted backfill and connected to the concrete wall units in accordance with the manufacturer's recommendations.
   1. Pull geogrid taut and anchor before backfill is placed on it.

B. Remove slack in the geogrid at the wall unit connections.

C. Lay geogrid at the proper elevation and orientation as recommended by manufacturer.

D. Verify correct orientation (roll direction) of the geogrid.

E. Pull pinned geogrid taut to eliminate loose folds. Stake or secure back edge of geogrid prior to and during backfill and compaction.

F. Follow manufacturer's recommendation for overlap requirements of uniaxial and biaxial geogrids.

3.04 FILL PLACEMENT

A. Backfill material shall be placed in 6- to 8-inch lifts and compacted to 95 percent of maximum density.

B. Place, spread, and compact backfill in such a manner that minimizes the development of slack or loss of pretension of the geogrid.

C. Use only hand-operated compaction equipment within 3 feet of the back surface of the units.

D. Place backfill from the wall back into the embankment to ensure that the geogrid remains taut.

E. Do not operate tracked construction equipment directly on the geogrid.
   1. A minimum backfill thickness of 6 inches is required prior to operation of tracked vehicles over the geogrid.
   2. Keep turning of tracked vehicles to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

F. Rubber-tired equipment may pass over the geogrid reinforcement at slow speeds of less than 10 miles per hour. Avoid sudden braking and sharp turning.

3.05 SPECIAL CONSIDERATIONS

A. Geogrid can be interrupted by periodic penetration of column, pier, or footing structure.

END OF SECTION

SECTION 02353

GEOGRID REINFORCEMENT FOR PAVEMENT SUBGRADE GENERAL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Geogrid reinforcement of aggregate base within the pavement section.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus.
   2. D 4873 - Standard Guide for Identification, Storage, and Handling of Geotextiles Rolls and Samples.
   3. D 6637 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method.
   4. D 7737 - Standard Test Method for Individual Geogrid Junction Strength
   5. D 7748 - Standard Test Method for Flexural Rigidity of Geogrids, Geotextiles and Related Products.

B. Geosynthetic Research Institute (GRI):
   1. GRI GG9 - Torsional Behavior of Bidirectional Geogrids When Subjected to In-Plane Rotation.

1.03 DEFINITIONS

A. Mechanically Stabilized Layer (MSL): A composite layer of a defined thickness comprised of unbound aggregate or base course materials combined with one or more layers of a polymeric geogrid grid structure that has been formed by a regular network of integrally connected, multidirectional tensile elements of appropriate orientation, size and shape with apertures of appropriate size and shape to allow interlocking with the unbound aggregate or base course materials. The combination of the two materials creates an improved or modified composite layer with significantly improved properties and performance capabilities.

B. Biaxial geogrid contains four perpendicular intersecting ribs at each junction formed into a bi-directionally stable network of open rectangular apertures. Biaxial geogrid is used as secondary reinforcement in grade separation applications. Also used for subgrade stabilization, aggregate base reduction and/or life extension in pavement or railroad applications.

C. Multi-Axial geogrid contains six or more intersecting ribs at each junction formed into a radially stable network of open equilateral triangular apertures. Multi-axial geogrid is used for subgrade stabilization, aggregate base reduction, asphalt concrete reduction, and/or life extension in pavement or railroad applications.

D. Minimum average roll value (MARV):
   1. Property value calculated as typical minus 2 standard deviations.
   2. Statistically, it yields a 97.7 percent degree of confidence that any sample taken during quality assurance testing will exceed value reported.

1.04 PROJECT CONDITIONS

A. Field measurements:
   1. Limiting dimensions:
      a. Take field measurements to determine the exact lengths and dimensions of such roads, pavements, parking areas, and walks to receive the geogrid.

1.05 SUBMITTALS

A. Submit geogrid product sample approximately 1 foot by 1 foot.

B. Submit the manufacturer's certificate of compliance and certified test results on the product, tested within six months of the submittal date. Sampling shall be in accordance with ASTM D4354. Additionally, the following shall be included in the submittal:
   1. Manufacturer's name, current address, and telephone number.
   2. Manufacturer's current Quality Assurance / Quality Control Manual.
   3. Full product name by trademark and product number.
   4. Geogrid polymer type(s).
   5. Installation instructions.

C. Geogrid product data sheet.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Geogrid labeling, shipment, and storage following accordance with ASTM D 4873. Product labels shall clearly show the manufacturer or supplier name, style name, and roll number.

B. Storage and protection:
   1. Prevent excessive mud, wet concrete, epoxy, or other deleterious materials from coming in contact with and affixing to the geogrid materials.
   2. Store at temperatures above minus 20 degrees F (minus 29 degrees C).
   3. Rolled materials may be laid flat or stood on end.
   4. Geogrid materials should not be left directly exposed to sunlight for a period longer than the period recommended by the manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Tensar, TX140 or BX 1300.
   2. TenCate Geosynthetics Americas, Mirafi BXG 120.

2.02 MATERIAL REQUIREMENTS

A. Physical properties: Structural Soil Reinforcement Geogrid: The geogrid component of the MSL shall conform to the physical properties in the Greenbook (2013 Supplement) Biaxial Geogrid Table Section 213-5.2 (D) Type S2 or Multi-Axial Geogrid Table Section 213-5.2 (E) Type R2 shown below:

Bi-Axial Geogrid		
Property(1)	**Test Method**	**Requirements(1)(2)**
Tensile Strength at 2 Percent Strain	ASTM D 6637	600 lbs/ft
Tensile Strength at 5 Percent Strain	ASTM D 6637	1,340 lbs/ft
Ultimate Tensile Strength	ASTM D 6637	1,975 lbs/ft
Junction Strength	ASTM 7737	1,778 lbs/ft
Flexural Stiffness	ASTM D7748	750,000 mg-cm
Torsional Stiffness	GRI: GG9	6.5 cm-kg/degree
UV Resistance after 500 hours	ASTM D 4355	70%

Notes:
(1) Minimum average roll values.
(2) All property values are listed for the cross machine direction with the exception of flexural stiffness, measured in the machine direction, and torsional stiffness which is measured at the junction.

Multi-Axial Geogrid		
Property(1)	**Test Method**	**Requirements(1)(2)**
Aperture Shape	Observation	Triangular
Radial Stiffness @ 0.5% strain, Min.	ASTM D 6637(2)	15,430 lbs/ft
Radial Stiffness Ratio	ASTM D 6637(3)	>0.60
Junction Strength Efficiency	ASTM 7737(4)	93%
Ultraviolet Stability, @ 500 hrs	ASTM D4355-05	70%

Notes:
(1) Minimum average roll values
(2) Minimum measured radial stiffness at 0.5% strain. Radial stiffness is measured on both the rib directions and the mid-rib directions (directions that bisect the angles between ribs).
(3) Ratio of the minimum to maximum MARV values of radial stiffness at 0.5% strain.
(4) Load transfer capability determined in accordance with ASTM D7737 and ASTM D6637 and expressed as a percentage.

2.03 EQUIPMENT

A. Follow manufacturer's recommendations for equipment allowed when placing geogrid.

PART 3 EXECUTION

3.01 EXAMINATION

A. The Contractor shall check the geogrid upon delivery to verify that the proper material has been received. The geogrid shall be inspected by the Contractor to be free of flaws or damage occurring during manufacturing, shipping, or handling.

3.02 PREPARATION

A. The site shall be prepared by clearing, grubbing, stripping, and excavating or backfilling the area to the design grade.

3.03 INSTALLATION

A. The geogrid shall be placed at the interface of the subgrade and base material as indicated on the Drawings.

B. The geogrid shall be installed in accordance with the installation guidelines provided by the manufacturer or as directed by the Engineer.

C. The geogrid may be temporarily secured in place with ties, staples, pins, sand bags or backfill as required by fill properties, fill placement procedures or weather conditions, or as directed by the Engineer.

D. If 2 rolls of geogrid are to be placed side by side or end to end, overlap them based on California Bearing Ratio (CBR) as recommended by manufacturer. Care should be taken to ensure that the geogrid sections do not separate at the overlaps during construction.

END OF SECTION

SECTION 02372

STONE SLOPE PROTECTION (RIP RAP)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: This Section describes the requirements for providing stone slope protection, and includes the following components:
   1. Stone.
   2. Sand bedding layer.
   3. Geotextile fabric bottom layer over prepared subgrade.

1.02 SUBMITTALS

A. Product data: Manufacturer's catalog data and installation instructions for the geotextile fabric.

B. Geotextile samples: All samples shall be from the same production lot as will be supplied for the project. The sample size shall be a minimum of 1 square foot.

C. Certificates:
   1. A mill certificate or affidavit, signed by a legally authorized official of company manufacturing the geotextile, certifying the geotextile meets the specification.
   2. Certified weights of the rock delivered to the site.

D. Quality assurance submittals:
   1. Quarry source for the stone protection.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at the site:
   1. Rock: The Contractor shall provide the certified weight tickets to the Engineer at the time of delivery for each truckload of rock.

PART 2 PRODUCTS

2.01 STONE

A. Material: Rounded boulders or cobbles shall not be used.

PERCENTAGE LARGER THAN					
	Method B Placement				
	Classes				
Rock Mass	1 Ton	1/2 Ton	1/4 Ton	Light	Facing
2 ton	0-5	--	--	--	--
1 ton	50-100	0-5	--	--	--

PERCENTAGE LARGER THAN					
	Method B Placement				
	Classes				
Rock Mass	**1 Ton**	**1/2 Ton**	**1/4 Ton**	**Light**	**Facing**
1/2 ton	--	50-100	0-5	--	--
1/4 ton	95-100	--	50-100	0-5	--
200 pounds	--	96-100	--	50-100	0-5
84 pounds	--	--	95-100	--	50-100
25 pounds	--	--	--	95-100	90-100

1. The amount of material smaller than the smallest rock mass listed in the table for any class of rock slope protection shall not exceed the percentage limit listed in the table determined on a mass basis.
2. Compliance with the percentage limit shown in the table for all other rock masses of the individual pieces of any class of rock slope protection shall be determined by the ratio of the number of individual pieces larger than the specified rock mass compared to the total number of individual pieces larger than the smallest rock mass listed in the table for that class.
3. The material shall also conform to the following quality requirements:

Test	California Test	Requirement
Apparent Specific Gravity	206	2.5 minimum
Absorption	206	4.2% maximum
Durability Index	229	52 minimum
Coarse Durability Index = Durability Absorption Ratio % Absorption + 1 *Based on the formula contained herein, absorption may exceed 4.2 percent if durability absorption ratio is greater than 10. Durability index may be less than 52 if durability absorption ratio is greater than 24.		

4. Rocks shall be of an angular shape as to form a stable protection structure of the required section.
   a. Flat or needle shapes will not be accepted unless the thickness of the individual pieces are greater than 0.33 times the length.

2.02 SAND

A. Gradation: Shall consist of washed sand free of clay lumps or other deleterious materials and meeting the following gradation:

Sieve Size	Percentage Passing
Number 10	100
Number 40	80-100
Number 200	0-3

2.03 GEOTEXTILE FABRIC

A. Manufacturers: One of the following or equal:
   1. Amoco Fabrics and Fibers Company, Amoco 4561.
   2. Contech Construction Products, Inc.; Trevera 011/550.
   3. Nicolon Corporation, Nicolon S1600.
   4. Philips Fibers Corporation, Supac 30 N/P.

PART 3 EXECUTION

3.01 PREPARATION

A. Geotextile fabric:
   1. At the time of installation, the geotextile fabric shall be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.
   2. The surface that is to receive the geotextile fabric shall be prepared to a relatively smooth condition, free of obstructions, depressions, debris, and soft or low-density pockets of material.
   3. Erosion features such as rills and gullies shall be graded out of the surface before geotextile fabric placement.

3.02 INSTALLATION OF THE GEOTEXTILE FABRIC

A. Place geotextile fabric in the manner and at the locations indicated on the Drawings.

B. The geotextile fabric shall be placed with the long dimension parallel to the slope and laid smooth and free of tension, stress, folds, wrinkles, or creases.
   1. The strips of geotextile fabric shall be placed to provide a minimum width of 24 inches of overlap for each joint.
   2. The edge of the top layer of geotextile fabric at the overlap shall be on the side of geotextile fabric strip, which is in the direction of water flow.

C. Temporary pinning of the textile fabric to help hold it in place until the stone protection and embankment fill is placed will be allowed.

D. Remove temporary pins as the stone protection and embankment fill is placed to relieve high tensile stress, which may occur during placement of material on the geotextile fabric.

E. Protect geotextile at all times during construction from contamination by surface runoff.
   1. Replace any geotextile fabric so contaminated with uncontaminated geotextile fabric.
   2. Replace any geotextile fabric that is damaged during its installation.
   3. In no case shall any type of equipment be allowed on the unprotected geotextile fabric.

3.03 INSTALLATION OF STONE PROTECTION

A. Footing trench: Excavate a footing trench along the toe of the slope as indicated on the Drawings.

B. Sand bedding layer: Place and compact sand above the geotextile fabric to a minimum depth of 12 inches prior to placement of stone protection.

C. Stone placement:
   1. Install stone protection to the lines, grades, and the minimum dimensions indicated on the Drawings.
   2. Place rocks so as to provide a minimum of voids and the larger rocks shall be placed in the toe course and on the outside surface of the slope protection.
   3. Place and spread the rock so as not to damage the layer of the geotextile fabric.
      a. The end dumping of rock on slopes or below the water will not be permitted.
      b. Use a hydraulic shovel or similar equipment to place rock on slopes, or below the water.
   4. Place stone protection to the satisfaction of the Engineer, within a tolerance of minus 0 to plus 3 inches as measured using a 10-foot straight edge oriented parallel and normal to slope.

D. At the completion of slope protection work, fill the footing trench with excavated material and compaction of the material will not be required.

3.04 SCHEDULE

A. Unless otherwise indicated on the Drawings the class of rock used shall be:

Location of Placement	Class of Rock
Culvert Outlets	Light
REW Pond Spillway Outlet	Light
Swale Lining	Facing
Headwall Outlet	Light(1)
Notes: (1) Riprap will be set with mortar as indicated in the Drawings.	

END OF SECTION

SECTION 02553

IN PLANT TEMPORARY PUMPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for temporary pumping of water and wastewater flows on plant sites as needed to complete the Work, including but not limited to:
   1. Water leakage testing for concrete structures specified in Section 01759.
   2. Pipe pressure testing.
   3. Field quality control testing of mechanical equipment.
   4. 10-day Operational Test specified in Section 01660.
   5. Final Acceptance Testing specified in Sections 01660 and 01140.

B. Related section:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01660 - Testing, Training, and Commissioning.
      c. Section 01759 - Water Leakage Test for Concrete Structures.
      d. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. National Fire Protection Association (NFPA):
   1. 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

1.03 GENERAL REQUIREMENTS

A. Provide all necessary labor, tools, materials, and supervision to provide temporary pumping and flow control in accordance with the requirements of this Section.

B. Operate and maintain pumping facilities including, but not limited to, pumps, piping, valves, controls, and monitoring until the involved portion(s) of the Work have been completed to the satisfaction of the ENGINEER. Refer to Section 01140 for additional requirements.

C. Pumping water and wastewater in a way that assures that no water is allowed to leak outside of the temporary system or plant facilities. If leakage does occur, pay all fines and reimburse the OWNER for all costs associated with the cleanup of the leakage, as wells as costs associated with legal actions.

D. Accept responsibility for any release of wastewater and for penalties associated with temporary pumping activities, including commissioning, operating, and decommissioning of temporary pumping facilities.

E. Coordinate the placement of the temporary piping and pumping equipment with the OWNER.

F. The means and methods of accomplishing and maintaining the temporary pumping and associated facilities shall be the sole responsibility of the CONTRACTOR.

G. Except as otherwise specified or authorized in writing, no interruption of wastewater flow shall be permitted throughout the duration of the project. CONTRACTOR is responsible for all wastewater overflows during construction of this Work and temporary operations.

H. Take precautions to prevent any potential spillage of wastewater from entering the stormwater system.

I. Temporary pumping operation:
   1. Limited to the months, times, or seasons indicated, unless approved in writing by the ENGINEER.
   2. Continuous operation for 24 hours per day and 7 days per week may be required during the period of Work.

J. Continuously monitor temporary pumping.

K. Provide qualified operators continuously during operation of the temporary systems.

1.04 SUBMITTALS

A. Prepare and submit a project-specific water and wastewater pumping plan with completed water and wastewater pumping checklist.
   1. Be advised that the temporary plan must provide accessibility for pedestrians and vehicular traffic in accordance with OWNER requirements.

B. Water and wastewater temporary pumping plan: Include the following at a minimum:
   1. Capacities and sizes of pumps, standby equipment, and power requirements, if applicable.
   2. Design calculations of the system and selected equipment, including flow, TDH with static head including all friction and minor losses, pump curves showing operating range of flow and TDH at minimum, average, and peak flow.
   3. Standby power generator size and location for electrically driven pumps.
   4. Downstream discharge plan.
   5. Pipe thrust and restraint types, sizes, and locations.
   6. Temporary pipe supports and anchoring required.
   7. Plans for access to temporary pumping locations.
   8. Schedule that shows duration of temporary pumping including milestones for installation, maintenance, and removal of equipment and accessories.
   9. Means and methods of installing, operating, monitoring, and maintaining the temporary pumping.

10. Plan indicating temporary pumping line locations.
    a. Include details showing methods used to protect and identify the temporary pumping lines through the length of the piping route.
11. Detailed plans of a backup system.
12. Address access for pedestrians and vehicular traffic.
13. Mechanical plan showing equipment, valves, pipe sizes and locations, pipe materials, dimensions, vehicle access (where applicable), pedestrian access (where applicable).
14. Schematic drawings and written description of the control system and its' operating sequence.
15. Proposed type and location of collection system plugs.
16. Catalog cut sheets for pumping equipment, pipe and fittings, valves.
17. Emergency response plan.
18. Staffing plan.
19. Spill prevention and cleanup plan.
20. Noise control system.
21. Health and safety plan.
22. Surge or water hammer calculations and attenuation means.
23. Maintenance history of pumps.
24. Operating permits from jurisdictional air quality agency for each engine.

1.05 QUALITY ASSURANCE

A. CONTRACTOR's qualifications:
   1. Minimum 5 years experience in performing substantially similar temporary pumping operations.
   2. Submit evidence of satisfactory operation of temporary pumping facilities similar to those specified in at least 5 separate projects in accordance with the specifications, including references.

B. Fulfillment of the specified experience requirements shall be a condition of acceptance.

PART 2 PRODUCTS

2.01 CAPACITY

A. Pumps, piping and accessories: Of adequate capacity and size to handle the range of wastewater flows from minimum flow to peak flow.

B. Piping, fittings, and all accessories shall withstand 2.0 times the maximum pressure.

C. Maintain on site sufficient equipment and materials to ensure continuous and successful operation of the temporary pumping system.
   1. Have standby pump(s) on site to provide 100 percent redundancy of the temporary system design Peak Flow.
      a. The redundant pump(s) shall be plumbed, fueled, and ready for operation at all times.
   2. Maintain on site a sufficient number of valves, tees, elbows, connections, tools, pipe plugs, piping, and other parts or system hardware to ensure immediate repair or modification of any part of the temporary system as necessary.

2.02 TEMPORARY PUMPS

A. Provide a minimum of 2 pumps: 1 duty and 1 standby.

B. Pump capacity: Sufficient to pump the anticipated peak hour flow with the largest pump out of service.

C. Pumps: Packaged units with a skid base or trailer.

D. Pumps: Fully automatic, self-priming, close-coupled centrifugal units that do not require use of foot valves or vacuum pumps for priming.

E. Pumps shall use oil-lubricated mechanical seal.

F. Pump materials: As follows:
   1. Volute: Cast iron.
   2. Impeller: Cast iron or chromium steel.
   3. Pump shaft: Type 431 stainless steel.
   4. Mechanical seal faces: Silicon carbide.

G. Pumps shall be capable of passing 3-inch diameter solids, rags, rocks, hair, and other debris encountered in municipal wastewater.

H. Pump driver: Diesel engine or 480-V electric engine and include the following:
   1. Minimum 24-hour capacity diesel fuel tank as defined by fuel consumption during peak pumping rate.
   2. Fuel gauge with red warning light when tank approaches empty.

I. Maximum pump speed: Not exceeding 2,200 revolutions per minute.

J. The system shall include the following features:
   1. START/STOP operation.
   2. Instrumentation and controls for operation and monitoring for each pump.

K. Electrical equipment, instrumentation and accessories: Suitable for Class 1 Division 1 or Class 2 Division 1 service as defined by NFPA 820 and based on hazardous area classifications as specified in Section 16050.

L. Comply with applicable air quality regulations.

2.03 TEMPORARY PIPING

A. Use HDPE piping for the temporary pumping system.

B. Piping integrity: 0 leakage.

C. Provide sewage type air release valve at high point in piping and containment spills from valves.

D. Provide temporary ramps constructed over pipelines 6 inches in diameter or less to allow access to driveways.
   1. Bury pipelines larger than 6 inches in diameter crossing driveways, a minimum of 6 inches below the existing ground or pavement surface and backfilled with temporary asphalt concrete.
   2. No driveway access shall be blocked without the written authorization of the OWNER.

2.04 PIPE PLUGS IN NEW OR EXISTING PIPE

A. Pipe diameters 24 inches and smaller: Mechanical plugs with rubber or EPDM gaskets.

2.05 NOISE CONTROL

A. Pumping equipment: Equipped with devices or enclosures for noise attenuation including but not limited to mufflers and/or acceptable noise panels or enclosures.

B. The noise level: At or below 75 decibels on the A-scale at 50 feet from the pumping equipment.

PART 3 EXECUTION

3.01 GENERAL

A. Notify the OWNER a minimum of 15 working days prior to the Work and notify the ENGINEER at least 96 hours prior to pumping or diverting flow in any of the pipelines or laterals.

B. Place pumps, generators, and other equipment on a plastic tarp to protect against spills of petroleum products used by the equipment.

C. Before undertaking temporary pumping operation, verify that temporary system is ready for operation and its readiness is acceptable to ENGINEER.

3.02 PROTECTION

A. Be responsible for all temporarily pumped flows.
   1. Inspect the entire temporary pumping and piping system for leaks or spills at a frequency of not less than 2 times per hour.
   2. Do not shutdown the temporary pumping system between shifts, on holidays or weekends, or during work stoppages without written permission from the ENGINEER.

B. Provide trained and qualified attendants 24 hours per day 7 days per week until the temporary pumping is no longer required. The attendants shall:
   1. Be capable of performing pump and piping maintenance required.
   2. Have cellular phones for communication with the CONTRACTOR and the OWNER in the event of emergencies.

C. No temporary pumping of wastewater to the ground surface, receiving waters, or off-site storm drains that results in soil or groundwater contamination or any potential health hazards shall be permitted.
   1. In the event of any wastewater spill, be responsible for the prompt cleanup and disinfecting of the spill as called for in the wastewater temporary pumping plan.
   2. Compensate the OWNER for the cost of any fines levied as the result of a spill or unauthorized discharge.

D. Implement measures to prevent interference between plant staff and the temporary pumping equipment, pipelines and wastewater.

E. Take precautions to protect all temporary lines from damage.
   1. Clearly identify aboveground portions of the temporary lines by flashers, fencing, or other means to warn of their presence.

3.03 FIELD QUALITY CONTROL

A. Hydrostatic pressure test:
   1. Prior to operation, test each section of discharge piping with maximum pressure equal to 2.0 times the maximum operating pressure.
   2. Conduit test for a duration of 2 hours.
   3. Test using water to be pumped.
   4. The line in service after test if the pressure has been maintained and there are no observable leaks.
   5. Notify ENGINEER at least 48 hours prior to testing.

B. Inspection:
   1. Inspect temporary piping system at a minimum of every hour 24 hours per day.
   2. An attendant/operator shall be present to monitor the operation of the temporary pumps at all times 24 hours per day.
   3. Inspection log: Keep at each pumping location.

3.04 CLEAN-UP

A. The temporary pumping system: Flush, clean and drain prior to dismantling.

B. Dispose of flushing water in approved manner.

C. Disturbed areas: Upon completion of temporary pumping operation, clean disturbed areas, restoring to original condition, including pavement restoration, at least equal to that which existed prior to start of Work.

END OF SECTION

SECTION 02581

PRECAST ELECTRICAL HANDHOLES AND ELECTRICAL MANHOLES

PART 1 GENERAL

1.01 SUMMARY

A. Design, fabricate, and install precast electrical handholes and precast electrical manholes of the size and type indicated on the Drawings and specified.
   1. Construction of cast-in-place concrete electrical structures, including handholes and manholes, are specified in other Sections.

B. Section includes:
   1. Precast polymer concrete handholes and accessories.
   2. Precast portland cement concrete handholes and accessories.
   3. Precast portland cement concrete manholes and accessories.

C. Related sections:
   1. The Contract Documents are complimentary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's work.
   3. The following sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Code Requirements.
      b. Section 01610 - Project Design Criteria.
      c. Section 01612 - Seismic Design Criteria.
      d. Section 02300 - Earthwork.
      e. Section 03150 - Concrete Accessories.
      f. Section 03300 - Cast-in-Place Concrete.
      g. Section 05500 - Metal Fabrications.
      h. Section 06611 - Fiberglass Reinforced Plastic Fabrications.
      i. Section 07110 - Dampproofing.
      j. Section 07900 - Joint Sealants.
      k. Section 08320 - Floor Access Doors.
      l. Section 09960 - High-Performance Coatings.
      m. Section 16050 - Common Work Results for Electrical.
      n. Section 16070 - Hangers and Supports.
      o. Section 16133 - Duct Banks.

D. Alternates:
   1. CONTRACTOR may propose to construct cast-in-place structures in lieu of the precast structures specified.
      a. Obtain ENGINEER's acceptance of this alternative before submitting, providing, or installing.
      b. Submit full information on design and detailing of proposed alternatives including design details and drawings of the same types required by this Section for precast structures.

1.02 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.

C. ASTM International (ASTM):
   1. A 48 - Standard Specification for Gray Iron Castings.
   2. C 857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   3. C 858 - Standard Specification for Underground Precast Concrete Utility Structures.
   4. C 891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
   5. C 1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
   6. C 1037 - Standard Practice for Inspection of Underground Precast Concrete Utility Structures.

D. National Fire Protection Association:
   1. National Electrical Safety Code (NEC).

E. National Precast Concrete Association (NPCA).

F. Society of Cable Telecommunications Engineers (SCTE):
   1. 77 - Specification for Underground Enclosure Integrity.

G. Underwriters Laboratories (UL).

1.03 DEFINITIONS

A. Handhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to reach into, but not enter, the enclosure to install, operate, or maintain equipment or wiring or both. (Reference: NEC, Article 100.)
   1. As used in this Section, “handhole” will refer to a precast electrical handhole.

B. Manhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to enter the enclosure to install, operate, or maintain equipment or wiring or both.
   1. As used in this Section, “manhole” will refer to a precast electrical manhole.

C. Polymer concrete: A composite material consisting of an organic polymer binder mixed with embedded aggregate particles. Also known as “resin concrete”.
   1. Abbreviated “PC” as in “PC HANDHOLE.”

D. Portland cement concrete: A composite material consisting of a portland cement binder, water, admixtures, and a combination of fine and coarse mineral aggregates.
   1. Abbreviated “PCC” as in “PCC HANDHOLE” or “PCC MANHOLE.”

E. Precast concrete: A concrete fabrication designed by a qualified engineer and subsequently fabricated at a qualified fabrication site, which is usually located some distance from the site where the fabrication will be installed.

1.04 SYSTEM DESCRIPTION

A. General requirements for handholes and manholes:
   1. As specified in Section 16050 for general requirements for electrical work.
   2. Provide structures of the sizes and shapes indicated on the Drawings, with layouts, dimensions, and details as indicated on the Drawings and as specified.
   3. Conform to the requirements of:
      a. NEC.
      b. Project regulatory requirements as specified in Section 01410.

B. Polymer concrete handholes:
   1. Load resistance of boxes and covers.
      a. Conform to all provisions of SCTE 77 for Tier 5, 8, 15 or 22 applications as specified in this Section.
         1) Where multiple “Tiers” are specified, handholes shall adequately support compatible covers while providing the highest Tier rating specified.
         2) Load rating of cover for an assembly shall not exceed the load capability of the box below.
         3) Coefficient of friction between cover and box: Not less than 0.50 when measured in accordance with ASTM C 1028.
   2. Testing and certification.
      a. Each handhole to be installed shall have a report certifying that the design and construction of the unit has successfully passed all tests for materials and product performance required by SCTE 77.
         1) Testing and report shall be by a qualified testing agency, independent of the manufacturer. Test report shall bear the seal of a licensed professional engineer.
         2) Provide evidence of UL listing as required under by NEC for products to be provided.

C. Portland cement concrete handholes and manholes:
      a. Load resistance of boxes and covers.
   2. Design requirements: Loads on structures:
      a. In accordance with ASTM C 857, except as modified in this Section.
      b. Loads at the ground surface:
         1) See “Electrical Handhole and Manhole Schedule” indicated on the Drawings for minimum surface loading requirements at each structure. Loads are designated as “sidewalk,” or ”roadway.”
         2) The vehicle and pedestrian loadings in the following paragraphs need not be additive; however structures designated for “roadway” loading shall also support “sidewalk” loads.

3) “Sidewalk”: Load from regular pedestrian traffic with considerations for occasional non-deliberate vehicular traffic:
   a) Designation A-0.3 in ASTM C 857 Table 1; (300 psf uniform load).
4) ”Roadway”: Load from heavy, frequently repeated vehicle traffic:
   a) Designation A-16 in ASTM C 857 Table 1 (AASHTO HS20-44).

c. Lateral earth pressure loads:
   1) Determine in accordance with the following requirements. Include effects of groundwater and seismic accelerations on earth pressures.
      a) Equivalent lateral pressure: 60 pounds per square foot per foot of depth (triangular distribution) plus backfill-induced live load surcharge of 72 pounds per square foot (rectangular uniform distribution).
      b) Surface surcharge load: In accordance with ASTM C 857 A-16 wheel load if such surcharge exceeds backfill loads described in the preceding paragraph.
      c) Groundwater effects: Include groundwater effects on lateral earth pressure loads using design elevation of at surface specified in Section 01610.
         (1) Use equivalent lateral pressure of 90 pounds per square foot per foot of depth (triangular distribution) for soil below the design groundwater elevation.
      d) Seismic acceleration effects:
         (1) Uniform Pressure = 20H, with H = Height of wall.

d. Groundwater and flood loads, and buoyancy effects:
   1) Groundwater: Design for site groundwater elevation taken at the level of finished grade around the structure.
   2) Lateral pressure effects: Determine based on groundwater and flood elevations specified.
   3) Buoyancy: For groundwater and flood conditions, provide factor of safety against flotation of at least 1.20.
      a) If the weight of soil overlying footing projections on the structure is considered to resist flotation, use a buoyant unit weight of soil equal to not more than 60 pounds per cubic foot.
      b) Concrete fill may be provided in bottom section of precast portland cement concrete structures to add weight. Submit proposed details.

e. Soil bearing pressure at base:
   1) Maximum 2,500 pounds per square foot total pressure on prepared subgrade soils

f. Lifting and handling loads:
   1) Make provision in design for effects of loads or stresses that may be imposed on structures during fabrication, transportation, or erection.

g. Load combinations:
   1) Design structures to sustain specified loads individually or in combination.

3. Design requirements: Structural analysis, design and detailing:
   a. General:
      1) Analyze and design structures including effects of 2-way action (“plate action”) and of load transfer around current and future openings.
      2) Where structures include panels designed for future removal (“knockout panels”), design structures for loads and stresses with any combination of any or all such panels in place or removed.
   b. Precast polymer concrete handholes:
      1) Design to resist loads with cover in place or removed.
      2) Detail cover support and top edges to maintain cover in place over walls and to prevent soil from sloughing into the handhole when cover is removed.
   c. Precast portland cement concrete handholes and manholes:
      1) Design structures in accordance with the requirements of ACI 318 and this Section.
      2) Provide reinforcement at all areas subject to tensile stress when loaded with the specified loads and combinations thereof.
      3) Provide temperature and shrinkage reinforcement to equal or exceed ACI 318 requirements in all concrete sections.
      4) Provide minimum clear concrete cover over reinforcement at both interior and exterior faces of all members in accordance with the following:
         a) Handholes: 1.25 inches.
         b) Manholes: 2 inches.
      5) Reinforcement details:
         a) Walls: For structures with wall thickness of 8 inches or less, locate a single mat of reinforcement at the center of the wall.
         b) Slabs: For structures with slab thickness of 7 inches or less, locate a single mat of reinforcement at the center of the slab.
         c) Structures with wall or slab thicknesses exceeding these limits shall have a reinforcement at each face of the member.
      6) Joints:
         a) Provide structures with watertight joints between sections, and detailed to minimize water infiltration at duct bank and conduit penetrations.
         b) Provide structures with non-skid, shiplap or tongue and groove joints between sections.
4. Design requirements : Materials:
   a. Polymer concrete handholes:
      1) Polyester or vinyl ester resin systems designed for use in this application, with resin content a minimum 7% by weight.
      2) All aggregate, sand, and quartz powder shall meet the requirements of ASTM C33, where applicable.
      3) Resin additives such as curing agents, fillers, and thixotropic agents, when used, shall be compatible
      4) Gaskets shall be suitable for the service intended.
   b. Portland cement concrete handholes and manholes:
      1) In accordance with ASTM C 858 except as modified in this Section.

2) Proportion concrete mixes to resist damage from freezing and thawing in a moist environment, and for exposure to deicing chemicals. Conform to ACI 318 requirements for minimum specified compressive strength and air entrainment.
3) Conform to ACI 318 Section 7.7 for minimum concrete cover for reinforcing and Section 12 for proper reinforcing development.

1.05 SUBMITTALS

A. Product data: Manufacturer's catalog data, details, and warranties for the following items.
   1. Polymer concrete handholes:
      a. Materials of construction, and resistance of those materials to water absorption, flammability, sunlight/ultraviolet exposure, and chemicals likely to be found in the area of use.
      b. Available colors.
      c. Details for covers, cover support, and cover attachment to the underlying box.
   2. Portland cement concrete handholes and manholes:
      a. Joint details and joint sealing materials.
      b. Data for hatches or covers and rings.
      c. Preformed channels and accessories for cable racking.
      d. Drain and sump details, including removable covers.
      e. Pulling iron details.

B. Shop drawings:
   1. Polymer concrete handholes:
      a. Manufacturer's catalog cuts showing dimensions and details of construction.
   2. Portland cement concrete handholes and manholes:
      a. Shop drawings for each structure shall bear the seal and signature of a professional engineer licensed in the state where the structures will be installed.
      b. Dimensioned and "to scale" plans, sections, and details for each structure including:
         1) Layout plan for that structure.
         2) Sizes, locations and vertical positions of duct bank windows and knockout panels.
         3) Locations and details for access openings, pulling irons, embedded cable supports and racks, and sumps.
         4) Details of structural reinforcement showing bar size and spacing; true position of reinforcement in structural members with clear concrete cover at both inside and outside faces; location, bar size, and spacing of added reinforcement around openings; and other details relevant to design and fabrication of the structure.
         5) Details of joints between adjacent precast sections, including provisions for overlap and for placement of sealants.

C. Product data: Manufacturer's catalog data, details, and warranties for the following items.
   1. Polymer concrete handholes:
      a. Materials of construction, and resistance of those materials to water absorption, flammability, sunlight/ultraviolet exposure, and chemicals likely to be found in the area of use.
      b. Available colors.
      c. Details for covers, cover support, and cover attachment to the underlying box.
   2. Portland cement concrete handholes and manholes:
      a. Joint details and joint sealing materials.
      b. Data for hatches or covers and rings.
      c. Preformed channels and accessories for cable racking.
      d. Drain and sump details, including removable covers.
      e. Pulling iron details.
      f. Structural calculations:
         1) Submit complete structural calculations for each structure.
         2) Provide calculations bearing the seal and signature of a professional engineer licensed in the state where the structures will be installed.
      g. Manufacturer's statement of materials used for fabrication and construction, in accordance with ASTM C 858, for record. Include the following:
         1) Concrete mix design: For each concrete mix design to be used for the structures, include data describing:
            a) Source and type of cement.
            b) Sources, grading and specific gravities of aggregates.
            c) Aggregate reactivity data.
            d) Concrete mix proportions and design strength.
            e) Type, name, and dosage of all admixtures included in the concrete mix.
         2) Reinforcing steel: Mill certificates.

D. Test reports:
   1. Polymer concrete handholes:
      a. Independent laboratory test reports bearing the seal of a licensed professional engineer and demonstrating compliance with the requirements of SCTE 77 for the loading conditions specified.
   2. Portland cement concrete handholes and manholes:
      a. Fabricator's tests for compressive strength of concrete used in structures, made in accordance with recommendations of ASTM C 858.

E. Certificates:
   1. Polymer concrete handholes:
      a. Manufacturer's certification that polymer concrete handholes in accordance with the requirements of SCTE 77.
   2. Portland cement concrete handholes and manholes:
      a. Manufacturer's current plant certification under NPCA for the structures to be supplied.
         1) Certification shall be current and in-effect at the time structures are manufactured.
      b. Manufacturer's certification that handholes and manholes in accordance with the requirements of ASTM C 858.

F. Manufacturer's instructions:
   1. Instructions for handling and setting structures in place.
   2. Polymer concrete handholes
   3. Portland cement concrete handholes and manholes

G. Manufacturer's field reports:
   1. Portland cement concrete handholes and manholes:
      a. Manufacturer's inspection reports in accordance with ASTM C 1037.

H. Closeout documents:
   1. Project record documents:
      a. Portland cement concrete handholes and manholes:
         1) Final, revised plans and details of as-constructed precast handholes and manholes if requested for record by the ENGINEER.
   2. Warranties.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Designer:
      a. Professional engineer qualified in the design of concrete structures and holding a current license in the state where the structures will be installed.
   2. Manufacturer:
      a. Polymer concrete handholes:
         1) Demonstrating at least 5 years' experience in the design and production of products of the type required for this Work.
         2) Holding product testing records demonstrating load resistance of products to be installed.
      b. Portland cement concrete handholes and manholes:
         1) Holding current NPCA plant certification for the products produced.
         2) Demonstrating at least 5 years' experience in the design, production, and installation of products of the type required for this Work.
         3) Capable of providing structural designs prepared by a professional engineer licensed in the state where the structures will be installed.
         4) Providing inspection during fabrication and handling in accordance with the requirements of ASTM C 1037.
   3. Installer:
      a. Capable of providing equipment of adequate capacity and mobility to handle and set units with proper bearing on the subgrade and without damage to the unit.

1.07 DELIVERY, STORAGE AND HANDLING

A. Packing, shipping, handling and unloading:
   1. Package and brace structures to avoid damage during shipping and handling.
   2. Furnish crane or forklift for unloading and setting of portland cement concrete handholes and manholes.

B. Acceptance at site:
   1. Structures delivered to the site with cracks, damage, and damaged or missing accessories shall be removed from the site and replaced at no additional cost to the OWNER.

C. Storage and protection:
   1. Store handholes and manholes and their appurtenances in areas protected from damage due to weather and site operations.

1.08 PROJECT SITE CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.09 SEQUENCING

A. Coordinate installation of precast electrical handholes and manholes with duct banks specified in Section 16133.

1.10 SCHEDULING

1.11 WARRANTY

A. The manufacturer shall guarantee that the materials and/or the workmanship of the product supplied be free of defects for a period of 5 years from the date of acceptance or date of first beneficial use of the equipment by OWNER, whichever is later.

1.12 SYSTEM START-UP

A. As specified in Section 16050.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cast-in-place concrete for fill at base sections of portland cement concrete manholes with deep sumps or ballast to resist buoyancy shall be Class A concrete as specified in Section 03300.

2.02 MANUFACTURED UNITS - POLYMER CONCRETE HANDHOLES

A. General:
   1. Enclosures, boxes and cover shall conform to all test provisions of SCTE 77.

B. Manufacturers: One of the following, or equal.
   1. Quazite Division of Hubble, Incorporated.

C. Materials:
   1. Polymer concrete with optional fiberglass reinforcement.
      a. Handholes constructed of plastic or fiberglass will not be permitted

D. Components:
   1. Cover:
      a. Provide gasketed cover with lifting slot and stainless steel hex head bolts for attachment to box.
      b. Fasten cover to box using stainless steel hex head bolts.

c. Skid-resistant surface. Coefficient of friction for walking surface on top of cover shall be at least 0.50 when measured in accordance with ASTM C 1028.
d. Custom logo not required.

2. Box:
   a. Open-bottom base unless otherwise indicated on the Drawings.
      1) Stackable sections with interlocking joints to maintain horizontal and vertical alignment.
   b. Provide knockouts, terminators, pulling eyes, and inserts as required for a complete installation.
3. Fabrication:
   a. All components in assembly (boxes and cover) shall be manufactured using matched surface tooling for consistency of production.

E. Load rating:
1. Provide “TIER” rating based on Schedule of Electrical Handholes and Electrical Manholes indicated on the Drawings, and the following loading requirements:

Surface Loading Rating	**Requirements**
“Sidewalk”	“TIER 15” - “Medium Duty” For driveway, parking, and ramp areas where vehicle wheel loads will not exceed 2000 pounds on a single wheel.
“Roadway”	Not allowed. - “Heavy Duty” For highway traffic or AASHTO wheel loads of at least 16,000 pounds.

2. Provide covers with “TIER” rating embossed or cast into the top surface.
3. Design load rating of cover for an assembly may not exceed the design load rating of the box below.

F. Accessories:
1. Provide 2 non-corroding steel lifting hooks for removing covers.

2.03 MANUFACTURED UNITS - PORTLAND CEMENT CONCRETE HANDHOLES AND MANHOLES.

A. General:
1. Provide portland cement concrete handholes and manholes configured and designed as indicated on the Drawings and specified.
2. In accordance with ASTM C 858 unless otherwise noted.

B. Manufacturers: One of the following, or equal:
1. Oldcastle Precast.
2. Jensen Precast.
3. Hanson Precast.

C. Components:
1. Floor:
   a. Construct floors as a monolith.
   b. Where sump or low-point drain is included, slope floor to that point.

2. Roof, walls, and base:
    a. Designed and rated to support vehicle and pedestrian loads at the spans indicated.
    b. See the Electrical Handhole and Manhole Schedule indicated on the Drawings for required load rating by structure location.
3. Access covers:
    a. Handholes:
        1) Load rating:
            a) “Heavy Duty” for covers at locations designated for “Roadway” loads.
            b) “Medium Duty” or stronger for covers at locations designated for “Sidewalk” loads.
        2) Minimum access door size not less than 36 inches square, unless otherwise indicated on the Drawings.
        3) Provide bearing surface with pre-installed continuous elastomeric gasket to minimize water infiltration at lid.
        4) Provide skid-resistant lid with cast-in or machined-in grid pattern and the word “ELECTRICAL” in block letters at least 1.5 inches high.
    b. Manholes: Cast iron frame and cover.
        1) Manhole rings and covers: As specified in Section 05500.
            a) Cover with word “ELECTRICAL” cast into the top exposed face for electrical manholes.
            b) Manhole riser access:
                (1) Heavy duty bottom flange frame with solid cover for placement on grade adjustment rings above top slab
                (2) 36-inch diameter nominal opening.
                Manufacturer: The following or equal.
                    (a) Neenah Foundry Company, R1640-D.
            c) Embedded in top slab of structure:
                (1) Heavy-duty top flange frame with solid cover for embedment in top slab of a structure.
                (2) 36-inch diameter nominal opening.
                (3) Manufacturer: The following or equal.
                    (a) Neenah Foundry Company, R6095.

D. Accessories:
1. Provide accessories as indicated on the Drawings and specified.
2. Materials at duct bank penetrations:
    a. Joint filler as specified in Section 03150.
    b. Backer rod and sealant as specified in Section 07900.
3. Pulling irons:
    a. Provide non-corroding cable pulling irons located for use with each current duct bank location and additional irons for use with duct banks that may be installed though future knockout panels.
    b. Pulling irons may not be located on the floor.
    c. Where pulling irons are installed on the wall, any pockets surrounding the irons shall have bottom surfaces sloped to drain.
    d. Secure pulling eyes to structure reinforcement.
4. Cable racks and racking hardware:
    a. Materials: Fiberglass as specified in Section 16070.
    b. Embedded slots: Maximum depth of 1.5 inches.

5. Sumps and drains:
    a. Fiberglass or HDPE fabrications including removable lids to prevent tripping hazards.
6. Grounding conductor:
    a. Furnish a 4/0bare copper grounding electrode conductor cast into the floor slab of each handhole and manhole.
    b. Provide minimum 8-foot length of exposed conductor for grounding connection to duct bank grounding conductor(s).
7. Exterior dampproofing:
    a. As specified in Section 07110.
    b. Field applied to all wall and roof surfaces exposed to soil.

E. Fabrication:
1. Embeds:
    a. Install embedded items with provisions for drainage to remove dripping or standing water, and to minimize corrosion.
        1) Pulling irons may not be placed on the floor or in pockets that will collect water.
        2) Detail bottom of cable rack channels to provide a downward sloping “sill” at the bottom of each vertical channel, so that the channel slot drains toward the floor.
    b. Concrete cover:
        1) Provide minimum 0.75-inch clear concrete cover between embeds and surrounding reinforcement.
        2) Provide minimum 1.25-inch clear concrete cover between embed and exterior face of wall.

F. Tests, inspections:
1. Test and inspect structures in accordance with ASTM C 858 and C 1037.

PART 3 EXECUTION

3.01 GENERAL

A. Furnish and install precast electrical handholes and manholes as indicated on the Drawings and specified.

B. Install additional handholes and manholes required so installation procedures will conform to cable manufacturer’s pulling tension requirements.
1. Include proposed locations and details of such additional handholes and manholes with the submittals under Part 1.

3.02 PREPARATION

A. Design:
1. Prepare detailed and scalable layouts for each manhole structure showing locations of conduit or duct bank penetrations, clearances, locations, and sizes of access openings, and major accessories.

B. Protection:
   1. Where handhole and manhole structures are installed adjacent to existing site structures or utilities, provide excavation support or other protection as required to maintain those facilities in service and to prevent damage to both existing and new facilities.

C. Site preparation:
   1. Excavate and prepare exposed subgrade as indicated on the Drawings and as specified.
   2. Install and compact foundation layer as indicated on the Drawings and specified.
   3. Level foundation materials so that structures will be set plumb and duct banks will be at proper grade and alignment.
      a. Install with uniform bearing on foundation materials.
      b. Wedging or blocking of base sections for leveling over the foundation materials will not be permitted.

3.03 INSTALLATION

A. General:
   1. Protect handholes and manholes from displacement, flooding, or flotation.

B. Polymer concrete handholes:
   1. Install structures in accordance with the manufacturer's recommendations.
   2. Clean joints between adjacent sections for tight fit.
   3. Set covers at elevations indicated on the Drawings.
      a. Securely attach cover to below-grade box.
   4. Backfill polymer concrete handholes as indicated on the Drawings and as specified.

C. Portland cement concrete handholes and manholes:
   1. Install structures in accordance with ASTM C 891 and the provisions of this Section.
      a. In the event of conflicts, the more restrictive provisions shall apply.
   2. Clean and prime joints between adjacent precast sections.
      a. Install sealing compound between sections and provide watertight joints.
   3. Set covers and hatches at elevations indicated on the Drawings.
      a. Securely attach frames to top of precast structures and grade adjustment rings.
   4. Penetrations:
      a. Holes for duct banks and other penetrations may not be cut into precast handholes and manholes unless they are located at designated locations shown on the shop drawings or at knockout panels cast into the structure during manufacturing.
      b. Carefully remove concrete from knockout panel areas with saws.
         1) Ensure that break-back does not extend beyond the designated limits of the knockout panel.
      c. Coat any reinforcement cut or exposed during removal of knockout panel sections with minimum 2 coats of High Solids Epoxy as specified in Section 09960.
         1) Apply epoxy coating applied over and at least 1-inch past the perimeter of the reinforcement.

5. Install duct banks and conduit penetrations in accordance with the penetration details indicated on the Drawings.
    a. Place all joint fillers, caulks, and sealants before coating exterior concrete surface with bituminous dampproofing.
6. Fill holes that were provided for handling or other temporary purposes with non-shrink cement grout using procedures as specified in Section 03300 unless otherwise detailed by the manufacturer.
7. After structures are set and before backfilling, coat exterior below-grade surfaces (around the sidewalls, over the top slab, and around any vertical risers to grade) with 2 heavy coats of bituminous dampproofing as specified in Section 07110.
    a. Apply dampproofing in accordance with the coating manufacturer's instructions and at a rate of 40 to 60 square feet per gallon per coat.
    b. Mask over and at least 1 inch back from joint caulks or sealants, and prevent dampproofing from coming in contact with those materials.
8. Backfill handholes and manholes specified in Section 02300.

D. Site tolerances:
1. Set electrical handholes and manholes plumb and true at locations indicated on the Drawings.
2. Tolerances on placing:
    a. Horizontal location: Plus or minus 1 inch.
    b. Vertical elevation: Plus or minus 1/2 inch.
    c. Plumb: Plus or minus 1/8 inch over 10 feet.

3.04 REPAIR / RESTORATION

A. Repair cracks or blemishes in concrete as described in Section 03300

3.05 ADJUSTING

A. After final grading is complete, adjust access covers to grade.

3.06 CLEANING

A. Before installation of cables in any duct banks and handholes or manholes, remove all concrete spoil, forms, debris, silt, dust, and other foreign material.

B. Pressure wash interior of structures if required to provide clean interior surfaces.
1. Block drains and provide pumps to remove washwater from structures.
2. Do not permit washwater to drain into subgrade soils.

3.07 SCHEDULES

A. See Drawings for Electrical Handhole and Electrical Manhole Schedule.

END OF SECTION

SECTION 02620

FILTER FABRIC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Non-woven filter fabric.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 4491 - Standard Test Method for Water Permeability of Geotextiles by Permittivity.
   2. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   3. D 5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

1.03 DEFINITIONS

A. Filter fabric: Nonwoven geotextile fabric manufactured from polypropylene fibers.

1.04 SUBMITTALS

A. Product data.

B. Samples.

C. Quality control submittals:
   1. Certificates of Compliance.
   2. Manufacturer's Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection:
   1. Furnish filter fabric in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

1.06 PROJECT CONDITIONS

A. Take field measurements to determine the lengths and dimensions of the surfaces to receive the fabric.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Amoco, Style 4551.
   2. Ten Cate Nicolon, Charlotte, NC, Mirafi 160N.

2.02 MATERIAL REQUIREMENTS

A. Conforming to Section 88-1.02B, Class C of the Standard Specifications.

B. Physical properties: Meet the following minimum requirements:

Property(1)	Test Method	Requirements(1)
Minimum Weight	ASTM D 5261	4.5 ounces per square yard
Grab tensile strength	ASTM D 4632	157 pounds
Grab tensile elongation	ASTM D 4632	50 percent
Minimum Permittivity	ASTM D 4491	1.1 per second
(1) Minimum average roll values.		

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Verify that conditions are satisfactory for the installation of filter fabric.

3.02 PREPARATION

A. Surface preparation:
   1. During grading operations, take care not to disturb the subgrade.
   2. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils.

B. Prior to placement of fabric: Prepare surface to smooth condition free of debris, depressions, or obstructions that may damage the fabric.

3.03 INSTALLATION

A. Follow manufacturer's installation instructions and as complimented herein.

B. Place the filter fabric smoothly without folds or wrinkles.

C. Use special care when placing the filter in contact with the soil so that no void spaces occur between the filter and the prepared surface.

D. Overlap the parallel rolls and ends of rolls a minimum of 24 inches and not less than manufacturer's instructions.

E. Do not drag filter fabric across subgrade.

F. Make overlaps at ends of rolls in the direction of the aggregate placement with the previous roll on top.

G. Use lightweight dozers if necessary. Do not allow equipment directly on filter fabric.

3.04 FIELD QUALITY CONTROL

A. Inspection:
   1. Before covering, the condition of the fabric will be observed by the ENGINEER to determine that no holes or rips exist in the fabric.
   2. Repair all holes and rips by placing a new layer of fabric extending beyond the defect in all directions a distance equal to the minimum overlap required for adjacent rolls.

END OF SECTION

SECTION 02621

STABILIZATION FABRIC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Woven stabilization fabric used for subgrade enhancement.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 3786 - Standard Test Method for Bursting Strength of Textile Fabric - Diaphragm Brushing Strength Tester Method.
   2. D 4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   3. D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   4. D 4833 - Standard Test Method for Index Puncture Resistance of, Geomembranes and Related Products.

1.03 DEFINITIONS

A. Stabilization fabric: Woven geotextile fabric manufactured from polypropylene yarns.

1.04 SUBMITTALS

A. Product data.

B. Samples.

C. Quality control submittals:
   1. Certificates of Compliance.
   2. Manufacturer's Installation Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection:
   1. Furnish stabilization fabric in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

1.06 PROJECT CONDITIONS

A. Field measurements:
   1. Take field measurements to determine the exact lengths and dimensions of the surfaces to receive the fabric.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Ten Cate Nicolon, Charlotte, NC, Mirafi S800.
   2. Amoco Propex.

2.02 MATERIAL REQUIREMENTS

A. Conforming to Section 88-1.02I, Class 8 of the Standard Specifications.

B. Physical properties: Meet the following minimum requirements:

Property (1)	Test Method	Requirements (1)
Grab Tensile Strength	ASTM D 4632	200 pounds
Mullen Burst Strength	ASTM D 3786	400 pounds per square inch
Trapezoid Tear Strength	ASTM D 4533	75 pounds
Puncture Strength	ASTM D 4833	90 pounds
(1) Minimum average roll values.		

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Verify that conditions are satisfactory for the installation of stabilization fabric.

3.02 PREPARATION

A. Surface preparation: During grading operations, take care not to disturb the subgrade. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils.

B. Prior to placement of fabric: Prepare surface to smooth condition free of debris, depressions, or obstructions that may damage the fabric.

3.03 INSTALLATION

A. Follow manufacturer's installation instructions and as complimented herein.

B. Place the stabilization fabric smoothly without folds or wrinkles.

C. Use special care when placing the stabilization fabric in contact with the soil so that no void spaces occur between the stabilization fabric and the prepared surface.

D. Overlap the parallel rolls and ends of rolls a minimum of 24 inches and not less than recommended by manufacturer.

E. Do not drag stabilization fabric across subgrade.

F. Make overlaps at ends of rolls in the direction of the aggregate placement with the previous roll on top.

G. Use lightweight dozers, if necessary. Do not allow equipment directly on stabilization fabric.

3.04 FIELD QUALITY CONTROL

A. Inspection: Before covering, the condition of the fabric will be observed by the ENGINEER to determine that no holes or rips exist in the fabric. Repair all holes or rips by placing a new layer of fabric extending beyond the defect in all directions, a distance equal to the minimum overlap required for adjacent rolls.

END OF SECTION

SECTION 02666

HIGH DENSITY POLYETHYLENE GEOMEMBRANE LINERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: High Density Polyethylene geomembrane waterproofing liner.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01450 - Quality Control.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
   2. D 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement.
   3. D 1004 Test Method for Initial Tear Resistance of Plastics Film and Sheeting.
   4. D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
   5. D 1505 Test Method for Density of Plastics by the Density-Gradient Technique.
   6. D 1603 Test Method for Carbon Black in Olefin Plastics.
   7. D 3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis.
   8. D 4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
   9. D 4437 Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
   10. D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products.
   11. D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
   12. D 5397 Procedure to Perform a Single Point Notched Constant Tensile Load – (SP-NCTL) Test: Appendix.
   13. D 5596 Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
   14. D 5721 Practice for Air-Oven Aging of Polyolefin Geomembranes.

15. D 5885 Test method for Oxidative Induction Time of Polyolefin Geosynthetics by High Pressure Differential Scanning Calorimetry.
16. D 5994 Test Method for Measuring the Core Thickness of Textured Geomembranes.
17. D 6370 Standard Test Method for Rubber-Compositional Analysis by Thermogravimetry (TGA).
18. D 6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
19. D 7238 Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.
20. D 7466 Test Method for Measuring the Asperity Height of Textured Geomembranes.

B. Geosynthetic Institute (GSI):
1. GRI GM13: Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

1.03 DEFINITIONS

A. Batch: Quantity of resin, usually 1 railcar, used in fabrication of high density polyethylene geomembrane rolls with number corresponding to resin batch.

B. Bridging: Condition existing when geomembrane is not in contact with underlying material.

C. Extrudate: High-density polyethylene material produced in form of rods used to extrusion weld panels of geomembrane together.

D. Geomembrane: Very-low permeability synthetic flexible membrane liner barrier used to minimize fluid migration.

E. Geomembrane contractor: Entity responsible of manufacturing, shipping, field handling, transporting, storing, deploying, seaming, temporarily restraining against wind, and installing geomembrane.

F. Geomembrane subsurface: Material surface upon which geomembrane is placed.

G. Quality assurance consultant or testing laboratory: Entity, independent from the CONTRACTOR, responsible for conducting laboratory tests on samples of geomembrane obtained at the site.

H. Panel: Unit of geomembrane area, roll, or portion of roll that will be seamed on the site.

I. Panel layout drawings: Drawings indicating panel numbers, field seams, and details.

J. Subgrade: In situ material.

1.04 SUBMITTALS

A. Product data: Include manufacturer's specifications, description of seaming by extrusion welding and hot wedge welding, descriptive drawings, product

identification, supplier of polymer resin, and recommended method of material handling and storage prior to installation.

B. Quality assurance program: Include polymer resin supplier, product identification, acceptance testing, production testing, installation testing, and documentation of changes, alterations, repairs, retests, and acceptance.

C. Statement of resin and geomembrane production dates.

D. Factory test results and material certification: Demonstrate conformance with Contract requirements and certify that material delivered is similar and of same formulation as that for which test results are submitted.

E. Shop drawings: Include installation drawings, procedures, and schedule, geomembrane sheet layout with proposed sizes, number, position, and sequence of sheet placement, and location of field seams and intermediate and final anchor trenches.

F. Factory visit information: Contact names, telephone numbers, addresses, and production schedule for possible visit by ENGINEER to manufacturing plant during manufacturer of sheets for the Project.

G. Subsurface certification: Certify acceptance of subsurface.

H. Welder certification: Certify availability of each welder's performance record including linear feet of welds completed, number of samples tested and weld test failure rate, and qualifications.

I. Record drawings: Include identity and location of each repair, cap strip, penetration, boot, and sample taken from installed geomembrane for testing.

J. Quality control record: Identify each test by date and sample, date of test, sample location, name of individual who performed test, and standard test method used.

K. Weld test summary report: Show normal distribution of test results, and individual test results identifying high, low, and average of 5 coupon samples for each test.

1.05 QUALITY ASSURANCE

A. Geomembrane contractor qualifications: Manufacturer and installer of geomembranes for minimum 20 projects similar in complexity and size as the Project, and minimum 20 million square feet of geomembrane; employer of the following personnel for the Project:
   1. Superintendent or foreman with minimum experience on 5 projects similar in complexity and size as the Project.
   2. Master welders with minimum of 10,000,000 square feet of geomembrane seaming experience with maximum 2 percent weld failure rate.
   3. Welders with minimum of 1,000,000 square feet of geomembrane seaming experience with maximum 2 percent weld failure rate.

B. Engage and pay for services of Construction Quality Assurance Consultant or Testing Laboratory as specified in Section 01450.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, unload, and store geomembrane with minimum handling.

B. Protect materials from mud, soil, dirt, and debris.

C. Store geomembrane directly on prepared level surface, maximum 3 rolls high.

PART 2 PRODUCTS

2.01 GEOMEMBRANE

A. Manufacturers: One of the following or equal:
   1. Agru America, Georgetown, SC.
   2. GSE Environmental, Houston, TX.

B. Type: First quality unmodified high density polyethylene, designed and manufactured specifically for reservoir and pond lining containing the following:
   1. No plasticizers, fillers, chemical additives, reclaimed polymers, or extenders.
   2. Approximately 2 percent carbon black.
   3. Maximum 1.5 percent anti-oxidants and heat stabilizers.

C. Thickness: 80 mils.

D. Width: Minimum 22.5 feet with no factory seams.

E. Roll identification: Unique number printed on label affixed to inside and outside of roll, and continuous name of manufacturer, thickness, material type, and date of manufacturer printed on membrane.

F. Surface texture: Smooth or textured as indicated on the Drawings.

G. Resin properties:
   1. Specific gravity of resin: Minimum 0.935 grams per cubic centimeter when tested in accordance with ASTM D 1505A/ASTM D 792B.
   2. Melt index of resin: Maximum 1.0 grams per 10 minutes when tested in accordance with ASTM D 1238, Condition E.

H. Membrane properties: As follows:

Properties	Test Method	Test Value							Testing Frequency (minimum)
		30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Thickness (min. ave.)	D5199	Nom.	Nom.	Nom.	Nom.	Nom.	Nom.	Nom.	10 times per roll
lowest individual of 10 values		-10%	-10%	-10%	-10%	-10%	-10%	-10%	
Density mg/l (min.)	D 1505A D 792B	0.935 g/cc	0.935 g/cc	0.935 g/cc	0.935 g/cc	0.935 g/cc	0.935 g/cc	0.935 g/cc	200,000 lb
Melt Flow Index (g/10min) maximum value	D 1238	1.0	1.0	1.0	1.0	1.0	1.0	1.0	per each formulation
Low Temperature Brittleness (°F)[9]	D 746B	-112	-112	-112	-112	-112	-112	-112	N/A
Tensile Properties[1] (min. ave.) yield strength break strength yield elongation break elongation	D 6693 Type IV	63 lb/in. 114 lb/in. 12% 700%	84 lb/in. 152 lb/in. 12% 700%	105 lb/in. 190 lb/in. 12% 700%	126 lb/in. 228 lb/in. 12% 700%	168 lb/in. 304 lb/in. 12% 700%	210 lb/in. 380 lb/in. 12% 700%	252 lb/in. 456 lb/in. 12% 700%	20,000 lb
Tear Resistance (min. ave.)	D 1004	21 lb	28 lb	35 lb	42 lb	56 lb	70 lb	84 lb	45,000 lb
Puncture Resistance (min. ave.)	D 4833	54 lb	72 lb	90 lb	108 lb	144 lb	180 lb	216 lb	45,000 lb
Stress Crack Resistance[2]	D5397 (App.)	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	300 hr.	per GRI-GM10
Carbon Black Content (range)	D 4218[3]	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	2.0-3.0%	20,000 lb
Carbon Black Dispersion	D 5596	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	note (4)	45,000 lb

Properties	Test Value								Testing Frequency (minimum)
	Test Method	30 mils	40 mils	50 mils	60 mils	80 mils	100 mils	120 mils	
Oxidative Induction Time (OIT) (min. ave.)[5] Standard OIT — or — High Pressure OIT	D 3895 D 5885	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	100 min. 400 min.	200,000 lb
Oven Aging at 85°C[5][6] Standard OIT (min. ave.) -% retained after 90 days — or — High Pressure OIT (min. ave.) -% retained after 90 days	D 5721 D 3895 D 5885	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	55% 80%	per each formulation
UV Resistance[7] High Pressure OIT (min. ave.) -% retained after 1600 hrs[8]	D 5885	50%	50%	50%	50%	50%	50%	50%	per each formulation

Notes:

(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gage length of 1.3 inches Break elongation is calculated using a gage length of 2.0 in.
(2) The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
(3) Other methods such as D 1603 (tube furnace) or D 6370 (TGA) are acceptable if an appropriate correlation to D 4218 (muffle furnace) can be established.
(4) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.
(5) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(6) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90-day response.
(7) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(8) UV resistance is based on percent retained value regardless of the original HP-OIT value.
(9) Certification only required.

2.02 RELATED MATERIALS

A. Extrudate: Made from same resin as geomembrane, free of contamination by moisture or foreign matter, additives thoroughly dispersed.

B. Cleaning solvents and adhesives: As recommended by geomembrane manufacturer.

2.03 EQUIPMENT

A. Welding equipment: Equipped with gauges showing temperature at nozzle for extrusion welder, or at wedge for wedge welder.

B. Field tensiometer: Build to ASTM specifications; accompanied by evidence of recent calibration; motor driven with jaws capable of traveling at 2 inches per minute; equipped with gauge that measures force in unit pounds exerted between jaws with digital readout.

C. Punch press: Capable of cutting specimens in accordance with ASTM D 4437.

D. Vacuum box: With transparent viewing window on top and soft, closed-cell neoprene gasket attached to bottom; rigid housing equipped with bleed valve and vacuum gauge; separate vacuum source connected to vacuum box; capable of inducing and holding 5-pound-per-square-inch vacuum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions. Correct conditions detrimental to timely and proper installation of geomembrane.

3.02 PREPARATION

A. Repair damage to geomembrane subsurface during geomembrane deployment or other activities prior to installation.

B. Verify smooth subsurface without protrusions, sharp objects, and deleterious materials. Round excavation and grade change edges to minimum 6-inch radius.

C. Place geomembrane when air temperature is greater than 25 degrees Fahrenheit and increasing, and less than 100 degrees Fahrenheit, unless otherwise accepted by the ENGINEER.

3.03 DEPLOYMENT

A. Assign each deployed panel with simple and logical identifying code consistent with panel layout drawing.
   1. Deploy no more panels than can be welded during same day.
   2. Do not leave temporary tack welded seams overnight.
   3. Shingle panels on slopes with upper panels overlapping lower panels.

B. Orient panels perpendicular to line of slope crest, or down and not across slope. Locate seams parallel to crest or toe of slope for slopes greater than 10 horizontal to 1 vertical at least 6 feet away from crest or toe.

C. Unroll geomembrane panels using methods that will not damage, stretch, or crimp geomembrane.
   1. Protect underlying subsurface from damage.
   2. Use ballast that will not damage geomembrane to prevent wind uplift.
   3. Minimize wrinkles.
   4. Remove folds.

D. Do not engage in activities that may damage geomembrane.
   1. Wear shoes that will not damage geomembrane.
   2. Prohibit smoking while working on geomembrane.

E. Prohibit vehicular traffic directly on geomembrane. Prevent equipment from damaging geomembrane by handling, trafficking, leakage of hydrocarbons, or other means. Do not use geomembrane surface as work area, for preparing patches, storing tools and supplies, or other uses. Spread out protective cover as work area when needed.

F. Provide sufficient material to allow for geomembrane shrinkage and contraction to avoid bridging. Obtain ENGINEER's acceptance of methods used to determine amount of additional material.

3.04 SEAMING

A. Use seam coding system that is compatible with panel coding system.
   1. Require master welders to supervise other welders during welding operations.

B. Clean geomembrane surface of grease, moisture, dust, dirt, debris, or other foreign material with solvents or adhesives. Overlap panels by minimum 4 inches at welds. Weld seams to outside edge of panels placed under anchor berms or in anchor trenches.

C. Cut fishmouths or wrinkles at seam overlaps to achieve flat overlap. Extrusion weld or patch cut fishmouths or wrinkles where overlap is more than 3 inches. With less than 3-inch overlaps, use oval or round patch that extends at least 6 inches beyond cut in every direction.

D. Weld seams only when ambient temperature is between 35 and 110 degrees Fahrenheit as measured 6 inches above geomembrane surface unless otherwise accepted by the ENGINEER.

E. Extrusion welding:
   1. Tack bond adjacent panels together using procedures that do not damage geomembrane, allow required tests to be performed, and are not detrimental to final seaming.
   2. Free welding apparatus of heat-degraded extrudate before welding.
   3. Abrade geomembrane surface no more than 1/4 inch beyond weld bead area with disc grinder, or equivalent, not more than 1/2 hour before extruding seam.
   4. Bevel top edges of 60-mil thick geomembrane or thicker at 45 degrees using hand held grinders.

5. Grind ends of seams more than 5 minutes old when restarting weld.
6. Do not grind more than 10 percent of liner thickness.

F. Hot-wedge seaming:
1. Use automated, vehicular-mounted welding apparatus, equipped with devices giving applicable temperatures and pressures.
2. Grind edges of cross seams to smooth incline, top and bottom, prior to welding.

G. Trial welds:
1. Perform on geomembrane to verify welding equipment operations and performance of seaming methods and conditions.
2. Make minimum 2 trial welds per day or shift per welding apparatus.
3. Make minimum trial welds prior to start of work and at mid shift.
4. Make welds under same surface and environmental conditions as production welds.

H. Trial weld testing:
1. Cut 4-foot long by 2-foot wide sample with seam centered lengthwise.
2. Cut three 1-inch wide test strips from trial weld.
3. Test each specimen in field for peel and shear.
4. Retain remaining sample for future testing.
5. For double-wedge welding, test both welds individually.

3.05 FIELD QUALITY CONTROL

A. Conformance testing by testing laboratory:
1. Obtain one sample, 3-foot long by entire width of roll, excluding first 3 feet, per 100,000 square feet.
2. Perform test to determine geomembrane density, thickness, tensile strength, carbon black content, and carbon black dispersion.

B. Other testing by CONTRACTOR:
1. Non-destructively test field seams over full length using vacuum test unit, air pressure for double fusion seams only, or other methods acceptable to ENGINEER.
2. Perform vacuum, air-pressure, spark testing as seaming progresses.

C. Vacuum testing:
1. Use equipment consisting of 2 vacuum box assemblies with rigid housing, transparent viewing window, soft neoprene gasket attached to bottom, port hole or valve assembly, vacuum gauge, vacuum pump assembly with pressure control, rubber pressure and vacuum hose with fittings and connections, soapy solution and applicator.
2. Brush soapy solution on geomembrane.
3. Place vacuum box over wetted seam area.
4. Ensure leak-tight seal.
5. Apply vacuum of approximately 5 pounds per square inch.
6. Examine geomembrane through viewing window for presence of soap bubbles for minimum 15 seconds.
7. Mark areas where soap bubbles appear.
8. Repair defective areas.

D. Air pressure testing for double seams with enclosed space:
   1. Use equipment consisting of manual or motor driven air pump with pressure gauge capable of generating and sustaining pressure over 25 pounds per square inch and mounted on cushion to protect geomembrane, rubber hose with fittings and connections, sharp hollow needle, or other ENGINEER-accepted pressure feed device, and pressure gauge with accuracy of 1 pound per square inch.
   2. Seal both ends of seams to be tested.
   3. Insert needle or other pressure-feed device acceptable to ENGINEER into channels created by double-wedge welds.
   4. Energize air pump to minimum pressure of 25 pounds per square inch, close valve, and sustain pressure for minimum 5 minutes.
   5. When pressure loss exceeds 2 pounds per square inch or does not stabilize, locate and repair defective area.
   6. Puncture opposite end of seams to release air.
   7. When blockage is present, locate and test seam on both sides of blockage.
   8. Remove needle or other pressure-feed device acceptable to ENGINEER and seal penetration holes by extrusion welding.

E. Spark testing:
   1. Test extrusion welded seams that cannot be tested by vacuum box.
   2. Place 24-gauge copper wire 1/8 inch under top sheet overlap.
   3. Test with Holiday detector operating at 20,000 volts.

F. Destructive test sampling:
   1. Collect one 18- by 36-inch sample with seam centered lengthwise, per 500 feet of seam length where directed by testing laboratory.
   2. Testing laboratory will number each sample, mark sample number and location on panel layout drawing, and cut sample into 3 equal parts: 1 for OWNER, 1 for CONTRACTOR, and 1 for testing laboratory testing.
   3. Immediately repair holes in geomembrane resulting from sampling.
   4. Vacuum test repaired area for continuity.

G. Laboratory testing: Testing laboratory will:
   1. Test seam welds from samples for peel adhesion and shear strength in accordance with ASTM D 4437.
   2. Test minimum 5 coupons from each sample for each test method.
   3. Test adjacent coupons by different testing methods.
   4. Test both welds of double-wedge seam samples.
   5. Declare failure when welds exhibit film tearing bond type of separation before geomembrane or when shear strength and peel adhesion fails to withstand the following minimum stresses:

Test	**Minimum Acceptable Stress (lbs/inch width)**			
	40 mil	**60 mil**	**80 mil**	**100 mil**
Shear Strength	86	126	171	216
Peel Adhesion				
Wedge Weld	57	84	114	144
Extrusion Weld	48	70	95	120

6. Notify parties of Contract of testing results verbally within 24 hours and in writing within 7 days of receipt of samples.

H. Repair defective seams uncovered by testing by one of the following methods:
   1. Reconstruct seams between 2 passed test locations.
   2. Trace welds to intermediate locations at least 10 feet or to where seams end, in both directions from failed test locations.
      a. Check adjacent seams welded using same welding device when required to obtain additional samples.
      b. Take bounding samples for testing.
      c. When bounding samples pass, reconstruct seams between passed test locations.
      d. When bounding samples fail, repeat process until additional bounding samples pass.

I. Reconstruct seams by extrusion welding of previously wedge welded seams, cap stripping of seams, or replacing seams with new 1-foot wide panels and welding in place, or other ENGINEER-accepted method.

3.06 REPAIR OF DEFECTS

A. Examine geomembrane for defects, holes, blisters, undispersed raw materials, and signs of contamination by foreign matter.
   1. Clean geomembrane surfaces during examination.
   2. Repair and non-destructively test suspect locations.
   3. Do not cover geomembrane at locations that have been repaired until accepted by the ENGINEER.

B. Remove and replace geomembrane that cannot be satisfactorily repaired with new.

C. Repair portions of geomembrane exhibiting flaws, or failing testing by one of the following methods or ENGINEER-accepted method:
   1. Patching: For holes larger than 3/8-inch diameter, tears over 2 inches long, undispersed raw materials, and contamination by foreign matter.
   2. Abrading and re-welding: For small seam section less than 12 inches long.
   3. Spot welding: For small tears less than 2 inches long, pinholes, or other minor, localized flaws.
   4. Capping: For large lengths of failed seams.
   5. Replacement with new: For unsatisfactory materials.

D. For extrusion welds only, repair geomembrane surfaces to be repaired within 1/2 hour of being abraded.
   1. Extend patches or caps at least 6 inches beyond edges of defects.
   2. Round corners of materials to be patched and patches to minimum 3-inch radius.
   3. Cut geomembrane below large caps to avoid water or gas collection between 2 sheets.

E. Verify repairs by testing as determined by testing laboratory.

END OF SECTION

SECTION 02742A

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Asphalt pavement on prepared subgrade or aggregate base course to lines, grades and compacted thickness as indicated on the Drawings.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 02050 - Soils and Aggregates for Earthwork.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft. lbf/f_4^3)(2,700 kN-m/m^3).
   2. D 1561 - Standard Practice for Preparation of Bituminous Mixture Test Specimens by Means of California Kneading Compactor.

B. Caltrans Standard Test Methods:
   1. Calif Test 202 - Sieve Analysis of Fine and Coarse Aggregates.
   2. Calif Test 304 - Preparation of Bituminous Mixtures for Testing.
   3. Calif Test 362 - Determining Asphalt Content in Bituminous Mixtures by Vacuum Extraction.
   4. Calif Test 375 - Determining the In-Place Density and Relative Compaction of AC Pavement.
   5. Calif Test 379 - Determining Asphalt Content in Bituminous Mixtures (Troxler Nuclear Gauge Model 3241).

C. State of California Department of Transportation Standard Specifications, latest edition (Caltrans Standard Specifications):
   1. Section 37 - Bituminous Seals.
   2. Section 39 - Asphalt Concrete.
   3. Section 88 - Engineering Fabrics.
   4. Section 92 - Asphalts.
   5. Section 93 - Liquid Asphalts.
   6. Section 94 - Asphaltic Emulsions.

1.03 SYSTEM DESCRIPTION

A. This Work shall consist of furnishing and mixing aggregate and asphalt binder at a central mixing plant, spreading and compaction of the mixture as specified and as indicated on the Drawings.

B. In general, asphalt concrete and asphalt concrete base shall conform to Section 39 “Asphalt Concrete,” and all applicable referenced sections, of the Caltrans Standard Specifications:
   1. Where conflicts exist, this specification shall govern.

1.04 DEFINITIONS

A. “Asphalt Concrete” as used by Caltrans shall be considered the “Surface Course,” or the final lift of the pavement section.

B. “Asphalt Concrete Base” as used by Caltrans shall be the remaining portion of the asphalt pavement section excluding the final lift.

C. “Asphalt Pavement” shall be the total pavement section of asphalt including Asphalt Concrete and Asphalt Concrete Base.

1.05 SUBMITTALS

A. Mix design.

B. Shop drawings.

C. Product Data:
   1. Asphalt.
   2. Asphalt aggregate.
   3. Pavement reinforcing fabric.

D. Quality control submittals:
   1. Test results.
   2. Certificate of Compliance.
   3. Certificate of Competence.

E. Equipment list.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Asphalt pavement delivery:
   1. Transport the mixture from the mixing plant to the point of use in vehicles having tight bodies previously cleaned of all foreign materials.
   2. Treat bodies as necessary to prevent material from sticking to the bodies.
   3. Cover each load with canvas or other suitable material of sufficient size and thickness to protect the asphalt mixture from the weather.

1.07 PROJECT CONDITIONS

A. Environmental requirements:
   1. Asphalt concrete:
      a. Place asphalt concrete only when surface is dry, when atmospheric temperature in the shade is 40 degrees Fahrenheit and rising, or above 50 degrees Fahrenheit if falling.
      b. Do not place asphalt concrete when weather is foggy or rainy nor when base on which material is to be placed is in wet or frozen conditions or when, in the opinion of the ENGINEER, weather conditions will prevent proper handling, finishing, compaction of the mixtures.

1.08 SEQUENCING

A. As specified in Section 01140.

PART 2 PRODUCTS

2.01 ASPHALT PAVEMENT MATERIALS

A. Asphalts:
   1. Asphalt binder: Steam-refined paving asphalt, PG 64-10,conforming to Section 92-1.02 “Grades” of the Caltrans Standard Specifications.
   2. Tack coat: Grade SC-70, conforming to Section 93-1.01 of the Caltrans Standard Specifications.
   3. Fog seal: Asphaltic emulsion, Grade SS-1h, conforming to Section 94-1.01 of the Caltrans Standard Specification.

B. Asphalt aggregate:
   1. Aggregate for asphalt concrete shall conform to Section 39-2.02 of the Caltrans Standard Specifications for Type B grading, 1/2-inch maximum, medium.
   2. Aggregate for asphalt concrete base shall conform to Section 39-2.02 of the Caltrans Standard Specifications for Type B grading.
   3. Aggregate for HMA Dikes shall be 3/8-inch maximum.

C. Asphalt pavement shall be produced in a batch mixing plant, a continuous pugmill mixing plant, or drier-drum mixing plant:
   1. Storage shall conform to section 39-3.01 and Section 39-3.05 of the Caltrans Standard Specifications.
   2. Drying shall conform to Section 39-3.02 of the Caltrans Standard Specifications.
   3. Proportioning shall conform to Section 39-3.03 of the Caltrans Standard Specifications.
   4. Mixing shall conform to Section 39-3.04 of the Caltrans Standard Specifications.

2.02 FOG SEAL

A. A fog seal shall be applied to all surfaces of Types A and B asphalt concrete in conformance with the provisions in Section 37-1, and all applicable referenced sections of the Caltrans Standard Specifications.

2.03 AGGREGATE BASE COURSE

A. Aggregate base course: As specified in Section 02050.

B. Aggregate base course shall be placed at the following locations:
   1. At all locations indicated on the Drawings.
   2. All asphalt pavement.

C. Compacted thickness of aggregate base course shall be as indicated on the Drawings.

2.04 EQUIPMENT

A. Spreading and compacting equipment:
   1. Spreading equipment shall conform to Section 39-5.01 and all applicable referenced sections, of the Caltrans Standard Specifications:
      a. Only in areas inaccessible to the machine, by approval of the ENGINEER, will hand spreading be permitted.
   2. Compaction equipment shall conform to Section 39-5.02 and all applicable referenced sections, of the Caltrans Standard Specifications.

2.05 SOURCE QUALITY CONTROL

A. The ENGINEER will perform sampling and tests of materials in accordance with California Test Method Number 304 and California Test Method Number 362 or 379, as applicable. Samples will be taken from materials as delivered to the site.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Verify surfaces and site conditions are ready to receive work. If unsatisfactory conditions exist, do not commence installation until such conditions have been corrected. Beginning application means acceptance of existing conditions.

3.02 PREPARATION

A. Protection:
   1. Protect concrete pavements and walks, curbs and bases, and other improvements adjacent to the operations with suitable materials.
   2. Building and other surfaces shall be covered with paper or other protection, when required.
   3. CONTRACTOR shall be responsible for any damage caused by CONTRACTOR's employees. All damage caused by the CONTRACTOR's operations shall be repaired to the satisfaction of the ENGINEER at no additional cost to OWNER.

B. Subgrade preparation:
   1. Immediately prior to applying tack coat, or immediately prior to placing the asphalt pavement when tack coat is not required, the subgrade to receive asphalt pavement shall conform to the compaction requirement and elevation tolerances specified for the material involved and shall be cleaned to remove any loose or extraneous material.

2. If the asphalt pavement is to be placed on an existing base or pavement which was not constructed as part of the contract, the CONTRACTOR shall clean the surface by sweeping, flushing or other means to remove all loose particles of paving, all dirt and all other extraneous material immediately before applying the tack coat.

3.03 TACK COAT

A. Tack coat:
   1. A tack coat of asphaltic emulsion shall be applied to all vertical surfaces of existing pavement, curbs, gutters, and construction joints in the surfacing against which additional material is to be placed, or as otherwise specified in this Section.
   2. Tack coat shall be applied in one application at a rate of 0.1 gallon per square yard of surface covered.

3.04 ASPHALT PAVEMENT

A. Placing materials in a windrow, then picking it up and placing it in the asphalt paver with loading equipment will be permitted provided that:
   1. The asphalt paver is of such design that the material will fall into a hopper which has a movable bottom conveyor to feed and screed.
   2. The loader is constructed and operated so that substantially all of the material deposited into windrows is picked up and deposited into the paving machine.
   3. The windrow is deposited only so far in advance of the paver to provide for continuous operation of the paver and not so far as to allow the temperature of the asphalt pavement in the windrow to fall below 260 degrees Fahrenheit.

B. Unless lower temperatures are directed by the ENGINEER, asphalt concrete shall be spread, and the first coverage of initial or breakdown compaction shall be performed when the temperature of the mixture is not less than 250 degrees Fahrenheit, and all breakdown compaction shall be completed before the temperature of the mixture drops below 205 degrees Fahrenheit.

C. Asphalt pavement shall be spread and compacted in the number of layers and of the thicknesses indicated in the following table:
   1. A thickness tolerance of within 0.1 inch is allowed for asphalt concrete.
   2. A total thickness tolerance of within 0.2 inch is allowed for asphalt concrete base.

Total Thickness Indicated on Drawings(1)	Number of Lifts	Top Layer Thickness		Next Lower Layer Thickness		All Other Lower Layer Thicknesses	
		Min	Max	Min	Max	Min	Max
3”	2	1-1/4”	1-1/2”	1-1/4”	1-1/2”	1	-
3-1/4” - 4-3/4”	2	1-3/4”	2-1/4”	1-3/4”	3”	-	-
> 5”	(2)	1-3/4”	2-1/4”	1-3/4”	3”	1-3/4”	4-3/4”

Notes:
(1) When pavement reinforcing fabric is shown to be placed between layers of asphalt pavement, the thickness of asphalt pavement above the pavement reinforcing fabric shall be considered to be the “Total Thickness Indicated on the Drawings” for the purpose of spreading and compacting the asphalt pavement above the pavement reinforcing fabric.
(2) At least 2 layers shall be placed if the total thickness is less than 5 inches. At least 3 layers shall be placed if the total thickness is more than 5 inches, and less than 10-1/2 inches. At least 4 layers shall be placed if the total thickness is greater than 10-1/2 inches.

D. A layer shall not be placed over another layer which exceeds 3 inches in compacted thickness until the temperature of the layer which exceeds 3 inches in compacted thickness is less than 160 degrees Fahrenheit at mid-depth:
   1. If the temperature of any layer drops below 140 degrees Fahrenheit, or if directed by the ENGINEER, apply tack coat before placing next layer.

E. Unless otherwise indicated on the Drawings, asphalt mixtures shall not be handled, spread, or windrowed in a manner that will stain the finished surface of any pavement or other improvements.

F. The completed mixture shall be deposited on the prepared subgrade at a uniform quantity per linear foot, as necessary to provide the required compacted thickness without resorting to spotting, picking-up or otherwise shifting the mixture.

G. Spreading:
   1. All layers of asphalt pavement shall be spread with an asphalt paver and shall conform to Section 39-6.02 and all applicable referenced sections of the Caltrans Standard Specifications.
   2. At locations where the asphalt pavement is to be placed over areas inaccessible to spreading and rolling equipment, all layers of asphalt pavement shall be distributed directly out of the back of the dump truck and spread by hand:
      a. Asphalt pavement spread by hand shall be compacted thoroughly to the required lines, grades, and cross-sections by means of pneumatic tampers, or by other methods that will produce the same degree of compaction as pneumatic tampers.

H. Compaction:
   1. Compaction of asphalt pavement shall conform to Section 39-6.03 and all applicable referenced sections of the Caltrans Standard Specifications.
   2. Minimum required density for each layer of asphalt pavement shall be 95 percent of that obtained in the laboratory in accordance with ASTM Test Method D 1561.

I. Segregation shall be avoided and the surfacing shall be free of pockets of coarse or fine material. Asphalt pavement containing hardened lumps shall not be used:
   1. In areas inaccessible to paving and compacting equipment where spreading is done by hand, minimize the amount of segregation.

J. Location of longitudinal joints in the top layer will be determined by the ENGINEER and shall not adversely affect the quality of the finished product.

K. At all locations, or as directed by the ENGINEER, the asphalt concrete shall be square and at least 1 inch thick when conforming to existing surfacing. Tapering or feathering is not allowed.

3.05 FIELD QUALITY CONTROL

A. The CONTRACTOR shall control the quality of Work and shall provide adequate testing to assure compliance with these Specifications:
   1. The type and size of the samples shall be suitable to determine conformance with stability, density, thickness and other specified requirements. Use an approved power saw or core drill for cutting samples. Furnish all tools, labor,

and materials for cutting samples, testing, and replacing the pavement where samples were removed. Take a minimum of 1 sample for every 4,000 square feet of asphalt pavement placed.

B. All asphalt pavement shall match the grades indicated on the Drawings and shall be completely free from unintended hollows and high spots:
   1. After completion of paving work, all paving shall be flooded with water. Any ponding that results in standing water greater than 3/4 inch in depth shall be ringed with chalk. Such hollows shall be corrected by removing and replacing the asphalt concrete. The asphalt concrete patch shall be square and at least 1 inch thick when conforming to existing surfacing. Tapering or feathering is not allowed.

C. CONTRACTOR shall perform in-place density and compaction tests of the completed pavement in accordance with California Test Method Number 375, to determine compliance with the specified requirements. Submit test results to ENGINEER for approval.

D. Cracks, settling of surface, improper drainage, improper compaction, and sloppy connection to previously laid surfaces will be construed as improper workmanship and will not be accepted.

3.06 MAINTENANCE OF PAVEMENT

A. Upon completion of final rolling, traffic shall not be permitted on the finished pavement for at least 6 hours, or until the asphalt pavement has cooled sufficiently to withstand traffic without being deformed.

3.07 WORKMANSHIP AND WARRANTY

A. CONTRACTOR shall provide written warranty against defects in materials or workmanship for a period of not less than 1 year upon completion of Work.

END OF SECTION

SECTION 02762

PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Pavement marking requirements for striping, text, and graphics; traffic signs.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 6628-01 - Standard Specification for Color of Pavement Marking Materials.
   2. D 6359-99 - Standard Specification for Minimum Retroreflectance of Newly Applied Pavement Marking Using Portable Hand-Operated Instruments.

B. State of California Department of Transportation:
   1. PTWB-01R2 - Paint, Rapid Dry Waterborne Traffic Line, White, Yellow and Black.

C. State of California Office of Construction Contract Standards:
   1. Standard Specification Section 84 - Traffic Stripes and Pavement Markings.
   2. Standard Specification Section 85 - Pavement Markers.

1.03 SUBMITTALS

A. Product data.

B. Manufacturer's instructions.

1.04 QUALITY ASSURANCE

A. Applicator qualifications: Minimum 5 years experience of applying traffic markings with satisfactory performance record.

B. Regulatory requirements: Comply with applicable requirements of governmental agencies having jurisdiction, including airborne emissions and industrial waste disposal requirements.

C. Comply with Caltrans Specification PTWB-01R2 and State Standard Specification Sections 84 and 85.

1.05 PROJECT CONDITIONS

A. Apply pavement marking paint when:
   1. Pavement is clean and thoroughly dry.
   2. Ambient temperature is above 40 degrees Fahrenheit.
   3. Precipitation is not expected within 12 hours of completion of application.

PART 2 PRODUCTS

2.01 PAVEMENT MARKING PAINT

A. Manufacturers: One of the following manufacturers or equal:
   1. Dunn-Edwards Corporation, Los Angeles, CA.
   2. Glidden Company, Cleveland, OH.
   3. Sherwin Williams Company, Cleveland, OH.

B. Materials:
   1. Pavement marking paint, latex based: One of the following or equal:
      a. Dunn-Edwards: No. W 801, Vin-L-Stripe, epoxy-modified acrylic-latex based paint.
      b. Glidden: 63240 Series, UltraHide Latex Traffic Paint.
      c. Sherwin Williams: Set fast acrylic water borne traffic marking paint.
   2. Masonry conditioner: One of the following or equal:
      a. Sherwin Williams: B46WZ1000, Masonry Conditioner.
   3. Colors:
      a. Text: White.
      b. Parking dividers: White.
      c. Handicap zone markings: Blue and white.
         1) Blue paint: As specified in Section 2-1720 of California Administrative Code Title 24 Handicap Regulations.
      d. Accessible parking dividers and accessible route: Yellow.
      e. Directional arrows: White.
      f. Driving lane dividers: White.
      g. Conform to ASTM D6628-01 and ASTM D6359-99.

2.02 TRAFFIC SIGNS

A. Manufacturers: One of the following or equal:
   1. Seton Name Plate Co., Branford, Connecticut.
   2. Emedco, Buffalo, New York.

B. Material, shapes, and graphics: Post mounted baked enamel on steel sheet, reflectorized to show the same shape and color both day and night, with mounting holes, in accordance with the Uniform Traffic Control Devices manual. Fasten sign to post with stainless steel bolts.

2.03 FIRE HYDRANT MARKERS

A. Manufacturers: One of the following or equal:
   1. Stimsonite.

B. Each hydrant shall be identified by a blue reflective dot located on a non-skid surface located just off of center on the fire hydrant side.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove dirt, oil, grease, and other materials which may affect paint adhesion.

B. Apply masonry conditioner on weathered or sandblasted surfaces, brick, or stucco.

3.02 APPLICATION

A. Apply paint at package consistency whenever possible. Thin paint as little as possible.

B. Apply paint with specifically designed and manufactured equipment for pavement marking. Provide:
   1. Uniform straight edges without overspray.
   2. Four inch wide lines, unless indicated otherwise.
   3. Hatching in handicap parking areas.

C. Provide striping between parking stalls as indicated on the Drawings:
   1. Identify parking spaces with text as indicated on the Drawings:
      a. Visitor spaces: “VISITOR”

D. Apply paint to obtain thickness recommended by paint manufacturer.

E. Paint traffic control markings, including striping, directional arrows, cross walks and lettering, bike lane striping, and handicap striping and symbols as indicated on the Drawings and in accordance with local governing agency's standards. Use stencils for arrows, lettering, and symbols.

F. Apply 700 square inch international handicap symbol on pavement surface where indicated on the Drawings:
   1. On asphalt surfaces, paint blue symbol on white square.
   2. On concrete surfaces, paint white symbol on blue square.

G. Install traffic signs including fire lane signs where indicated on the Drawings. Set post in concrete to depth to resist sign damage from wind speed of 100 miles per hour.

END OF SECTION

SECTION 02772

CONCRETE CURBS, GUTTERS, AND SIDEWALKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete curbs, gutters, sidewalks, driveways, access ramps, and alley intersections.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 02050 - Common Work Results for Earthwork.
      b. Section 03150 - Concrete Accessories.
      c. Section 03300 - Cast-In-Place Concrete.
      d. Section 03366 - Tooled Concrete Finishes.

1.02 SYSTEM DESCRIPTION

A. Performance requirements: Construct various types of concrete curb, gutter, sidewalk, driveways, and alley intersections to dimensions and details indicated on the Drawings.

1.03 SUBMITTALS

A. Product data: Submit data completely describing products.

B. Samples: Submit samples when requested.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete: Class A, as specified in Section 03300.

B. Curb finishing mortar: 1 part portland cement to 2 parts sand.

C. Form release material: Light oil or other releasing agent of type that does not discolor concrete or interfere with the application of finishing mortar to curb tops and faces.

D. Joint materials:
   1. Expansion: As specified in Section 03150.
   2. Construction: Steel dividers or plastic inserts.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Verify field conditions, including subgrade condition and interferences, before beginning construction.

3.02 PREPARATION

A. Surface preparation:
   1. Subgrade:
      a. Construct and compact true to grades and lines indicated on the Drawings and requirements as specified Section 02050.
      b. Remove soft or unsuitable material to depth of not less than 6 inches below subgrade elevation and replace with satisfactory material.
   2. Forms and subgrade: Water immediately in advance of placing concrete.

3.03 INSTALLATION

A. Special techniques:
   1. CONTRACTOR's option:
      a. Construct concrete curbs and gutters by conventional use of forms, or by means of curb and gutter machine when acceptable to the ENGINEER.
      b. When use of machines designed specifically for work of this Section are accepted by the ENGINEER, results must be equal to or better than those produced by use of forms.
      c. Applicable requirements of construction that apply to use of forms also apply to use of machines.
      d. Discontinue use of machines when results are not satisfactory to the ENGINEER.

B. Forms:
   1. Carefully set to line and grade and securely stake in position forms conforming to dimensions of items to be constructed.
   2. Thoroughly clean prior to each use and coat with form releasing material.

C. Expansion and contraction joints:
   1. Expansion joints:
      a. Construct vertically, and at right angles to centerline of street and match joints in adjacent pavement or sidewalks.
      b. Constructed at radius points, driveways, alley entrances, and at adjoining structures.
      c. Fill joints with expansion joint filler material.

2. Weakened-plane joints:
    a. Constructed as indicated on the Drawings.
    b. Make joints of construction joint material, scoring or saw cutting to depth of not less than 1-1/2 inches and matching joints in adjacent pavement or sidewalk.

D. Concrete:
1. Placing:
    a. Thoroughly spade concrete away from forms so that no rock pockets exist next to forms and so that no coarse aggregate will show when forms are removed.
2. Compacting:
    a. Compact by mechanical vibrators accepted by the ENGINEER.
    b. Continue tamping or vibrating until mortar flushes to surface and coarse aggregate is below concrete surface.
3. Form removal:
    a. Front form faces: Do not remove before concrete has taken initial set and has sufficient strength to carry its own weight.
    b. Gutter and rear forms: Do not remove until concrete has hardened sufficiently to prevent damage to edges. Take special care to prevent damage.
4. Finishing and curing: Comply with requirements as specified in Section 03366 except as modified here:
    a. As soon as curb face forms are stripped, apply finishing mortar to the top and face of curb and trowel to a smooth, even finish. Finish with fine haired broom in direction of work.
    b. Where curb is installed without integral gutter, extend finish 2 inches below grade.
    c. Edge concrete at expansion joints to 1/4 inch radius.
    d. Flow lines of gutters shall be troweled smooth 4 inches out from curb face for integral curb and gutter and 4 inches on both sides of flowline for gutters without curbs.
    e. Sidewalks and ramps: Broom finish.

E. Backfilling:
1. Unless otherwise specified, backfill behind curbs, gutters, or sidewalks with soil native to area and to lines and grades indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Tests:
1. Curbs and gutters:
    a. Test face, top, back, and flow line with 10-foot straightedge or curve template longitudinally along surface.
    b. Correct deviations in excess of 1/4 inch.
2. Gutters:
    a. Frequency of testing: When required by the ENGINEER, where gutters have slope of 0.8 foot per 100 feet or less, or where unusual or special conditions cast doubt on capability of gutters to drain.

b. Test method: Establish flow in length of gutter to be tested by supplying water from hydrant, tank truck, or other source.
c. Required results:
   1) 1 hour after supply of water is shut off, inspect gutter for evidence of ponding or improper shape.
   2) In the event water is found ponded in gutter to depth greater than 1/2 inch, or on adjacent asphalt pavement, correct defect or defects in manner acceptable to the ENGINEER without additional cost to the Contract.

3.05 ADJUSTING

A. Repair portions of concrete damaged while stripping forms or, when damage is severe, replace such work at no additional cost to the Contract. Evidence of repairs shall not be noticeable in the finished product.

B. Remove and replace sections of work deficient in depth or not conforming to requirements indicated on the Drawings and specified in the Specifications at no additional cost to the Contract. Removal and replacement shall be the complete section between 2 joints.

END OF SECTION

SECTION 02776

PRECAST CONCRETE CURBS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Precast concrete curbs or parking bumpers.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03300 - Cast-in-Place Concrete.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   2. C 150 - Standard Specification for Portland Cement.

1.03 SUBMITTALS

A. Shop drawings.

B. Product data.

C. Field sample: Include configuration and dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete: As specified in Section 03300 with minimum 4,000 pounds per square inch compressive strength at 28 days containing portland cement in accordance with ASTM C 150, low alkali.

B. Reinforcing: In accordance with ASTM A 615, Grade 60 steel, Number 3 bars.

C. Bonding agent: Approved epoxy resin cement.

D. Hold-down pins: In accordance with ASTM A 615, Grade 60 steel, plain Number 4 bar by 24 inches long.

2.02 FABRICATION

A. Precast concrete curbs: In accordance with local highway standards; approximately 8-inch base width; 6-inch top width; 72-inch base length; 70-inch top length; 3/4- to 1-inch radius top/side edges; 2 reinforcing bars at 3 inches on center, 2 inches from base, 1-1/2-inch concrete cover at ends; holes to accommodate pins at 4 inches from curb ends.

PART 3 EXECUTION

3.01 INSTALLATION

A. Set back of curbs at property line, unless otherwise indicated on the Drawings.

B. Drill holes for hold-down pin in portland cement paving.

C. Embed precast concrete curbs in continuous bead of bonding agent on pavement.

D. Anchor precast concrete curbs with at least 2 steel hold-down pins through holes cast in curbs. Drive hold-down pins until pins are flush with top of curb.

E. When installing curbs on natural earth or gravel surfaces, place minimum 24-inch diameter by 24-inch deep concrete foundation around each hold-down pin.

END OF SECTION

SECTION 02820

FENCES AND GATES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fence, framework, fabric, and accessories.
   2. Excavation for post bases and concrete foundation for posts.
   3. Manual gates and related hardware.
   4. Gate operators.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01060 - Regulatory Agency and Utility Requirements.
      b. Section 01500 - Temporary Facilities and Controls.
      c. Section 09960 - High-Performance Coatings.
      d. Section 17100 - Control Strategies.
      e. Section 17101 - Specific Control Strategies.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
   2. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   4. A 385 - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
   5. A 392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
   6. A 702 - Standard Specification for Steel Fence Posts and Assemblies, Hot-Wrought.
   7. F 626 - Standard Specification for Fence Fittings.
   8. F 668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
   9. F 1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.
   10. F 1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.

B. State of California Department of Transportation (Caltrans).

1.03 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Gate operator controls:
      a. In addition to standard controls furnished with gate operators, make provisions for and provide terminal connection points for controls indicated on the Drawings and clearly indicate such connection points on operator control terminal board.
      b. Operational sequence: Provide sequence as specified in Section 17100.

B. Provide protective fencing as specified Section 01060. Protective fencing is referred to as ESA fencing on the Drawings.

C. Provide temporary fences and gates in accordance with Section 01500.

1.04 SUBMITTALS

A. Product data: Submit data completely describing products.

B. Shop drawings:
   1. Remote and automatic gates: Submit drawings showing connection details indicating methods and means of mounting, attaching, and installing operators and locks to gates, including wiring diagrams.

C. Quality control submittals:
   1. Certificates of compliance: Provide certification that materials conform to referenced specifications.
   2. Qualifications: Provide installer's references and list of local references.
   3. Manufacturer's instructions: Provide for gate operator equipment.

D. Contract closeout submittals:
   1. Operation and maintenance manuals: Provide for electrical and mechanical equipment.

1.05 QUALITY ASSURANCE

A. Pre-installation conference: Participate in conference, if required.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and handling: Unload, store, and protect materials such that they are not damaged.

1.07 PROJECT CONDITIONS

A. Field measurements:
   1. Verify actual field distances so that CMU column and post spacing can be made uniform.
   2. Verify and coordinate gate opening and column distances for driveway.

1.08 WARRANTY

A. The manufacturer shall guarantee that the materials and/or the workmanship of the equipment supplied be free of defects for a period of 5 years from the date of acceptance or date of first beneficial use of the equipment by OWNER, whichever is later.

PART 2 PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Chain link fence and gates: One of the following or equal:
   1. Master-Halco.
   2. Allied Tube and Conduit.

B. Commercial black roller security gate: One of the following or equal:
   1. Master Halco.
   2. Ameristar.

2.02 MATERIALS

A. Chain link fence:
   1. Fabric:
      a. Height:
         1) Plant Fence: 6 feet 0 inch.
      b. Mesh: 2 inches for all fence without privacy slats.
      c. Size wire: 9 gauge.
         1) Coating: Zinc coating, ASTM A 392, Class 1.
         2) Tensile strength: 80,000 pounds per square inch minimum.
   2. Framework: In accordance with ASTM F 1043 Group 1A or 1C. Pipe shall be straight and conform to the following weights:

Pipe Size Outside Diameter (Inches)	Group IA Weight (Lbs/ft)	Group IC Weight (Lbs/ft)
1-5/8	2.27	1.84
1-7/8	2.72	2.28
2-3/8	3.65	3.12
2-7/8	5.79	4.64
3-1/2	7.58	5.71
4	9.11	6.56
6-5/8	18.97	-
8-5/8	24.70	-

      a. Top rail:
         1) Size: 1-5/8 inches outside diameter.
         2) Tension wire: 7-gauge galvanized coil spring wire.

b. Line posts:
   1) Size: 2-3/8-inch outside diameter.
c. Terminal, corner, and pull posts:
   1) Size: 2-7/8-inch outside diameter.
d. Coatings:
   1) Group IA: External coatings in accordance with ASTM F 1043 Type A; internal coatings in accordance with ASTM F 1043 Type A.
   2) Group IC: External coatings in accordance with ASTM F 1043 Type B; internal coatings in accordance with ASTM F 1043 Type D.

3. Accessories:
   a. Fence fittings: In accordance with ASTM F 626.
      1) Post top fittings:
         a) Provide post caps that fit snugly over posts to exclude moisture. Provide dome style caps for terminal posts and loop style caps for line posts.
      2) Rail and brace ends: Provide pressed steel or malleable castings that are cup shaped to receive rail and brace ends.
   b. Fabric accessories:
      1) Wire clips: Minimum 6 gauge hot-dip galvanized.
      2) Tension bars: 1/4 inch by 3/4 inch, galvanized.
      3) Steel bands: 11 gauge, 1 inch wide, hot-dip galvanized.
      4) Bolts and nuts: 3/8-inch diameter.
      5) Hog rings: 11 gauge.
   c. Privacy screen:
      1) Fencescreen 200 Series Enviro Privacy Screen, or equal.
      2) Locations as indicated on the Drawings.
      3) Color as indicated by the ENGINEER.
      4) Install per manufacturer recommendations.
      5) Fence slats will not be acceptable.

B. Chain link gates:
   1. Gate posts and concrete foundations for gate posts: Except where differently indicated on the Drawings, determine gate posts and concrete foundations for gate posts in accordance with following schedule:

Gate Leaf Widths (Feet)	**Gate Posts**	**Foundations**	
	Post O.D. ASTM F 1043 Group IA or IC (Inches)	**Diameter (Inches)**	**Depth (Feet)**
0 to 6	2-7/8	12	4
Over 6 to 13	4	18	3
Over 13 to 18	6-5/8 (Group IA)	18	4
Over 18 to 25	8-5/8 (Group IA)	18	4.5

   2. Chain link gates:
      a. Located as shown on the Drawings.
      b. Frames and center supports: 1-7/8-inch outside diameter galvanized steel pipe that in accordance with ASTM F 1043 Group IA or IC.

c. Gate accessories:
   1) Post top fittings:
      a) Provide post caps that fit snugly over posts to exclude moisture.
      b) Provide dome style caps for terminal posts and loop style caps for line posts.
   2) Corner fittings: Heavy pressed steel or malleable castings.
   3) Gate tensioning:
      a) Cross tensioning rods: 3/8 inch, galvanized.
      b) Turnbuckles: Heavy duty.
   4) Tension rods for 4-foot gates: 3/8 inch, easily adjustable, galvanized.
   5) Gate frame corner fittings: Fitting designed for purpose, Manufacturer's standard.
   6) Horizontal gate stiffeners: 1-7/8-inch outside diameter galvanized steel pipe that in accordance with ASTM F 1043 Group IA or IC.
   7) Gate hardware:
      a) Catch and locking attachment: Combination steel or malleable iron catch and locking attachment of acceptable design.
      b) Stops:
         (1) Type 1: Capable of holding gates open.
         (2) Type 2: Center rest with catch.
      c) Color: Match color of fabric.

2.03 MANUFACTURED UNITS

A. Special gates:
   1. Black roller security gates:
      a. Manufacturer: One of the following, or equal:
         1) Master Halco.
         2) Ameristar.
      b. Slide type complete with gate support, 6-inch heavy-duty V-groove wheels with sealed bearings and post mounted guide rollers sized for a clear opening as shown in the Security Gate Schedule.
      c. Designed in accordance with UL 325.
      d. Gate: Steel construction, 6 feet high.
      e. Gate Posts: Size, number, and foundation of posts per gate manufacturer’s recommendations.
      f. Gate Frame: Top and side rails 3-inch by 3-inch by 1/4-inch thick steel. Picket rails 2-inch by 2-inch by 1/4-inch thick steel. Bottom rail 3-inch by 4-inch by 1/4-inch thick steel. Provide 1/2-inch diameter adjustable rod with turnbuckle. Picket rails spaced at a maximum of 5 inches on center.
      g. Fabricated to operate along a V-groove track embedded in concrete runway as shown on the Drawings.
      h. Equipped with guide rails and post-mounted guide rollers sized for proper gate construction and operation.
      i. Shop welded by arc-gas shield method. Provide welds that are smooth and clean. No weld residue will be allowed.
      j. Outside gate operator stands.
      k. Provide 1 Knox switch system with proper access at the main entrance gate as required by CAL FIRE/SLOCFD standards.

2.04 EQUIPMENT

A. Black roller security gates:
   1. Gate operator equipment:
      a. Main Entrance gate:
         1) Manufacturer: Hy Security, SlideDriver 40, or equal.
         2) Tag number: 05-GAT-820.
      b. Service Entrance gate:
         1) Manufacturer: Hy Security, SlideDriver 15, or equal.
         2) Tag number: 06-GAT-840.
      c. Designed in accordance with UL 325.
      d. Motors: Totally enclosed, high starting torque, rated 460V, 60Hz, three phase. Motor horsepower as required by gate furnished, minimum rated 1 hp. Provide soft stop feature to prevent shock loads to the gate and drive.
      e. Gate Operator furnished for each movable gate slide as indicated on the Drawings. Two new gate operators to be provided and installed.
      f. Provided with open and closed contacts. Digital input and output signals to interface with Access Control Cabinet. SCADA system interface by others.
      g. Operator designed to move gate at a speed of 1.2 feet per second.
      h. Operation by means of rigid metal drive rail passing between two metal drive wheels, each driven by its own hydraulic motor. Provide polyurethane wheel tread on drive wheels.
      i. Gate Operator Drive Rail: Extruded 6061 T6 aluminum, not less than 1/8 inch thick. Incorporate alignment pins for ease of replacement or splicing. Pins enable a perfect butt splice. Coordinate installation with security gate supplier.
      j. Operators provided with all required appurtenances to interface with control systems described herein.
      k. Housed in heavy-duty NEMA 3R, galvanized sheet metal, all weather enclosure with hinged cover and provisions for padlocking. Mounting bolts concealed in the interior of the operator.
      l. Supplied with adjustable torque limit switches, adjustable rotary limit switches, and emergency disconnects for manual operations in case of power failure.
      m. Hydraulic Hose: 1/4 inch synthetic, rated to 2,750 psi.
      n. Hydraulic Valves: Individually replaceable cartridge type, in an integrated hydraulic manifold.
      o. Hose Fittings: Quick-disconnect type at manifold, others swivel type.
      p. Hydraulic Fluid: High performance type with viscosity index greater than 375.
      q. Pressure Gauge: 0 to 2,000-psi range, mounted on manifold for diagnostics.
      r. Provide pneumatic release option for manual operation of gate during power failure.
   2. Card reader:
      a. Located as indicated on the Drawings.
      b. Provide stands containing phone handset connected to in-plant communication system.
      c. Provide conduit, wires, and mounting support to achieve a complete and working system.

2.05 FABRICATION

A. Shop finishing:
   1. Fences and chain link gates:
      a. Galvanizing: For items not fabricated of galvanized materials hot-dip galvanize products after fabrication in accordance with following as applicable:
         1) ASTM A 123.
         2) ASTM A 153.
         3) ASTM A 385.
      b. Mark galvanized products with name of galvanize, applicable ASTM designation, and weight of zinc coating.
      c. Galvanize fabricated items complete, or in largest practicable sections.
      d. Provide galvanizing at rate of 2.0 ounces per square foot, minimum.
      e. Hardware:
         1) Padlocks: Cadmium plated.
         2) Chain: Galvanized.
      f. Field finish touch-up painting:
         1) Galvanized repair paint: Apply paint having minimum dry film thickness of 2.0 to 3.5 mils.
   2. Black roller security gates:
      a. Coat security gate per Specification Section 09960.
      b. Coat gate operator enclosure with an epoxy and polyurethane system per Specification Section 09960, and manufacturer's recommendations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Verify field conditions prior to construction.

3.02 PREPARATION

A. Surface preparation:
   1. Before locating fence posts grade ground to permit grade of fence to remain constant over any local elevations or depressions in ground line.

3.03 INSTALLATION

A. Chain link fences and gates:
   1. General:
      a. Install chain link fence and gates as indicated on the Drawings and specified in this Section.
      b. Provide fence systems that are plumb, taut, true to line and grade, and complete in all details.
      c. Install fencing to generally follow finish grade of ground and provide pull posts at points where required to conform to change in grade.
      d. Install fencing such that space between bottom of fence and finish ground line does not exceed 3 inches.
   2. Concrete foundation for fence posts:
      a. Set fence posts in concrete foundations, that extend at least 3 feet into ground, and space posts not over 10 feet apart.

b. Provide concrete foundations having minimum of 10 inches in diameter for line posts and 12 inches in diameter for corners and gates.
c. Provide foundations that extend minimum of 1 inch above finish grade and have tops that are shaped to slope to drain away from posts.
d. Trowel finish tops of footings, and slope or dome to direct water away from posts.
e. Set keepers, stops, sleeves, tracks, eye bolts, and other accessories into concrete as required.
f. Wheel rolling area for sliding gates shall be steel-trowel smooth finish concrete.

3. Post bracing:
   a. End corner, pull, and gate posts: Brace with same material as top rail and trussed to line posts with 3/8-inch rods and tighteners.
   b. Bracing end, corner, slope, and gate posts:
      1) Brace to midpoint of nearest line post or posts with horizontal braces used as compression members.
      2) Then from such line posts truss from brace back to bottom of end, corner, slope, or gate post with 3/8-inch steel truss rods with turnbuckles or other suitable tightening devices used as tension members.
4. Top rail:
   a. Unless otherwise specified or indicated on the Drawings, install fencing with top rail and bottom tension wire.
5. Fabric:
   a. Place fabric on outward facing side of the posts and install so that top edge projects over top rail of fence.
   b. Stretch fabric taut and securely fasten to posts, top rail, and bottom tension wire.
   c. Install tension wire parallel to line of fabric.
   d. Fabric: Connect fabric to:
      1) Line posts with wire clips minimum every 14 inches.
      2) Terminal, corner, and gate posts with tension bars tied to posts minimum 14 inches on center and with steel bands and bolts and nuts.
      3) Tension wires with hog rings minimum 24 inches on center.

B. Black security roller gates:
1. Install roller gate, complete with gate operator equipment and gate yoke.
2. Install gates so that gate overhangs 2 feet on both sides of roadway.
3. Motor operator controls:
   a. Install manually operated switches where indicated on the Drawings.
   b. Install switch station stands where indicated on the Drawings.
4. All equipment secured neatly and firmly in place, cleaned, lubricated, and adjusted in perfect working order.
5. All field control components, card reader system, and closed circuit television control circuits interconnected to achieve a complete working system.
6. All wiring, except detector loops, provided in raceways.
7. Detector loops laid out in a neat, symmetrical pattern. Provide standard copper wire with water and oil resistant thermoplastic insulation. Install wires with concealed connections and sealed grooves.

8. Seal pavement over all detector and emergency loops with 3M “Detector Loop Sealant,” Prseco Industries “Gold Label Flex,” or equal.
9. Coat exposed surface of equipment in accordance with Section 09960.

3.04 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

C. Components shall not infringe adjacent property lines.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's field service: Manufacturer shall check and test all powered gates and accessories before acceptance.

3.06 ADJUSTING

A. Adjust gate travel, stops, and operator position to meet field conditions.

3.07 CLEANING

A. Clean up surplus dirt, concrete, and other waste material and dress grade up upon completion of the work.

3.08 PROTECTION

A. Protect installed fences and gates against damage and, if damaged, repair prior to final acceptance.

END OF SECTION

BLACK ROLLER SECURITY GATE SCHEDULE

The Security Gate Schedule is not a gate take-off list.

Operator Tag Numbers	Reference Drawing	Minimum Clear Opening (ft)	Control	Appurtenances	Remarks
05-GAT-820	03C03	40’-0”	OL, SC, AV, TC	CR, CCTV	Main Entrance
06-GAT-840	03C03	25’-4”	OL, XL, SC, TC	CCTV	Service Entrance

Definitions:

1. Control Loops
   a. EL = Free Entrance Loop
   b. XL = Free Exit Loop
   c. OL: Obstruction Loop
   d. SC = SCADA
   e. AV = Automatic Vehicle Identification Access System
   f. TC = Time Controlled
2. Appurtenances
   a. CR = Card Reader
   b. CCTV = Close Circuit Television

SECTION 02836

INTERLOCKING BLOCK RETAINING WALL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete modular interlocking block retaining wall.

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 01410 - Regulatory Requirements.
   c. Section 01612 - Seismic Design Criteria.
   d. Section 02300 - Earthwork.
   e. Section 02352 - Geogrid Reinforcement for Interlocking Block Retaining Wall.

1.02 REFERENCES

A. ASTM International (ASTM):
1. C 90 - Standard Specification for Loadbearing Masonry Units.
2. C 140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.

1.03 SYSTEM DESCRIPTION

A. Design requirements:
1. Design and install concrete modular retaining wall in accordance with manufacturer's suggested design procedure.
2. Seismic lateral force requirements: Design to meet the requirements of Section 01612.
   a. Design retaining walls in accordance with the building code as specified in Section 01410 and Section 01612.

1.04 SUBMITTALS

A. General: Submit as specified in Section 01330.

B. Product data:
1. Latest edition of manufacturer's specifications for proposed materials, method of installation, and list of material proposed for use.

C. Shop drawings and calculations:
   1. Shop drawings including design calculations prepared by the manufacturer of the modular units.
   2. Calculations: Submit engineering structural design calculations for retaining walls, sealed and signed by a licensed registered Structural Engineer licensed in the state where the project is located.

D. Samples:
   1. Samples of all products specified in this Section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prevent excessive mud, wet cement, epoxy, and similar materials that may affix themselves from coming in contact with the modular units.

B. Protect the materials from damage.
   1. Damaged materials shall not be incorporated into the retaining wall structure.
   2. Damaged materials shall be removed from the jobsite upon discovery.

1.06 SEQUENCING AND SCHEDULING

A. Order units well before start of installation to ensure adequate time for manufacturing and curing before start of installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Keystone Retaining Wall Systems, Standard.
   2. Anchor Wall Systems, Anchor Diamond Pro or Anchor Vertica.

2.02 CONCRETE UNITS

A. Concrete units: In accordance with ASTM C 90 and ASTM C 140.

B. Compressive strength:
   1. Concrete units shall have a minimum compressive strength of 3,000 psi at 28 days.
   2. The concrete shall have a maximum moisture absorption of 8 percent.

C. Exterior dimensions may vary in accordance with ASTM C 90.

D. Units shall have angled sides capable of concave and convex alignment curves with a minimum radius of 3.5 feet. Where applicable for straight walls, use non-angled straight side cap units.

E. Standard unit: 8 inches high by 18 inches wide, unless otherwise indicated on the Drawings, or other sizes as needed to minimize cutting.

F. Cap units: 3 or 4 inches high. Provide straight-sided or beveled as required and indicated on the Drawings for curved walls and angles.

G. Color: Integral natural concrete gray. Ensure exposed-to-view finish surfaces of concrete block units are uniform in color and appearance.
   1. Manufacturers: One of the following or equal:
      a. Pavestone, Winters, California, 530-795-4400.
      b. Keystone Retaining Walls, Murrieta, California, 619-571-9868.

2.03 BASE LEVELING PAD MATERIAL

A. Material shall consist of compacted sand, gravel, or aggregate base course.
   1. Pea gravel shall not be used.

2.04 UNIT FILL

A. Fill for units shall be drain rock, Class 2 permeable or aggregate base course as specified in Section 02300.
   1. Gradation of the fill shall be approved by the ENGINEER.

B. Place recommended fill behind the retaining wall units.
   1. Pea gravel shall not be used.

2.05 BACKFILL

A. Do not use unsuitable soils for backfill or in the reinforced soil mass.
   1. Use backfill as specified in Section 02300.

2.06 MISCELLANEOUS

A. Materials such as adhesives and pins shall be in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavate to the lines and grades indicated on the Drawings. Take care to not disturb embankment materials beyond lines indicated on the Drawings.

3.02 FOUNDATION SOIL PREPARATION

A. Excavate foundation soil as required for leveling pad dimensions recommended by manufacturer.

B. Foundation soil shall be approved by the ENGINEER to confirm that the actual soil conditions meet or exceed assumed design strength.
   1. Soils not meeting required strength shall be removed and replaced with acceptable material.

C. Fill over-excavated areas with compacted backfill material.

3.03 BASE LEVELING PAD

A. Place leveling pad materials to a minimum thickness of 6 inches.

B. Material shall be compacted so as to provide a level surface on which to place the first course of units.
   1. Compaction shall be to 95 percent of Standard Proctor for sand or gravel type materials.
   2. For crushed rock, material shall be densely compacted.

C. Prepare leveling pad to ensure complete contact of retaining wall units with base. Gaps shall not be allowed.

3.04 UNIT INSTALLATION

A. Erect units in accordance with manufacturer's printed instructions and as specified.

B. First course of concrete wall units shall be placed on the prepared base material.
   1. Units shall be checked for level and alignment.
   2. The top of all units shall be at the same elevation.

C. Ensure that the units are in full contact with base.

D. Place units side by side for full length of wall alignment. Alignment may be done using a string line or offset of wall line.

E. Fill all voids at units with fill material.

F. Sweep all excess material from top of units and install next course.
   1. Ensure each course is completely filled, backfilled, and compacted prior to proceeding to next course.

G. A minimum of 12 inches of free-draining backfill shall be placed behind the units.

H. As appropriate where wall changes elevation, units can be stepped with grade or turned into the embankment with a convex return end.
   1. Provide appropriate buried units on compacted leveling pad in area of convex return end.

3.05 PARAPET WALL UNIT INSTALLATION

A. Product: One of the following or equal.
   1. Keystone Retaining Wall Systems, Compac.

B. Parapet wall shall be between 42 inches and 45 inches high from top of walking surface to top of cap unit.

C. Erect units in accordance with manufacturer's printed instructions and as specified.

D. Use mortar to fill block cells if recommended by manufacturer.

E. First course of concrete wall units shall be placed on the prepared base material.
   1. Units shall be checked for level and alignment.
   2. The top of all units shall be at the same elevation.

F. Ensure that the units are in full contact with base.

G. Place units side by side for full length of wall alignment. Alignment may be done using a string line or offset of wall line.

H. Fill all voids at units with fill material.

I. Sweep all excess material from top of units and install next course.
   1. Ensure each course is completely filled and compacted prior to proceeding to next course.

3.06 CAP UNIT INSTALLATION

A. Apply construction adhesive to the top surface of the unit below and place the cap unit into desired position.

B. Backfill and compact to finish grade.

3.07 GEOSYNTHETIC REINFORCEMENT

A. Where required by manufacturer, install soil reinforcement as specified in Section 02352.

3.08 ADJUSTING AND CLEANING

A. Replace damaged units with new units during construction.

B. Remove debris caused by this construction and leave adjacent areas broom clean.

END OF SECTION

SECTION 02939

SEEDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Seeding.
   2. Hydromulching.
   3. Erosion-control material(s).

1.02 REFERENCES

A. Association of Official Seed Analysts (AOSA).

B. United States Department of Agriculture (USDA).

C. United States Environment Protection Agency (EPA).

1.03 DEFINITIONS

A. Duff layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish grade: Elevation of finished surface of planting soil.

C. Manufactured topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Surface soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

I. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Russian Thistle, Leafy Spurge, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Weed, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass, and all weeds listed on the San Luis Obispo County website:
   1. http://www.slocounty.ca.gov/agcomm/Weed_Control/SLO_County_s_Weed_Management_Area/Invasive_Weeds_of_SLO_County.htm.

1.04 SUBMITTALS

A. Product data: For each type of product indicated.
   1. Pesticides and herbicides: Include product label and manufacturer's application instructions specific to this Project.
   2. Fertilizer and organic matter: Include product label and manufacturer's application instructions specific to this Project.
   3. Soil amendment: Analysis.

B. Certification of grass seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
   1. Certification and inspection as required by governmental authorities of the seed mixture defined in Article 2.01 of this Specification. Include identification of source and name and telephone number of supplier.

C. Qualification data: For qualified landscape Installer.

D. Samples: Imported topsoil, organic matter, erosion control blanket, and mulch.

E. Product certificates: For soil amendments and fertilizers, from manufacturer.

F. Maintenance instructions: Recommended procedures to be established by OWNER for maintenance of turf and meadows during a calendar year. Submit before expiration of required initial maintenance periods.

1.05 QUALITY ASSURANCE

A. Installer qualifications: A qualified landscape Installer whose work has resulted in successful turf and meadow establishment.
   1. Professional membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Experience: 5 years' successful experience in the installation of seeded areas similar in size to this project.
   3. Installer's field supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel certifications: Installer's field supervisor shall have certification in all of the following categories from the Professional Landcare Network:
   a. Certified Landscape Technician - Exterior, with installation and irrigation specialty area(s).
5. Maintenance proximity: Not more than 2 hours' normal travel time from Installer's place of business to Project site.
6. Pesticide applicator: State licensed, commercial.

B. Soil-testing laboratory qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil. Refer to plan notes for number and location of soil analysis tests.
   1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
   2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from ENGINEER.
      a. A minimum of 3 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
   3. Report suitability of tested soil for turf growth.
      a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated.
         1) State recommendations in weight per 1,000 square feet or volume per cubic yard for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
      b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Pre-installation conference: Conduct conference at project site.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Seed and other packaged materials:
   1. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
   2. Protect seed during delivery and storage.
   3. Seed that has become wet or otherwise damaged will not be acceptable.

B. Deliver packaged materials in waterproof bags showing weight, chemical analysis and name or trademark of manufacturer.
   1. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, percentage of purity (PLS), percentage of germination and location of packaging.

C. Local sourcing of seed not in sealed containers is permitted for smaller projects.

D. Bulk materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

E. Truck receipts: For verification of all soil amendments and imported topsoil.

1.07 SITE CONDITIONS

A. Planting restrictions: Plant during 1 of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date.
   1. Non-irrigated seed areas: Seed from November to March in order to take advantage of rain.

B. Coordinate with CONTRACTOR’s work requiring access to site over existing vegetation areas.
   1. No trucking or moving of equipment or materials shall be permitted over completed seed areas.

C. Coordinate with installation of all underground system piping and outlets.

D. Weather limitations:
   1. Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained.
   2. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.08 WARRANTY

A. Warranty:
   1. Guarantee all seeding to be alive and healthy for 2 years following date of final completion by the ENGINEER.
   2. Seeded areas shall have an even stand of grass with germination, over 100 percent of the site within 45 days of seeding.
   3. All seeded grass areas are to be assured of obtaining a satisfactory stand of growth.
   4. The total area occupied by bare spots larger than 0.25 square feet must not exceed 10 percent of the total seeded area.
   5. Maximum single bare spot size of irrigated seed 3 inches by 3 inches.
   6. Maximum single bare spot size of non-irrigated seed is 1 square foot.
   7. All seeded grass areas that do not meet the satisfactory stand of growth qualification shall be reseeded and mulched.

B. Replace seeding when it is no longer in a satisfactory condition or do not meet the preceding standard as determined by the ENGINEER or the duration of the Guarantee/Warranty Period.
   1. Make replacements as soon as possible within the recommended seeding schedule.

C. Replacements:
   1. Seed of same mix, quality, and species as originally specified, as soon as possible within the recommended seeding schedule, with a new 1-year warranty commencing on date of replacement.
   2. Repairs and replacements shall be made at no expense to the OWNER.

PART 2 PRODUCTS

2.01 SEED

A. Grass seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed species:
   1. Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed.

Hydroseed Species for LOWRF		
Species	**Common Name**	**Application Rate (lbs/acre)**
Festuca Rubra "Molate"	Molate Native Red Fescue	14
Calandrina Ciliata	Red Maids	2
Deschampsia Elongatum	Slender Hairgrass	6
Deschampsia Cespitosa	Tufted Hairgrass	6
Eschscholzia Californica	Cailfornia Poppy	3
Koelaria Macrantha	Junegrass	6
Lupine Nanus	Sky Lupine	4
Melica Californica	California Oniongrass	5

   2. The percentage of material, other than grass seed in the mixture, shall not include more than 18 percent non-viable seed, chaff, hulls, live seed of crop plants (other than those specified), harmless inert matter.

C. Proprietary seed mix can be made at S&S Seeds, Carpinteria, CA or other approved seed source:
   1. Products: Subject to compliance with requirements. Provide seed mixes per seed as indicated on the Drawings.

2.02 WATER

A. Clean, fresh, and free of substances or matter which could inhibit vigorous growth of grass.

2.03 SOIL AMENDMENTS

A. Soil amendments and fertilizer shall be applied as indicated on the Drawings unless imported topsoil is used.
   1. Soil amendment and fertilizer recommendations, along with supporting soil test analysis, shall be submitted to and approved by the ENGINEER prior to application on the site.

2.04 FERTILIZERS

A. Uniform in composition, free flowing and suitable for application with approved equipment, of the proportions necessary to eliminate any deficiencies of topsoil, as indicated in analysis.
   1. Fertilizer shall be delivered to the site fully labeled according 10 applicable state fertilizer laws and shall bear the name, tradename, trademark and warranty of the provider.

B. As indicated on the Drawings and notes.

2.05 PLANTING SOILS

A. Topsoil: Fertile soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, stones over 1 inch in diameter, clay clumps, or impurities, plants weeds and roots; pH value of minimum 6.5 and maximum 7.5.

B. Stockpiled on-site topsoil free of subsoil, stones over 1 inch in diameter, clay clumps, or impurities, plants, weeds and roots.

2.06 MULCHES

A. Mulching material:
   1. Straw mulch:
      a. Straw of oats, barley, wheat, or rye only.
      b. Straw shall be free from weeds, foreign matter detrimental to plant life, and dry. 50 percent of straw shall be minimum 10 inches long.
      c. Hay or chopped cornstalks are not acceptable.
      d. Straw in such an advanced stage of decomposition as to smother or retard the normal growth of grass will not be accepted.
      e. Old straw mulch that breaks during crimping will not be accepted.
   2. Wood cellulose fiber mulch:
      a. Wood cellulose fiber mulch, containing no substance or factor that might inhibit germination or growth of grass seed, with organic tackifier.
      b. Wood fibers must be capable of being evenly dispersed and suspended when agitated in water.
      c. Furnish dyed wood cellulose fiber with green color to allow visual metering of its application.
   3. As indicated on the Drawings.

B. Erosion control blanket:
   1. Jute matting, open weave.
   2. Excelsior erosion control blankets or approved equal:
      a. Regular blanket, machine produced mat of curled wood excelsior of 80 percent 6 inch or longer fiber length with a consistent width of fibers evenly distributed throughout mat; a photo-biodegradable extruded plastic netting shall cover the top side of blanket.
      b. Netting shall be secured to wood excelsior by extra heavy lines of plastic woven into the width of each blanket.
      c. Blanket shall be smolder resistant with no chemical additives.
   3. As indicated on the Drawings.

C. Herbicide and pesticide: Submit labels for approval.

D. Stakes: Softwood lumber, chisel pointed.

2.07 PESTICIDES

A. General:
   1. Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application.
   2. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-emergent herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-emergent herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Start of work covered in this Section constitutes CONTRACTOR's approval of all existing site conditions.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the ENGINEER and replace with new planting soil.

3.02 PREPARATION

A. Protect existing and new structures, fences, utilities, sidewalks, paving, curbs, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydromulching overspray.
   2. Protect grade stakes set by others until directed to remove them.
   3. Protect landscaping and other features remaining as final work.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.03 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly graded subgrades:
   1. Loosen/scarify subgrade to a minimum depth of 6 inches.
   2. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off OWNER's property.
   3. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted the subgrade.
   4. Tolerances: Top of subgrade plus or minus 1 inch.

C. Prepare subgrade and eliminate uneven areas and low spots.
   1. Maintain lines, levels, profiles, and contours.
   2. Make changes in grade gradual. Blend slopes into level areas.

D. Do not prepare subgrade in areas of on-site plant preservation.

E. Do not bury foreign material beneath areas to be seeded.

F. Remove any contaminated subgrade.
   1. Apply superphosphate fertilizer directly to subgrade before loosening.
      a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
      b. Mix lime with dry soil before mixing fertilizer.

2. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
    a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
    b. Reduce elevation of planting soil to allow for soil thickness of sod.

G. Unchanged subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
1. Remove existing grass, vegetation, and turf.
    a. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches.
    a. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil.
    b. Apply superphosphate fertilizer directly to surface soil before loosening.
3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including contaminated soils, grass, vegetation, and turf, off OWNER's property.

H. Finish grading:
1. Grade seeding areas to a smooth, uniform surface plane with loose, uniformly fine texture.
2. Grade to within plus or minus 1/2 inch of finish elevation.
3. Roll and rake, remove ridges, fill depressions to meet finish grades, and ensure positive surface drainage.
4. Maintain profiles and contour of subgrade.
5. Limit finish grading to areas that can be planted in the immediate future.

I. Rip topsoil that has been spread to a minimum depth of 8 inches in one direction using an agricultural ripper with tines spaced at no greater than 18 inches.
1. Areas adjacent to walks, structures, curbs, etc., where the use of large mechanical equipment is difficult, shall be worked with smaller equipment or by hand.

J. Manually spread topsoil close to plant materials and structures to prevent damage.

K. Spread amendments, as determined by the soil test results or indicated on the Drawings**,** over the entire area to be seeded and incorporate into the top 6 inches of soil by disking or rototilling until a uniform mixture is obtained with no pockets of soil or amendments remaining.

L. Restore fine grade with float drag to remove irregularities resulting from tilling operations.
1. Float drag or rake in 2 directions.
2. Remove any additional stones over 1 inch that have come to the surface.
3. Perform drainage test by applying water with the irrigation system.
4. Do not plant until the finished grade is reviewed by the ENGINEER.
5. This review does not reduce CONTRACTOR's responsibility to provide a finished product that drains.

M. Apply fertilizer, if necessary, after smooth raking of topsoil and prior to planting of seed.
   1. Apply fertilizer at a rate as determined by the soil tests or indicated on the Drawings.
   2. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
   3. Mix thoroughly into upper 6 to 8 inches of soil.

N. Lightly water to aid the dissipation of fertilizer.

O. Remove any additional stones over 1 inch that have come to the surface.

P. Moisten prepared area before planting if soil is dry.
   1. Water thoroughly and allow surface to dry before planting.
   2. Do not create muddy soil.

Q. Before planting, obtain ENGINEER's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

R. Tolerances: Top of topsoil plus or minus 1/2 inch.

3.04 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. Install per manufacturers recommendations.

C. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions.
   1. Fasten as recommended by material manufacturer.

D. Moisten prepared area before planting if surface is dry.
   1. Water thoroughly and allow surface to dry before planting.
   2. Do not create muddy soil.

3.05 SEEDING

A. Preparation for seeding:
   1. Prior to seeding, if weeds exists, apply Round-Up herbicide per manufacturer's specifications after germination of weed seeds and at least 2 weeks prior to seeding.
   2. Do not spray on a day when wind is detectable.
   3. Remove remaining vegetative matter.
   4. Repeat herbicide application until no weeds are evident for 14 days after last herbicide application, as determined by the ENGINEER.

B. Drill seeding:
   1. Drill seed by means of a Brillion mechanical power-drawn drill seeders, or equal, to a maximum depth of 1/4-inch followed by packer wheels or drag chains to provide smooth finish.
   2. Seed at the rates given below.
   3. Seed in 2 passes at right angles to one another.
   4. Sow half the seed in each pass.

5. Provide markers or other means to assure that the successive seeded strips will overlap or be separated by a space no greater than the space between the rows planted by the equipment being used.
6. Do not seed during windy weather.
7. Restore fine grade after seeding as requested by the ENGINEER.
8. Remove irregularities by hand raking or rolling.

C. In areas inaccessible to a drill seeder, broadcast seed by hand in 2 opposite directions.
   1. Rake in seed after broadcasting.
   2. Do not broadcast seed during windy weather.

D. Seeding rates:
   1. Seeding rates shall be as indicated on the Drawings for drill-seeded areas.
   2. Hand and broadcast seeded areas shall receive 2 times the seeding rate indicated.

E. Do not seed areas in excess of that which can be mulched on same day.

F. Do not sow immediately following rain, when ground is too dry, frozen, or during windy periods.

G. Roll seeded area with roller not exceeding 100 pounds.

H. Immediately following seeding and compacting, apply mulch.

I. Sow seed with spreader or seed drill machine.
   1. Do not broadcast or drop seed when wind velocity exceeds 5 miles per hour.
   2. Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.
      a. Do not use wet seed or seed that is moldy or otherwise damaged.
      b. Do not seed against existing trees.
         1) Limit extent of seed to outside edge of planting saucer.

J. Sow seed at a total rate as indicated on the Drawings.

K. For any Broadcast seeded areas rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

L. Protect seeded areas with erosion-control mats where indicated on the Drawings; install and anchor according to manufacturer's written instructions.

3.06 SEED ESTABLISHMENT ON SLOPES

A. Protect seeded areas with slopes and swales exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.

B. Roll fabric onto slopes without stretching or pulling.

C. Lay fabric smoothly on surface in direction of water flow.
   1. Bury top end of each section in 6-inch deep excavated topsoil trench.
   2. Provide 6-inch overlap of adjacent rolls.
   3. Backfill trench and rake smooth, level with adjacent soil.

D. Secure outside edges and overlaps at 24-inch intervals with stakes.

E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

F. For sides of ditches, lay fabric laps in direction of water flow.
   1. Lap ends and edges minimum 6 inches.

3.07 MULCHING

A. Straw mulching:
   1. After seeding, apply 2 tons of small-grained straw per acre.
      a. Spread straw to give a 1/2-inch to 1-inch thick layer of mulch (3 to 5 straws thick) and crimp in 2 to 3 inches with a mechanical crimper or other approved equipment.
   2. Hand crimping shall be employed in areas inaccessible to crimper, or where excessive slopes would cause unsatisfactory results.
   3. Crimping against the contour shall not be accepted.
   4. Apply water and tackifier with a fine spray immediately after each area has been mulched.
      a. Saturate to 4 inches of soil.

B. Hydromulching:
   1. Hydromulch all dormant seeded areas with a slurry mix containing additional tackifier.
   2. Utilize hydraulic equipment with nozzle adapted for hydraulic mulching with storage tanks having means of estimating volume used or remaining in the tank.
   3. Hydromulch shall consist of tackifier applied at a rate of 100 pounds per acre and a cellulose fiber mulch mixed to form a homogeneous slurry; spray applied to seeded area at a rate of 2,200 pounds per acre.
      a. Hydromulch applied to dormant seeded areas shall consist of tackifier applied at a rate of 150 pounds per acre and a cellulose fiber mulch mixed to form a homogeneous slurry; spray applied to seeded area at a rate of 2,200 pounds per acre.

C. Protect seeded areas with slopes not exceeding 1:4 by spreading straw mulch.
   1. Spread uniformly at a minimum rate of 2 tons per acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas.
   2. Spread by hand, blower, or other suitable equipment.
      a. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
      b. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gallons per 1,000 square feet.
         1) Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas.
         2) Immediately clean damaged or stained areas.

D. Protect seeded areas from hot, dry weather or drying winds by applying hydro mulch and tackifier within 24 hours after completing seeding operations.
   1. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

3.08 EXISTING VEGETATION RENOVATION

A. Renovate existing vegetation.

B. Renovate existing vegetation damaged by CONTRACTOR's operations, such as storage of materials or equipment and movement of vehicles.
   1. Reestablish vegetation where settlement or washouts occur or where minor regrading is required.
   2. Install topsoil as required.

C. Remove sod and vegetation from diseased or unsatisfactory vegetation areas; do not bury in soil.

D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from CONTRACTOR's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing vegetation.

F. Prior to seeding, irrigate for a minimum of 2 weeks to allow germination of weed seeds.
   1. Apply Round-Up herbicide per manufacturer's specifications after germination of weed seeds and at least 2 weeks prior to seeding.
   2. Do not spray on a day when wind is detectable.
   3. Remove remaining vegetative matter.
   4. Repeat irrigation and herbicide application until no weeds are evident for 14 days after last herbicide application, as determined by the ENGINEER.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off OWNER's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil.
   1. Install new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with hydro mulch as required for new vegetation.

K. Water newly planted areas and keep moist until new turf is established.

3.09 SATISFACTORY SEED AREAS

A. Turf installations shall meet the following criteria as determined by the ENGINEER:
   1. Acceptance for soil preparation (topsoil installation] and final grading shall be given by the ENGINEER upon satisfactory completion of each section or area prior to seeding as indicated on the Drawings or as otherwise specified.
   2. Final completion for seeded areas shall be given by the ENGINEER as soon as there is an even stand of grass with germination over 100 percent of the site.
      a. Warranty:
         1) Guarantee all seeding to be alive and healthy for 2 years following date of final completion by the ENGINEER.

2) Seeded areas shall have an even stand of grass with germination, over 100 percent of the site within 45 days of seeding.
3) All seeded grass areas are to be assured of obtaining a satisfactory stand of growth.
4) The total area occupied by bare spots larger than 0.25 square feet must not exceed 10 percent of the total seeded area.
5) Maximum single bare spot size of irrigated seed 3 inches by 3 inches.
6) Maximum single bare spot size of non-irrigated seed is 1 square foot.
7) All seeded grass areas which do not meet the satisfactory stand of growth qualification shall be reseeded and mulched.

b. Re-seed areas that in the opinion of the ENGINEER do not meet the preceding standards.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.10 SEEDED AREA MAINTENANCE

A. Maintain and establish seeded area by watering, noxious weed management, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable seeded area.
1. Roll, regrade, and replant bare or eroded areas and remulch.
2. Provide materials and installation the same as those used in the original installation.
a. Fill in as necessary soil subsidence that may occur because of settling or other processes.
1) Replace materials and seeded area damaged or lost in areas of subsidence.
b. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
c. Apply treatments as required to keep seeded area and soil free of pests and pathogens or disease.
1) Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and seeded area watering equipment to convey water from sources and to keep meadow uniformly moist.
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch.
a. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water meadow with fine spray at a minimum rate of 1/2 inch per week or more for seed establishment for 6 weeks after planting or until seed establishment is determined by the ENGINEER (whichever is longer) unless rainfall precipitation is adequate.

3.11 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations.
   1. Coordinate applications with OWNER's operations and others in proximity to the Work.
   2. Notify OWNER before each application is performed.

B. Post-emergent herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas.
   1. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly seeded areas from traffic.
   1. Maintain fencing and barricades throughout initial seed establishment.

C. Remove nondegradable erosion-control measures after grass establishment period.

D. During landscape installation:
   1. All areas shall be reasonably clean at the end of each workday.
   2. Sidewalks and other paved areas shall be swept or washed down as needed.

E. Project completion:
   1. All debris, soil, and trash resulting from landscape operations shall be removed from the site.
   2. All paved areas shall be washed down.

END OF SECTION

SECTION 03055

EPOXY BONDING REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bonding reinforcing bars and all thread rods in concrete using epoxy adhesive.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.
      b. Section 03200 - Concrete Reinforcing.
      c. Section 05120 - Structural Steel.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

B. ASTM international (ASTM):
   1. C 881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

C. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

D. Society for Protective Coatings (SSPC):
   1. Surface Preparation Standards (SP).
      a. SP-1 - Solvent Cleaning.

1.03 SUBMITTALS

A. Product Data: Furnish technical data for epoxy adhesives, including:
   1. Installation instructions.
   2. Independent laboratory test results.
   3. Handling and storage instructions.

B. Quality control submittals:
   1. Epoxy manufacturer's past project experience data on at least 3 similar projects supplied with proposed products within the last 3 years.
   2. Special inspection: Provide detailed step-by-step instructions for the special inspection procedure in accordance with the building code as specified in Section 01410.
   3. ICC Evaluation Service, Inc., Evaluation Services Report in compliance with the AC308-Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection.
   1. Store epoxy components on pallets or shelving in a covered-storage area.
   2. Control temperature above 60 degrees Fahrenheit and dispose of product if shelf life has expired.
   3. If stored at temperatures below 60 degrees Fahrenheit, test components prior to use to determine if they still meet specified requirements.

1.05 PROJECT CONDITIONS

A. Seismic design category: D.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

2.02 EPOXY ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

A. Epoxy adhesive shall have a current ICC Evaluation Service report documenting acceptance under AC308 for use with cracked concrete and for the seismic design categories specified.

B. Materials
   1. In accordance with ASTM C 881, Type IV, Grade 3, Class B or C depending on site conditions.
   2. 2-component, 100 percent solids, insensitive to moisture, and gray in color.
   3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

C. Packaging.
   1. Furnished in side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer’s static mixing nozzle. Nozzle designed to thoroughly blend the components for injection from the nozzle directly into prepared hole.
   2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

D. Manufacturers: One of the following or equal:
   1. Hilti, Inc., Tulsa, OK: RE 500-SD.
   2. Simpson Strong-Tie Company, Inc., Pleasanton, CA: SET-XP.

2.03 ALL THREAD RODS

A. Materials: As specified in Section 05120.

2.04 REINFORCING BARS

A. As specified in Section 03200.

PART 3 EXECUTION

3.01 GENERAL

A. Provide Epoxy Adhesive Packaged as Follows:
   1. Disposable, self-contained cartridge system capable of dispensing both epoxy components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.
   2. Dispense components through a mixing nozzle that thoroughly mixes components.

3.02 HOLE SIZING AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device, and mark locations with construction crayon on the surface of the concrete.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by ENGINEER.

B. Hole drilling equipment:
   1. Electric or pneumatic rotary impact type with medium or light impact.
   2. Drill bits: Carbide-tipped in accordance with ANSI B212-15 unless otherwise recommended by the manufacturer or required as a “condition of use” in the ICC Evaluation Report submitted.
   3. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.
   4. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

C. Hole diameter: Reinforcing bar diameter or all thread rod diameter plus 1/8 inch.

D. Obstructions in drill path:
   1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling hole and fill the hole with drypack mortar. Relocate the hole to miss the obstruction and drill another hole. Repeat the above until the hole has been drilled to the required depth.
   2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the structural member and endanger the stability of the structure. Drypack holes which hit obstructions and allow

drypack to reach strength equal to the existing concrete before drilling adjacent holes. Epoxy grout may be substituted for drypack when acceptable to ENGINEER.

3. When existing reinforcing steel is encountered during drilling and when acceptable to ENGINEER, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.
4. Bent bar reinforcing bars: Where edge distances are critical, and striking reinforcing steel is likely, and if acceptable to ENGINEER, drill hole at 10 degree angle or less from axis of reinforcing bar or all thread rod being installed.

E. Install reinforcing bars and all thread rods to depth, spacings, and locations as indicated on the Drawings.
   1. Do not install epoxy bonded all-thread rods or reinforcing bars in overhead applications.

F. Cleaning holes:
   1. Insert long air nozzle into hole and blow out loose dust. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
   2. Use a stiff bristle brush to vigorously brush hole to dislodge compacted drilling dust.
   3. Repeat step 1.
   4. Repeat above steps as required to remove drilling dust or other material that will reduce bond. The hole shall be clean and dry.

G. Cleaning reinforcing bars and all thread rods:
   1. Solvent clean reinforcing bar and all thread rods over the embedment length in accordance with SSPC SP-1 Solvent Cleaning. Provide an oil and grease free surface to promote bonding of adhesive to steel.
   2. Clean reinforcing bars and all thread rods over embedment length to bare metal. The reinforcing bars and all thread rods shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.

H. Filling hole with epoxy:
   1. Fill hole with epoxy before inserting the reinforcing bar or all thread rod. Fill hole with epoxy starting from bottom of hole. Fill hole without creating air voids.
   2. Fill hole with sufficient epoxy so that excess epoxy is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.
   3. Do not install epoxy prior to receiving epoxy manufacturer's onsite training.

3.03 MANUFACTURERS' SERVICES

A. Furnish manufacturer's representative to conduct jobsite training for proper installation, handling, and storage of epoxy, for personnel who will perform actual installation. ENGINEER may attend training sessions.

3.04 FIELD QUALITY CONTROL

A. Testing laboratory hired by OWNER will:
   1. Review epoxy manufacturer’s recommended special inspection procedures.

2. Periodically inspect hole-drilling operations for conformance with Contract Documents and manufacturer's recommendations.
3. Certify in writing to the ENGINEER that depth and location of holes conform to the requirements in the Contract Documents prior to placement of epoxy.
4. Continuously inspect placement of epoxy and reinforcing bars installation.

END OF SECTION

SECTION 03071

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Epoxy.
   2. Epoxy gel.
   3. Epoxy bonding agent.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03072 - Epoxy Resin/Portland Cement Bonding Agent.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 638 - Standard Test Method for Tensile Properties of Plastics.
   2. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
   3. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Provide epoxy materials that are new and use them within shelf life limitations set forth by manufacturer.
   2. Perform and conduct work of this Section in neat orderly manner.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data completely describing epoxy materials.

B. Quality control submittals:
   1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Epoxy: Water-insensitive 2-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified: Manufacturers: One of the following or equal:
   1. BASF, MBT, Concresive Standard LVI.
   2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D 638	8,000 pounds per square inch minimum at 14 days and 77 degrees Fahrenheit cure.
Flexure Strength	ASTM D 790	11,000 pounds per square inch minimum at 14 days and 77 degrees Fahrenheit cure.
Compressive Strength	ASTM D 695	16,000 pounds per square inch minimum at 24 hours and 77 degrees Fahrenheit cure.
Bond Strength	--	Concrete shall fail before failure of epoxy.
Gel Time for 5 Mil Film	--	4 hours maximum at 77 degrees Fahrenheit.
Elongation	ASTM D 638	1 percent minimum at 14 days and 77 degrees Fahrenheit.

B. Epoxy gel: Manufacturers: One of the following or equal:
   1. Sika Chemical Corp., Sikadur 31, Hi-Mod Gel.

C. Epoxy bonding agent: Manufacturers: One of the following or equal:
   1. BASF, MBT, Concresive Liquid LPL.
   2. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.
   3. If increased tack time is required for concrete placement, epoxy resin/portland cement bonding agent as specified in Section 03072 may be used instead of epoxy bonding agent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Epoxy:
   1. Apply in accordance with manufacturer's installation instructions.

C. Epoxy gel:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Use for vertical or overhead work, or where high viscosity epoxy is required.
   3. Epoxy gel used for vertical or overhead work may be used for horizontal work.

D. Epoxy bonding agent:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

SECTION 03072

EPOXY RESIN/PORTLAND CEMENT BONDING AGENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Epoxy resin/portland cement bonding agent.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
   2. C 348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
   3. C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
   4. C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

B. Federal Highway Administration (FHWA):
   1. FHWA-RD-86-193 - Highway Concrete Pavement Technology Development and Testing Volume V: Field Evaluation of SHRP C9206 Test Sites (Bridge Deck Overlays).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sika Corporation, Lyndhurst, New Jersey, Sika Armatec 110.

B. Substitutions: The use of other than the specified product will be considered, providing the CONTRACTOR requests its use in writing to the ENGINEER. This request shall be accompanied by:
   1. A certificate of compliance from an approved independent testing laboratory that the proposed substitute product meets or exceeds specified performance criteria, tested in accordance with the specified test standards.
   2. Documented proof that the proposed substitute product has a 1-year proved record of performance of bonding portland cement mortar/concrete to hardened portland cement mortar/concrete, confirmed by actual field tests and 5 successful installations that the ENGINEER can investigate.

2.02 MATERIALS

A. Epoxy resin/portland cement adhesive:
   1. Component "A" shall be an epoxy resin/water emulsion containing suitable viscosity control agents. It shall not contain butyl glycidyl ether.

2. Component "B" shall be primarily a water solution of a polyamine.
3. Component "C" shall be a blend of selected portland cements and sands.
4. The material shall not contain asbestos.

2.03 PERFORMANCE CRITERIA

A. Properties of the mixed epoxy resin/portland cement adhesive:
   1. Pot life: 75 to 105 minutes.
   2. Contact time: 24 hours.
   3. Color: Dark gray.

B. Properties of the cured epoxy resin/portland cement adhesive:
   1. Compressive strength in accordance with ASTM C 109:
      a. 3 day: 4,500 pounds per square-inch minimum.
      b. 7 days: 6,500 pounds per square-inch minimum.
      c. 28 days: 8,500 pounds per square-inch minimum.
   2. Splitting tensile strength in accordance with ASTM C 496:
      a. 28 days: 600 pounds per square-inch minimum.
   3. Flexural strength:
      a. 1,100 pounds per square-inch minimum in accordance with ASTM C 348.
   4. Bond strength in accordance with ASTM C 882 modified at 14 days:
      a. 0 hours open time: 2,800 pounds per square-inch minimum.
      b. 24 hours open time: 2,600 pounds per square-inch minimum.
   5. The epoxy resin/portland cement adhesive shall not produce a vapor barrier.
   6. Material must be proven to prevent corrosion of reinforcing steel when tested under the procedures as set forth by the FHWA Program Report Number FHWA/RD86/193. Proof shall be in the form of an independent testing laboratory corrosion report showing prevention of corrosion of the reinforcing steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mixing the epoxy resin: Shake contents of Component "A" and Component "B." Empty all of both components into a clean, dry, mixing pail. Mix thoroughly for 30 seconds with a jiffy paddle on a low-speed with 400 to 600 revolutions per minute drill. Slowly add the entire contents of Component "C" while continuing to mix for a minimum of 3 minutes and until uniform with no lumps. Mix only that quantity that can be applied within its pot life.

B. Placement procedure:
   1. Apply to prepared surface with stiff-bristle brush, broom, or "hopper type" spray equipment:
      a. For hand applications: Place fresh, plastic concrete/mortar while the bonding bridge adhesive is wet or dry, up to 24 hours.
      b. For machine applications: Allow the bonding bridge adhesive to dry for 12 hours minimum.

C. Adhere to all limitations and cautions for the epoxy resin/portland cement adhesive in the manufacturer's current printed literature.

3.02 CLEANING

A. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

SECTION 03102

CONCRETE FORMWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete formwork.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03300 - Cast-in-Place Concrete.
      b. Section 03600 - Grouting.
      c. Section 07900 - Joint Sealants.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.

B. Underwriters Laboratories (UL).

1.03 DEFINITIONS

A. Green concrete: Concrete with less than 100 percent of the minimum specified compressive strength f'_c.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Design of concrete forms, falsework, and shoring in accordance with local, state, and federal regulations.
   2. Design forms and ties to withstand concrete pressures without bulging, spreading, or lifting of forms.

B. Performance requirements:
   1. Construct forms so that finished concrete conforms to shapes, lines, grades, and dimensions indicated on the Drawings.
   2. It is intended that surface of concrete after stripping presents smooth, hard, and dense finish that requires minimum amount of finishing.

3. Provide sufficient number of forms so that the work may be performed rapidly and present uniform appearance in form patterns and finish.
4. Use forms that are clean and free from dirt, concrete, and other debris.
   a. Coat with acceptable form release agent if required, prior to use or reuse.

1.05 SUBMITTALS

A. Information on the CONTRACTOR's proposed forming system:
   1. Submit in such detail as the ENGINEER may require to assure himself that intent of the Specifications can be complied with by use of proposed system.
   2. Alternate combinations of plywood thickness and stud spacing: May be submitted.

B. Form release agent. Confirmation of certification for conformance to NSF 61.

1.06 QUALITY ASSURANCE

A. Qualifications of formwork manufacturers: Use only forming systems by manufacturers having a minimum of 5 years experience, except as otherwise specified, or accepted in writing by the ENGINEER.

B. Regulatory requirements: Install work of this Section in accordance with local, state, and federal regulations.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Form ties:
   1. General:
      a. Provide form ties for forming system selected that are manufactured by recognized manufacturer of concrete forming equipment.
      b. Do not use wire ties or wood spreaders of any form.
      c. Provide ties of type that accurately tie, lock, and spread forms.
      d. Provide form ties of such design that when forms are removed, they locate no metal or other material within 1-1/2 inches of the surface of the concrete.
      e. Do not allow holes in forms for ties to allow leakage during placement of concrete.
   2. Cone-snap ties:
      a. Cone-snap ties shall form a cone shaped depression in the concrete with a minimum diameter of 1 inch at the surface of the concrete and 1-1/2 inches deep.
      b. Provide neoprene waterseal washer that is located near the center of the concrete.
   3. Taper ties:
      a. Neoprene plugs for taper tie holes: Size so that after they are driven, plugs are located in center third of wall thickness.

B. Built-up plywood forms:
   1. Built-up plywood forms may be substituted for prefabricated forming system subject to following minimum requirements:
      a. Size and material:
         1) Full size 4-foot by 8-foot plywood sheets, except where smaller pieces are able to cover entire area.
         2) Sheet construction: 5-ply plywood sheets, 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
      b. Wales: Minimum 2-inch by 4-inch lumber.
      c. Studding and wales: Contain no loose knots and be free of warps, cups, and bows.

C. Steel or steel framed forms:
   1. Steel forms: Provide forms that are:
      a. Rigidly constructed and capable of being braced for minimum deflection of finish surface.
      b. Capable of providing finish surfaces that are flat without bows, cups, or dents.
   2. Steel framed plywood forms:
      a. Provide forms that are rigidly constructed and capable of being braced.
      b. Plywood paneling: 5-ply, 5/8-inch nominal or 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.

D. Form release agent.
   1. Effective, non-staining, bond-breaking coating compatible with form surfaces and concrete mixes used.

E. Incidentals:
   1. External angles:
      a. Where not otherwise indicated on the Drawings, provide with 3/4-inch bevel, formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, slabs, walls, beams, columns, and openings.
      b. Provide 1/4-inch bevel formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, walls, and slabs at expansion, and construction joints.
   2. Keyways: Steel, plastic, or lumber treated with form release oil, applied according to label directions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site verification of conditions:
   1. Do not place any concrete until all forms have been thoroughly checked for alignment, level, strength, and to assure accurate location of all mechanical and electrical inserts or other embedded items.

3.02 INSTALLATION

A. Forms and accessories:
   1. Vertical forms:
      a. Remain in place minimum of 24 hours after concrete is placed.
      b. If, after 24 hours, concrete has sufficient strength and hardness to resist surface or other damage, forms may be removed.
   2. Other forms supporting concrete and shoring: Remain in place as follows:
      a. Sides of footings: 24 hours minimum.
      b. Vertical sides of beams, girders, and similar members: 48 hours minimum.
      c. Bottom of slabs, beams, and girders: Until concrete strength reaches specified strength f'_c or until shoring is installed.
      d. Shoring for slabs, beams, and girders: Shore until concrete strength reaches specified strength.
      e. Wall bracing: Brace walls until concrete strength of beams and slabs laterally supporting wall reaches specified strength.
   3. Green concrete:
      a. No heavy loading on green concrete will be permitted.
   4. Immediately after forms are removed, carefully examine concrete surfaces, and repair any irregularities in surfaces and finishes as specified in Section 03300.

B. Form ties:
   1. Cone-snap ties: Tie forms together at not more than 2-foot centers vertically and horizontally. After forms are removed from wall, fill tie holes as follows:
      a. Remove form ties from surfaces.
      b. Roughen cone shaped tie holes by heavy sandblasting before repair.
      c. Dry pack cone shaped tie holes with dry-pack mortar as specified in Section 03600.
   2. Taper ties:
      a. After forms and taper ties are removed from wall, plug tie holes with neoprene plug as follows:
         1) Heavy sandblast and then clean tie holes.
         2) After cleaning, drive neoprene plug into each of taper tie holes with steel rod. Final location of neoprene plug shall be in center third of wall thickness. Bond neoprene plug to concrete with epoxy.
         3) Locate steel rod in cylindrical recess, made in plug, during driving.
            a) At no time are plugs to be driven on flat area outside cylindrical recess.
      b. Dry-pack of taper tie holes: After installing plugs in tie holes:
         1) Coat tie hole surface with epoxy bonding agent and fill with dry-pack mortar as specified in Section 03600.
            a) Place dry-pack mortar in holes in layers with thickness not exceeding tie hole diameter and heavily compact each layer.
            b) Dry-pack the outside of the hole no sooner than 7 days after the inside of the hole has been dry packed.
            c) Wall surfaces in area of dry-packed tie holes: On the water side of water containing structures and the outside of below grade walls:
               (1) Cover with minimum of 10 mils of epoxy gel.

(2) Provide epoxy gel coating on wall surfaces that extend minimum of 2 inches past dry-pack mortar filled tie holes.
(3) Provide finish surfaces that are free from sand streaks or other voids.

C. Built-up plywood forms:
1. Studding:
a. Spaced at 16 inches or 24 inches on center.
b. Closer spacing may be required depending upon strength requirements of the forms, in order to prevent any bulging surfaces on faces of finished concrete work.
c. Install studs perpendicular to grain of exterior plys of plywood sheets.
2. Wales: Form wales of double lumber material with minimum size as specified in this Section.
3. Number of form reuses: Depends upon durability of surface coating or overlay used, and ability to maintain forms in condition such that they are capable of producing flat, smooth, hard, dense finish on concrete when stripped.

D. Steel or steel framed forms:
1. Steel forms:
a. Adequately brace forms for minimum deflection of finish surface.
2. Steel framed plywood forms:
a. Rigidly construct and brace with joints fitting closely and smoothly.
b. Number of form reuses: Depends upon durability of surface coating or overlay used.
3. Built-up plywood forms: As specified in this Section may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through forms.

E. Bracing and alignment of forms:
1. Line and grade: Limit deviations to tolerances which will permit proper installation of structural embedded items or mechanical and electrical equipment and piping.
2. Formwork:
a. Securely brace, support, tie down, or otherwise hold in place to prevent movement.
b. Make adequate provisions for uplift pressure, lateral pressure on forms, and deflection of forms.
3. When second lift is placed on hardened concrete: Take special precautions in form work at top of old lift and bottom of new lift to prevent:
a. Spreading and vertical or horizontal displacement of forms.
b. Grout "bleeding" on finish concrete surfaces.
4. Pipe stubs, anchor bolts, and other embedded items: Set in forms where required.
5. Cracks, openings, or offsets at joints in formwork: Close those that are 1/16-inch or larger by tightening forms or by filling with acceptable crack filler.

F. Incidentals:
1. Keyways: Construct as indicated on the Drawings.
2. Reentrant angles: May be left square.

3. Level strips: Install at top of wall concrete placements to maintain true line at horizontal construction joints.
4. Inserts:
   a. Encase pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Drawings or as required, in concrete.

G. Pipe and conduit:
1. Install pipe and conduit in structures as indicated on the Drawings, and seal with materials as specified in Section 07900.

3.03 CONSTRUCTION

A. Tolerances:
1. Finish concrete shall conform to shapes, lines, grades, and dimensions indicated on the Drawings.
2. The maximum deviation from true line and grade shall not exceed tolerances listed below at time of acceptance of project.
3. In accordance with ACI 117, paragraphs 2.1 through 2.2 and paragraphs 4.0 through 4.6, except as modified in following:
   a. Slabs:
      1) Slope: Uniformly sloped to drain when slope is indicated on the Drawings.
      2) Slabs indicated to be level: Have maximum deviation of 1/8-inch in 10 feet without any apparent changes in grade.
   b. On circular tank walls: The CONTRACTOR may deviate from finish line indicated on the Drawings by use of forms with chord lengths not to exceed 2 feet.
   c. Inserts: Set inserts to tolerances required for proper installation and operation of equipment or systems to which insert pertains.
   d. Maximum tolerances: As follows:

Item	Tolerance
Sleeves and Inserts	Plus 1/8 Minus 1/8 inches
Projected Ends of Anchor Bolts	Plus 1/4 Minus 0.0 inches
Anchor Bolt Setting	Plus 1/16 Minus 1/16 inches

END OF SECTION

SECTION 03142

BRIDGE FALSEWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bridge falsework.

1.02 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Provide the necessary rigidity, supports the loads imposed, and produces in the finished structure the lines and grades as indicated on the Drawings.
   2. Review by the ENGINEER of the falsework working drawings or falsework inspection performed by the ENGINEER will in no way relieve the CONTRACTOR of full responsibility for the falsework.

1.03 SUBMITTALS

A. Shop drawings:
   1. Submit working drawings and design calculations for falsework proposed for use at bridges.
      a. For bridges where the height of any portion of the falsework, as measured from the ground line to the soffit of the superstructure, exceeds 14 feet, or where any individual falsework clear span length exceeds 16 feet, such drawings shall be signed by an ENGINEER who is a registered ENGINEER in the state of where the project is located.
      b. Furnish 5 sets of the drawings and design calculations.
   2. Except for placement of foundation pads or piles, do not start the construction of any unit of falsework until the ENGINEER has reviewed and accepted the drawings for that unit.
   3. Include in the Drawings a superstructure placing diagram showing the concrete placing sequence and construction joint locations.
      a. When a schedule for placing concrete is indicated on the Drawings, no deviation will be permitted.
   4. When footing type foundations are to be used, determine the bearing value of the soil and show the values assumed in the design of the falsework on the falsework drawings.
   5. Show the anticipated total settlements of falsework and forms on the falsework drawings.
      a. These should include falsework footing settlement and joint take-up.
         1) Do not exceed 1 inch anticipated settlement.
         2) Design falsework supporting deck slabs and overhangs on girder bridges so that there will be no differential settlement between the girders and the deck forms during placement of deck concrete.

6. The design load for falsework shall consist of the sum of dead and live vertical loads and an assumed horizontal load.
    a. The minimum total design load for any falsework shall be not less than 100 pounds per square foot for the combined live and dead load regardless of slab thickness.
7. Dead loads shall include the weight of concrete, reinforcing steel, forms, and falsework. Assume the weight of concrete, reinforcing steel, and forms to be not less than 160 pounds per cubic foot for normal weight concrete.
8. Live loads shall consist of the actual weight of any equipment to be supported by falsework applied as concentrated loads at the points of contact and a uniform load of not less than 20 pounds per square foot applied over the area supported, plus 75 pounds per linear foot applied at the outside edge of deck overhangs.
9. The assumed horizontal load to be resisted by the falsework bracing system shall be the sum of the actual horizontal load due to equipment, construction sequence, or other causes and an allowance for wind.
    a. In no case shall the assumed horizontal load to be resisted in any direction be less than 2 percent of the total dead load.
    b. Design falsework so that it will have sufficient rigidity to resist the assumed horizontal load prior to the placement of concrete.
10. Do not exceed 14 feet plus 8.5 times the depth of the T-beam girder for the maximum length of falsework spans used to support T-beam girder bridges.
11. Design the falsework footings to carry the load imposed upon them without exceeding the estimated soil bearing values and anticipated settlements.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 INSTALLATION

A. Falsework construction:
    1. Construct the falsework to substantially conform to the falsework drawings.
        a. The materials used in the framework construction shall be of the quality necessary to sustain the stresses required by the falsework design.
        b. Use workmanship in falsework construction of such quality that the falsework will support the loads imposed on it without excessive settlement or take-up beyond that shown on the falsework drawings.
    2. Place falsework on a solid footing safe against undermining, protected from softening, and capable of supporting the loads imposed on it.
        a. Demonstrate by suitable load tests that the soil bearing values assumed for the design of the falsework do not exceed the supporting capacity of the soil with an adequate safety factor.
    3. Use camber strips to compensate for falsework deflection, vertical alignment, and anticipated structure deflection.
    4. Provide tell-tales attached to the soffit forms and readable from the ground in enough systematically placed locations to determine the total settlement of the entire portion of the structure where concrete is being placed.

5. Construct deck slab forms between girders with no allowance for settlement relative to the girders.
6. Do not apply dead loads, other than those due to forms and reinforcing steel to any falsework until accepted by the ENGINEER.
7. Should unanticipated events occur, including settlements that deviate more than plus or minus 3/8 inch from those indicated on the Drawings, which in the opinion of the ENGINEER would prevent obtaining a structure conforming to the requirements of these specifications, discontinue the placing of concrete until corrective measures satisfactory to the ENGINEER are provided.
    a. In the event satisfactory measures are not provided prior to initial set of the concrete in the affected area, discontinue the placing of concrete at a location determined by the ENGINEER. Remove unacceptable concrete.

B. Removing falsework:
1. Do not remove any falsework supporting any span of a simple span bridge before 10 days after the last concrete, excluding concrete above the bridge deck, has been placed and also not before the concrete has reached the specified strength.

END OF SECTION

SECTION 03150

CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Waterstops.
   2. Joint fillers.

B. Related sections:
   1. The Contract Drawings are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of the CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03154 - Hydrophilic Rubber Waterstop.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 570 - Standard Test Method for Water Absorption of Plastics.
   2. D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
   3. D 638 - Standard Test Method for Tensile Properties of Plastics.
   4. D 746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
   5. D 747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
   6. D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   7. D 2240 - Standard Test Method for Rubber Property – Durometer Hardness.

B. U. S. Army Corps of Engineers (USACE):
   1. CRD-C-572, Specification for Polyvinyl Chloride Waterstop.

1.03 SUBMITTALS

A. Product Data:
   1. Polyvinyl chloride waterstops: Complete physical characteristics.
   2. Preformed expansion joint material: Sufficient information on each type of material for review to determine conformance of material to requirements specified.

B. Samples:
   1. Polyvinyl chloride waterstop.

C. Laboratory test reports: Indicating that average properties of polyvinyl chloride waterstops material and finish conform to requirements specified in this Section.

D. Quality control submittals:
   1. Certificates of Compliance:
      a. Written certificates that polyvinyl chloride waterstops supplied on this Project meet or exceed physical property in accordance with USACE CRD-C-572 and the requirements of this Section.
   2. Manufacturer's instructions: For materials specified in this Section that are specified to be installed with such instructions.

1.04 QUALITY ASSURANCE

A. Mock-ups:
   1. Welding demonstration:
      a. Demonstrate ability to weld acceptable joints in polyvinyl chloride waterstops before installing waterstop in forms.

B. Field joints:
   1. Polyvinyl chloride waterstops field joints: Shall be free of misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. Replace defective joints. Faulty material will be removed from the site and disposed of by the CONTRACTOR at its own expense.

C. Inspections:
   1. Quality of welded joints will be subject to acceptance of the ENGINEER.
   2. Polyvinyl chloride waterstop: The following defects represent a partial list that will be grounds for rejection:
      a. Offsets at joints greater than 1/16 inch or 15 percent of the material thickness, at any point, whichever is less.
      b. Exterior crack at joint due to incomplete bond, which is deeper than 1/16 inch or 15 percent of the material thickness, at any point, whichever is less.
      c. Any combination of offset or crack that will result in a net reduction in the cross section of the waterstop in excess of 1/16 inch or 15 percent of the material thickness, at any point, whichever is less.
      d. Misalignment of the joint that will result in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
      e. Porosity in the welded joint as evidenced by visual inspection.
      f. Bubbles or inadequate bonding.

PART 2 PRODUCTS

2.01 WATERSTOPS

A. Waterstops - polyvinyl chloride (PVC):
   1. Manufactured from prime virgin polyvinyl chloride plastic compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of this Section.

2. Manufacturers: One of the following or equal:
   a. Vinylex Corporation.
   b. Greenstreak Plastic Products Company, Inc.
3. Type: Ribbed waterstop:
   a. Construction joints: 6-inch wide ribbed type.
   b. Expansion joint for wall penetrations for concrete encased electrical duct banks: 6-inch ribbed type with hollow center bulb.
   c. Expansion joints: 9-inch wide ribbed type with hollow center bulb.
   d. Dumbbell-type waterstop will not be allowed unless otherwise specified or indicated on the Drawings.
   e. No scrap or reclaimed material shall be used.
4. Properties as indicated in the following table:

Physical Characteristics	**Test Method**	**Required Results**
Specific Gravity	ASTM D 792	Not less than 1.3.
Hardness	ASTM D 2240	70 to 90 Type A15 Shore durometer.
Tensile Strength	ASTM D 638	Not less than 2,000 pounds per square inch.
Ultimate Elongation	ASTM D 638	Not less than 300 percent.
Alkali Extraction	CRD-C-572	Change in weight after 7 days: Between minus 0.1 percent and plus 0.25 percent. Change in hardness after 7 days: Not more than plus 5 points.
Low Temperature Brittle Point	ASTM D 746	No sign of cracking or chipping at -35 degrees Fahrenheit.
Water Absorption	ASTM D 570	Not more than 0.15 percent after 24 hours.
Accelerated Extraction Test	CRD-C-572	Tensile strength: Not less than 1,600 pounds per square inch. Elongation: Not less than 280 percent.
Stiffness in Flexure	ASTM D 747	Not less than 600 pounds per square inch.
Tear Resistance	ASTM D 624	Not less than 225 pounds per inch.
Thickness	–	3/8 inch.
Center Bulb		
6-inch Waterstops	–	7/8 inch or 1-inch nominal outside diameter.
9-inch Waterstops	–	For expansion joints 1 inch and narrower: 1-inch nominal outside diameter. For expansion joints wider than 1 inch: 2-inch nominal outside diameter.
Allowable Tolerances		
Width	–	Plus or minus 3/16 inch.
Thickness	–	Plus or minus 1/32 inch.

B. Waterstops - hydrophilic rubber:
   1. See Section 03154.

2.02 JOINT FILLERS

A. General:
   1. Use specific type in applications as indicated on the Drawings.
   2. No scrap or recycled materials shall be used.

B. Preformed expansion joint materials:
   1. Synthetic sponge rubber expansion joint material:
      a. Properties:
         1) Thickness: As recommended for width indicated on the Drawings.
         2) Material conforming to ASTM D 1752, Type I.
      b. Manufacturers: One of the following or equal:
         1) Durajoint.
         2) W.R. Meadows: SealTight Sponge Rubber.

PART 3 EXECUTION

3.01 INSTALLATION

A. Waterstops - General:
   1. Waterstops shall be stored so as to permit free circulation of air around the waterstop material and to prevent direct exposure to sunlight.
   2. Install waterstops in concrete joints where indicated on the Drawings.
   3. Carry waterstops in walls into lower slabs and join to waterstops in slabs with appropriate types of fittings.
   4. In waterbearing structures: Provide all joints with waterstops, whether indicated on the Drawings or not.
   5. Provide waterstops that are continuous.
   6. Set waterstops accurately to position and line as indicated on the Drawings.
   7. Hold and securely fix edges in position at intervals of not more than 24 inches so that they do not move during placing of concrete.
   8. Position the waterstop so that symmetrical halves of the waterstop are equally divided between the concrete pours. The center axis of the waterstop shall be coincident with the centerline of the joint.
   9. Do not drive nails, screws, or other fasteners through waterstops in vicinity of construction joints.
   10. Use wires at not more than 24 inches on centers near outer edge of the waterstop to tie waterstops into position.
   11. Special clips may be used in lieu of wires, at CONTRACTOR's option.
   12. Terminate waterstops 3 inches from top of finish surfaces of walls and slabs unless otherwise specified or indicated on the Drawings.
   13. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of sunlight during the entire exposure and until the exposed portion is embedded in concrete.
   14. When placing concrete at waterstops in slabs, lift the edge of the waterstop while placing concrete below the waterstop. Manually force the waterstop against and into the concrete. Then cover the waterstop with fresh concrete.

B. Polyvinyl chloride waterstops:
   1. Install waterstops so that joints are watertight.
   2. Weld joints such as unions, crosses, ells, and tees, with thermostatically controlled equipment recommended by waterstop manufacturer:
      a. The material shall not be damaged by heat sealing.
      b. Make joints by overlapping, then simultaneously cut the ends of the sections to be spliced so they will form a smooth even joint. Heat the cut ends with the splicing tool until the plastic melts. Press the 2 ends together until the plastic cools.
      c. The continuity of the waterstop ribs and tubular center axis shall be maintained.
      d. The splices shall have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
   3. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
   4. Split-type waterstops will not be permitted except where specifically indicated on the Drawings.

C. Joints:
   1. Construct construction, and expansion joints as indicated on the Drawings.
   2. Preformed expansion joint material: Fasten expansion joint strips to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.

END OF SECTION

SECTION 03154

HYDROPHILIC RUBBER WATERSTOP

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydrophilic rubber waterstop.

1.02 SUBMITTALS

A. General:
   1. Submit the following items for each type, style and size of hydrophilic waterstop to be installed.
   2. Product data:
      a. Manufacturer’s product data sheets.
         1) Include complete physical dimensions, expansion characteristics, and laboratory test reports indicating that average material properties conform to the requirements specified.
         2) Provide data sheets for all materials to be included in the waterstop system.
   3. Samples:
      a. Minimum 6-inch long samples of each type of waterstop to be used if requested by the ENGINEER.
   4. Manufacturer's installation instructions:
      a. Installation instructions and recommended installation details for the complete waterstop system, and for each component used in that system.

PART 2 PRODUCTS

2.01 HYDROPHILIC RUBBER WATERSTOP

A. General:
   1. System composed of flexible hydrophilic urethane polymer with preformed strips, adhesives, paste, fasteners, and other accessories required for a complete and watertight installation.
      a. To ensure compatibility of materials, a single manufacturer shall provide all products and accessories for the hydrophilic waterstop system.
      b. Products incorporating bentonite are not acceptable under this Section.
      c. Provide waterstop and accessories resistant to degradation under cyclic wetting and drying and to chemicals typically found in water treatment structures.

B. Hydrophilic strip waterstop.
   1. Pre-formed strips of flexible hydrophilic rubber designed to undergo controlled expansion when exposed to moisture.
      a. Strips manufactured to limit expansion in directions parallel to the plane of the joint, and to direct expansion against confining material perpendicular to that plane.

2. Provide normal or low-expansion pressure as scheduled and as indicted on the Drawings.
3. Manufacturers. One of the following, or equal.
   a. Hydrophilic strip.
      1) Adeka Ultra Seal USA: MC-2010MN.
      2) Greenstreak: Hydrotite CJ1020-2K.
   b. Low expansion hydrophilic strip.
      1) Adeka Ultra Seal USA: KBA-1510FP.
      2) Greenstreak: Hydrotite CJ0725-3K.

C. Hydrophilic paste waterstop.
   1. Single-component gun grade paste of hydrophilic rubber designed to undergo controlled expansion when exposed to moisture after initial curing.
   2. Manufacturers: One of the following, or equal.
      a. Adeka Ultra Seal USA: P-201.
      b. Greenstreak: Leakmaster LV-1.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and recommended details.

B. Prepare concrete joint surfaces:
   1. Use wire brushing or scraping to expose an uncontaminated, solid surface.
   2. Clean prepared surface with high-pressure air or water to remove residue and debris.
   3. Confirm that prepared surfaces conform to manufacturer’s recommendations for surface profile and moisture conditions before installing materials.

C. Provide manufacturer’s recommended lap, splice, and corner details for hydrophilic waterstops.
   1. Use hydrophilic paste at all corner joints and overlap splices of hydrophilic strips.

D. Hydrophilic strip waterstop.
   1. Install primers and adhesives when recommended by the manufacturer before setting hydrophilic strips.
   2. Keep hydrophilic strip taut during the fastening process.
   3. Secure hydrophilic strip in place with concrete nails, screws, or adhesive.
   4. Provide installation with no gap between the hydrophilic strip and the concrete to which it is attached. At rough or irregular surfaces, set hydrophilic strip waterstop strip in a bead of hydrophilic paste.
      a. Fill all voids and rough areas under the hydrophilic strip with hydrophilic paste.
      b. Allow hydrophilic paste to cure in accordance with manufacturer’s recommendations before encapsulating paste in fresh concrete.

3.02 SCHEDULE

A. Concrete construction joints:
   1. Joint where hydrophilic strip waterstop is placed under all of the following conditions:
      a. Slab or wall thickness is greater than 10 inches.
      b. Waterstop is placed between 2 rows of steel reinforcement.
      c. Concrete cover from waterstop to nearest concrete face is at least 4 inches.
   2. Hydrophilic strip waterstop set in bed of hydrophilic paste waterstop. Screw strip to concrete substrate.
   3. Joint where hydrophilic waterstop is placed under one of the following conditions:
      a. Waterstop is placed on 1 side of a single row of steel reinforcement.
      b. Concrete cover from waterstop to nearest concrete face is less than 4 inches.
   4. Low expansion hydrophilic strip waterstop set in bed of hydrophilic paste waterstop. Screw strip to concrete substrate.

B. Pipe penetrations through concrete:
   1. Pipe diameter less than 4 inches: Not allowed.
   2. Pipe diameter of 4 to 24 inches: Continuous bead of hydrophilic paste waterstop, minimum 1/4 inch high by 1/2 inch wide, encircling pipe.
   3. Pipe diameter greater than 24 inches: Continuous hydrophilic strip waterstop around perimeter of pipe, with hydrophilic paste seal at lapped ends of strip.

END OF SECTION

SECTION 03200

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Bar supports.
   2. Reinforcing bars.
   3. Thread bars.
   4. Tie wires.
   5. Welded wire fabric reinforcement.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 315 - Details and Detailing of Concrete Reinforcement.
   2. 318 - Building Code Requirements for Structural Concrete and Commentary.
   3. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.

B. American Welding Society (AWS):
   1. D1.4 - Structural Welding Code - Reinforcing Steel.

C. ASTM International (ASTM):
   1. A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   2. A 615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
   3. A 706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

1.03 DEFINITIONS

A. Give away bars: Bars that are not required by Contract Documents, but are installed by the CONTRACTOR to support the required reinforcing bars.

1.04 SYSTEM DESCRIPTION

A. The Drawings contain general notes concerning amount of reinforcement and placing, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete.

1.05 SUBMITTALS

A. Shop drawings:
   1. Changes to reinforcing steel contract drawing requirements:
      a. Indicate in separate letter submitted with shop drawings any changes of requirements indicated on the Drawings for reinforcing steel.
      b. Such changes will not be acceptable unless the ENGINEER has accepted such changes in writing.

2. Reinforcement shop drawings:
    a. Review of reinforcement shop drawings by the ENGINEER will be limited to general compliance with the Contract Documents.
    b. Submit reinforcement shop drawings in a complete package for each specific structure. Partial submittals will be rejected.

B. Samples:
1. Bar support chairs: Submit samples of chairs proposed for use along with letter stating where each type of chair will be used.

C. Procedures:
1. Welding procedures conforming to AWS D1.4 for reinforcement designated to be field welded.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
1. Deliver bars bundled and tagged with identifying tags.

B. Acceptance at site:
1. Reinforcing bars: Deliver reinforcing bars lacking grade identification marks accompanied by manufacturer's guarantee of grade.

1.07 SEQUENCING AND SCHEDULING

A. Bar supports: Do not place concrete until samples and product data for bar supports have been accepted by the ENGINEER.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bar supports:
1. Wire bar supports located between reinforcing bars and face of concrete:
    a. Stainless steel. Type 304 stainless steel bar supports.
        1) Support reinforcing for concrete placed on ground using bar support chairs with Type 304 stainless steel plates for resting on ground welded to the chairs.
2. Wire bar supports located between mats of reinforcing bar:
    a. Steel bar supports.

B. Reinforcing bars:
1. Reinforcing bars to be embedded in concrete:
    a. ASTM A 615 Grade 60 deformed bars:
        1) Actual yield strength based on mill tests of reinforcement provided shall not exceed the minimum yield strength specified in this Section by more than 18,000 pounds per square inch.
        2) Ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
2. Reinforcing bars that are required to be welded:
    a. Low alloy ASTM A 706 Grade 60 deformed bars.

C. Tie wires: Annealed steel.

D. Welded wire fabric reinforcement:
   1. In accordance with ASTM A 185.
   2. Fabric may be used in place of reinforcing bars if accepted by the ENGINEER.
   3. Provide welded wire fabric in flat sheet form.
   4. Provide welded wire fabric having cross-sectional area per linear foot of not less than cross-sectional area per linear foot of reinforcing bars indicated on the Drawings.

2.02 FABRICATION

A. Shop assembly:
   1. Cut and bend bars in accordance with provisions of ACI 315, ACI 318, and ACI 350.
   2. Bend bars cold.
   3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Reinforcing bars and welded wire fabric reinforcement: Verify that reinforcement is new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work.

3.02 PREPARATION

A. Surface preparation:
   1. Reinforcing bars: Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean any bars having rust scale, loose mill scale, or thick rust coat.
   2. Cleaning of reinforcement materials: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placement.

3.03 INSTALLATION

A. Reinforcing bars:
   1. No field bending of bars will be allowed.
   2. Hoop bars shall be rolled to the radius of the structure.
   3. Welding:
      a. Weld reinforcing bars where indicated on the Drawings or acceptable to the ENGINEER.
      b. Perform welding in accordance with AWS D1.4 and welding procedures accepted by the ENGINEER.
         1) Conform to requirements for minimum preheat and interpass temperatures.
      c. Submit welding procedures.
      d. Do not tack weld reinforcing bars.

B. Placing reinforcing bars:
   1. Accurately place bars to meet tolerances of ACI 318 and adequately secure them in position.
   2. Lap bars at splices as indicated on the Drawings or specified.
      a. Unless specifically otherwise indicated on the Drawings, install bars at lap splices in contact with each other and fasten together with tie wire.
      b. Where reinforcing bars are to be lap spliced at concrete joints, ensure that bars project from first concrete placement a length equal to or greater than the minimum lap splice length indicated on the Drawings.
      c. Where lap splice lengths are not indicated on the Drawings, provide lap splice lengths in accordance with ACI 318 and ACI 350.
   3. Bar supports:
      a. Provide a sufficient number to prevent sagging, to prevent shirting, and to support loads during construction; but in no case less than quantities and at locations as indicated in ACI 315.
      b. Do not use brick, broken concrete masonry units, spalls, rocks, wood or similar materials for supporting reinforcing steel.
      c. Do not use give away bars that have less cover than required by the Contract Documents. Do not adjust location of reinforcement required by the Contract Documents to provide cover to the give away bars.
   4. If not indicated on the Drawings, provide protective concrete cover in accordance with ACI 318 and ACI 350.

C. Tying of bar reinforcement:
   1. Fasten bars securely in place with wire ties.
   2. Tie bars sufficiently often to prevent shifting.
   3. Provide at least 3 ties in each bar length.
      a. Do not apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity.
   4. Tie slab bars at every intersection around periphery of slab.
   5. Tie wall bars and slab bar intersections other than around periphery at not less than every fourth intersection, but at not greater than following maximum spacings:

Bar Size	**Slab Bar Spacing Inches**	**Wall Bar Spacing Inches**
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

   6. After tying wire ties, bend ends of wire ties in towards the center of the concrete section.
      a. The cover for wire ties shall be the same as the cover requirements for reinforcing bars.

D. Welded wire fabric reinforcement:
   1. Install necessary wiring, spacing chairs, or supports to keep welded wire fabric in place while concrete is being placed.
   2. Bend fabric as indicated on the Drawings or required to fit work.

3. Unroll or otherwise straighten fabric to make flat sheet before placing in the Work.
4. Lap splice welded wire fabric as indicated on the Drawings.
5. If lap splice length is not indicated on the Drawings, splice fabric in accordance with ACI 318 and ACI 350.

END OF SECTION

SECTION 03212

REINFORCING BAR COUPLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Reinforcing bar couplers.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   2. A 706 - Standard Specification for Low-Alloy Steel Deformed Bars and Plain Bars for Concrete Reinforcement.

1.03 SYSTEM DESCRIPTION

A. Performance requirements for reinforcing bar coupler:
   1. Do not exceed the following total slip of the reinforcing bars within the splice sleeve after loading reinforcing bar in tension to 30,000 pounds per square inch and relaxing to 3,000 pounds per square inch, measured between gauge points clear of the splice sleeve:
      a. Number 14 reinforcing bars or smaller: 0.010 inch.
      b. Number 18 reinforcing bars: 0.030 inch.
   2. The splicing system and materials used in accordance with the manufacturer’s procedures shall develop in tension not less than the lesser of the following:
      a. ASTM A 615 and ASTM A 706 reinforcing bars: 95 percent of the ultimate tensile strength of the reinforcing bar.
      b. ASTM A 615 and ASTM A 706 reinforcing bars: 160 percent of the specified yield strength of the reinforcing bar.

1.04 SUBMITTALS

A. Submit the following information for each shipment of splice material:
   1. The type or series identification of the splice material. For threaded sleeve-type, the heat treatment lot number.
   2. The bar grade and size number to be spliced.
   3. A copy of the manufacturer's catalog giving complete data on the splice material and procedures.
   4. A statement that the splicing systems and materials used in accordance with the manufacturer's procedures will develop the strength requirements, the total slip requirements, and other requirements in these specifications.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing bar couplers: Mechanical butt splices of the threaded sleeve type or the swaged sleeve type, at the option of the CONTRACTOR:
   1. Threaded sleeve type of reinforcing bar coupler:
      a. Steel splice sleeve with tapered interior threads that join the reinforcing bars with matching tapered threads.
      b. Taper threads to such a degree that cross threading will not occur during assembly.
      c. Mark each splice sleeve with the heat treatment lot number.
      d. After completion of assembly of the splice, tighten splice to a torque value of not less than recommended by the manufacturer.
   2. Swaged sleeve type of reinforcing bar coupler: Seamless steel sleeve applied over the ends of the reinforcing bars and swaged to the bars by means of a hydraulic press.

PART 3 EXECUTION

3.01 INSTALLATION

A. Use reinforcing bar couplers where indicated on the Drawings or accepted by the ENGINEER.

B. Splice in accordance with the manufacturer's instructions, except as modified in this Section.
   1. Make splices using manufacturer's standard equipment, jigs, clamps, and other required accessories.

C. Cut ends of reinforcing bars to be spliced nominally square.

D. Provide clear cover over reinforcing bar couplers of not less than indicated on the Drawings or specified for the reinforcing bars when measured from the surface of the concrete to the outside of the coupler sleeve.
   1. With written acceptance of the ENGINEER, adjust stirrups, ties, and other reinforcement and place additional reinforcement, if necessary, to provide planned clear cover over reinforcement.

END OF SECTION

SECTION 03214

REINFORCING BAR END ANCHORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Reinforcing bar end anchors.

1.02 REFERENCE

A. ASTM International (ASTM):
   1. A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   2. A 706 - Standard specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.

1.03 SYSTEM DESCRIPTION

A. Performance requirements:
   1. Capable of develop strength of reinforcing bar without damage to concrete.
   2. The reinforcing bar end anchors and materials used in accordance with the manufacturer’s procedures shall develop in tension not less than the lesser of the following:
      a. 95 percent of the ultimate tensile strength of the reinforcing bar for ASTM A 615 and ASTM A 706 reinforcing bars.
      b. 160 percent of the specified yield strength of the reinforcing bar for ASTM A 615 and ASTM A 706 reinforcing bars.

1.04 SUBMITTALS

A. Submit the following information for each shipment:
   1. The type or series identification of the material and the heat treatment lot number.
   2. The bar grade and size number to be anchored.
   3. A copy of the manufacturer's catalog giving complete data on the material and procedures.
   4. A statement that the systems and materials used in accordance with the manufacturer's procedures will develop the strength requirements and other requirements in these Specifications.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing bar end anchor:
   1. Tapered interior threads that joins end anchor to reinforcing bar.
   2. Taper threads to such a degree that cross threading will not occur during assembly.

3. Mark each reinforcing bar end anchor with the heat treatment lot number.
4. After completion of assembly of the reinforcing bar end anchor, tighten splice to a torque value of not less than recommended by the manufacturer.

B. Manufacturers: One of the following or equal:
1. Lenton, Erico Terminator.

PART 3 EXECUTION

3.01 INSTALLATION

A. Use reinforcing bar end anchors where indicated on the Drawings or accepted by the ENGINEER.

B. Cut ends of reinforcing bars to be anchored nominally square.

C. Provide clear cover over reinforcing bar end anchors of not less than indicated on the Drawings or specified for the bars when measured from the surface of the concrete to the outside of the reinforcing bar end anchor.
1. Adjust stirrups, ties, and other reinforcement and place additional reinforcement if necessary to provide planned clear cover over reinforcement.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Cast-in-place concrete.

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 03071 - Epoxies.
   b. Section 03150 - Concrete Accessories.
   c. Section 03366 - Tooled Concrete Finishes.
   d. Section 03600 - Grouting.
   e. Section 03931 - Epoxy Injection System.
   f. Section 07900 - Joint Sealants.

1.02 REFERENCES

A. American Concrete Institute (ACI):
1. 305 - Hot Weather Concreting Standard.
2. 306 - Cold Weather Concreting Standard.
3. 318 - Building Code Requirements for Structural Concrete and Commentary.
4. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
5. Manual of Concrete Practice.

B. ASTM International (ASTM):
1. C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. C 33 - Standard Specification for Concrete Aggregates.
3. C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. C 40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
5. C 42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
6. C 88 - Standard Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
7. C 94 - Standard Specification for Ready-Mixed Concrete.
8. C 114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement.

9. C 117 - Standard Test Method for Materials Finer that 75-m (No. 200) Sieve in Mineral Aggregates by Washing.
10. C 123 - Standard Test Method for Lightweight Particles in Aggregate.
11. C 131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
12. C 136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
13. C 142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregate.
14. C 143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
15. C 150 - Standard Specification for Portland Cement.
16. C 156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete.
17. C 157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
18. C 171 - Standard Specifications for Sheet Materials for Curing Concrete.
19. C 172 - Standard Practice for Sampling Freshly Mixed Concrete.
20. C 173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
21. C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
22. C 289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
23. C 295 - Standard Guide to Petrographic Examination of Aggregates for Concrete.
24. C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. C 311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
26. C 469 - Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression.
27. C 494 - Standard Specification for Chemical Admixtures for Concrete.
28. C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
29. C 1260 – Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
30. C1293 - Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
31. D 75 - Standard Practice for Sampling Aggregates.
32. D 2103 - Standard Specification for Polyethylene Film and Sheeting.

1.03 DEFINITIONS

A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.

B. Cementitious materials: Portland cement and fly ash.

C. Cold weather: A period when for more than 3 consecutive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature is the average of the highest and lowest temperatures during the period from midnight to midnight. When temperatures above 50 degrees F occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.

D. Cold weather concreting: Operations for placing, finishing, curing, and protection of concrete during cold weather.

E. Green concrete: Concrete with less than 100 percent of the specified strength.

F. Hairline crack: Crack with a crack width of less than 4 thousandths of an inch.

G. Hot weather: A period when project conditions such as low humidity, high temperature, solar radiation, and high winds, promote rapid drying of freshly placed concrete.

H. Hot weather concreting: Operations for placing, finishing, curing, and protection of concrete during hot weather.

1.04 SYSTEM DESCRIPTION

A. Performance requirements:
   1. General:
      a. Except as otherwise specified, provide concrete composed of portland cement, fly ash, fine aggregate, coarse aggregate, admixtures and water so proportioned and mixed as to produce plastic, workable mixture in accordance with requirements as specified in this Section and suitable to specific conditions of placement.
      b. Proportion materials in a manner that will secure lowest water-cementitious materials ratio that is consistent with good workability, plastic and cohesive mixture, and a mixture that is within specified slump range.
      c. Proportion fine and coarse aggregates in manner such as not to produce harshness in placing or honeycombing.
   2. It is the intent of this Section to secure for every part of the Work concrete with homogeneous mixture, which when hardened will have required strength, watertightness, and durability:
      a. It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces.
      b. Construction and expansion joints have been specified and positioned in structures as indicated on the Drawings, and curing methods specified, for purpose of reducing number and size of cracks, due to normal expansion and contraction expected from specified concrete mixes.
      c. Repair cracks that develop in walls or slabs and repair cracks that show any signs of leakage until all leakage is stopped.
      d. Pressure inject visible cracks, other than hairline cracks and crazing, in following areas with epoxy as specified in Section 03931:
         1) Floors and walls of water bearing structures.
         2) Walls and overhead slabs of passageways or occupied spaces, outsides of which are exposed to weather or may be washed down and are not specified to receive separate waterproof membrane.
         3) Other items not specified to receive separate waterproof membrane: Slabs over water channels, wet wells, reservoirs, and other similar surfaces.

e. As specified above, walls or slabs that leak or sweat because of porosity or cracks too small for successful pressure injection with epoxy: Seal on water or weather side by coatings of surface sealant system, as specified in this Section.
f. Pressure injection and sealing: Continue as specified above until structure is watertight and remains watertight for not less than 1 year after final acceptance or date of final repair, whichever occurs later in time.

3. Workmanship and methods: Provide concrete work, including detailing of reinforcing, that conform to best standard practices and as set forth in ACI 318, ACI 350, Manual of Concrete Practices, and recommended practices.
4. Truck driver delivery tickets: Ticket for each delivery must be concise with respect to loading, delivery, and unloading times. Design mix shall be clearly noted, including all admixtures. No admixtures or water shall be added without the special inspector's approval as initialed on the delivery ticket.

1.05 SUBMITTALS

A. Cement mill tests: Include alkali content, representative of each shipment of cement for verification of compliance with specified requirements.

B. Cold weather concreting:
1. Procedures for the production, transportation, placement, protection, curing, and temperature monitoring for concrete during cold weather.
2. Procedures to be implemented upon abrupt changes in weather conditions or equipment failures.

C. Concrete mixes: Full details, including mix design calculations for concrete mixes proposed for use for each class of concrete:
1. Include information on correction of batching for varying moisture contents of fine aggregate.
2. Source quality test records with mix design submittal:
a. Include calculations for required compressive strength (f'_{cr}) based on source quality test records.

D. Concrete aggregate tests: Certified copies in triplicate of commercial laboratory tests not more than 90 days old of all samples of concrete aggregates:
1. Coarse aggregate:
a. Abrasion loss.
b. Clay lumps and friable particles.
c. Coal and lignite.
d. Materials finer than 200 sieve.
e. Reactivity.
f. Shale and chert.
g. Soundness.
2. Fine aggregate:
a. Clay lumps.
b. Color.
c. Decantation.
d. Reactivity.
e. Shale and chert.
f. Soundness.

E. Drying shrinkage test data.

F. Fine or coarse aggregate batched from more than 1 bin: Analyses for each bin, and composite analysis made from these, using proportions of materials to be used in mix.

G. Fly ash Certificate of Compliance: Identify source of fly ash and certify compliance in accordance with ASTM C 618.

H. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Corrective measures for use prior to placing concrete.

I. Hot weather concreting: Procedures for production, placement, finishing, curing, protection, and temperature monitoring for concrete during hot weather and appropriate corrective measures.

J. Heating equipment for cold weather concreting: Information on type of equipment used for heating materials and new concrete in process of curing during excessively cold weather.

K. Information on mixing equipment.

L. Modulus of elasticity test data.

M. Product data: Submit data completely describing products.

N. Sequence of concrete placing: Submit proposed sequence of placing concrete showing proposed beginning and ending of individual placements.

O. Sieve analysis: Submit sieve analyses of fine and coarse aggregates being used in triplicate at least every 3 weeks and at any time there is significant change in grading of materials.

P. Trial batch test data:
   1. Submit data for each test cylinder.
   2. Submit data that identifies mix and slump for each test cylinder.

Q. Weather monitoring: Records of:
   1. Relative humidity.
   2. Site ambient temperature.
   3. Wind speed.

R. Temperature of freshly placed concrete.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver, store, and handle concrete materials in manner that prevents damage and inclusion of foreign substances.

2. Deliver and store packaged materials in original containers until ready for use.
3. Deliver aggregate to mixing site and handle in such manner that variations in moisture content will not interfere with steady production of concrete of specified degree of uniformity and slump.

B. Acceptance at site: Reject material containers or materials showing evidence of water or other damage.

1.07 PROJECT CONDITIONS

A. Environmental requirements:
1. Monitoring weather conditions:
   a. Install an outdoor weather station capable of measuring and recording ambient temperature, wind speed, and humidity. Furnish instruments accurate to within 2 degrees F, 5 percent relative humidity, and 1 mile per hour wind speed.
   b. Measure and record temperature of fresh concrete. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature of concrete.
   c. Monitor and keep records of the weather forecast starting at least 48 hours prior to placing concrete in order to allow enough time for taking appropriate measures pertaining to Hot or Cold weather concreting.
2. Hot weather concreting:
   a. Initiate evaporation control measures when concrete and air temperatures, relative humidity of air, and wind velocity have the capacity to evaporate water from a free surface at a rate equal to or greater than 0.2 pounds per square feet per hour. Determine evaporation rate using the Menzel Formula and monograph in ACI 305 3.1.3.
   b. When ambient air temperature is above 85 degrees F: Prior to placing concrete, cool forms and reinforcing steel by water, cooling to below 90 degrees F.
   c. Monitor weather conditions at site including air temperature, humidity, and wind speed, to assess the need for evaporation control measures; begin monitoring site conditions no later than 1 hour before the start of concrete placement. Continue to monitor site conditions at 30-minute intervals until concrete curing has begun.
   d. Temperature of concrete mix at time of placement: Keep temperature below 90 degrees F by methods that do not impair quality of concrete.
   e. For conditions that promote rapid drying of freshly placed concrete such as low humidity, high temperature, and wind: Take corrective measures to minimize rapid water loss from concrete:
   f. Furnish and use sufficient number of maximum and minimum self-recording thermometers to adequately measure temperature around concrete.
3. Cold weather concreting:
   a. Concrete placed below ambient air temperature of 45 degrees F and falling or below 40 degrees F:
      1) Make provision for heating water.
   b. Follow recommendations of ACI 306 for preparation, placement, and protection of concrete during cold weather.
   c. If materials have been exposed to freezing temperatures to degree that any material is below 35 degrees F: Heat such materials.

d. Heating water, cement, or aggregate materials:
   1) Do not heat in excess of 160 degrees F.
e. Protection of concrete in forms:
   1) Do not remove forms from concrete when outside ambient air temperature is below 50 degrees F until concrete has attained its minimum specified compressive strength. Evidence of strength shall be based on by testing of cylinders stored in the field under equivalent conditions to those at the concrete structure.
   2) Protect by means of covering with tarpaulins, or other acceptable covering acceptable to ENGINEER.
   3) Provide means for circulating warm moist air around forms in manner to maintain temperature of 50 degrees F for at least 5 days.

1.08 SEQUENCING AND SCHEDULING

A. Schedule placing of concrete in such manner as to complete any single placing operation to construction or expansion joint.

PART 2 PRODUCTS

2.01 MATERIALS

A. Admixtures:
   1. General:
      a. Do not use admixtures of any type, except as specified, unless written acceptance has been obtained from ENGINEER.
      b. Admixtures shall be compatible with concrete and other admixtures. Admixtures other than pozzolans shall be the products of a single manufacture to ensure compatibility.
      c. Do not use admixtures containing chlorides calculated as chloride ion in excess of 0.5 percent by weight of cement.
      d. Use in accordance with manufacturer's recommendations. Add each admixture to concrete mix separately.
   2. Air entraining admixture:
      a. Provide concrete with 5 percent, within 1 percent, entrained air of evenly dispersed air bubbles at time of placement.
      b. In accordance with ASTM C 260.
   3. Water reducing admixture:
      a. May be used at the CONTRACTOR's option.
      b. In accordance with ASTM C 494, Type A or Type D.
      c. Not contain air-entraining agents.
      d. Liquid form before adding to the concrete mix.
      e. No decrease in cement, which results from the use of water-reducing admixture, is permitted.
   4. Superplasticizers: Are not to be used without ENGINEER’s acceptance.

B. Aggregate:
   1. General:
      a. Provide concrete aggregates that are sound, uniformly graded, and free of deleterious material in excess of allowable amounts specified.
      b. Grade aggregate in accordance with ASTM C 136 and D 75.

c. Provide unit weight of fine and coarse aggregate that produces in place concrete with weight of not less than 140 pounds per cubic foot.
d. Do not use aggregate made from recycled materials, e.g., crushed and screened hydraulic-cement concrete, brick, or other construction materials.

2. Fine aggregate:
   a. Provide fine aggregate for concrete or mortar consisting of clean, natural sand or of sand prepared from crushed stone or crushed gravel.
   b. Aggregate with deleterious substances that exceed the percentages by weight of contaminating substances listed in the following table shall not be permitted under any circumstances:

Item	Test Method	Percent
Removed by decantation (dirt, silt, etc.)	ASTM C 117	3
Shale or Chert	ASTM C 123 ASTM C 295(1)	1 1
Clay Lumps	ASTM C 142	1

Notes:
(1) Test Method C 123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C 295 is used to identify which of the lightweight particles are shale or chert. If the results of Test Method C 123 are less than 1 percent, Test Method C 295 is not required.

   c. Except as otherwise specified, grade fine aggregate from coarse to fine in accordance with ASTM C 33.

3. Coarse aggregate:
   a. Provide coarse aggregate consisting of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances.
   b. Not exceeding 15 percent by weight, of thin or elongated pieces having length greater than 5 times average thickness.
   c. Deleterious substances: Not in excess of following percentages by weight, and in no case having total of all deleterious substances exceeding 2 percent.

Item	Test Method	Percent
Shale or chert	ASTM C 123 ASTM C 295(1)	1.25 1
Coal and lignite	ASTM C 123	1/4
Clay lumps and friable particles	ASTM C 142	1/4
Materials finer than Number 200 sieve	ASTM C 117	1/2(2)

Note:
(1) Test Method C 123 is used to identify particles in the sample lighter than 2.40 Specific Gravity. Test Method C 295 is used to identify which of the lightweight particles are shale, chert, coal, or lignite. If the results of Test Method C 123 are less than 1.25 percent (the minimum combined percentage of shale, chert, coal and lignite), Test Method C 295 is not required.
(2) Except when material finer than Number 200 sieve consists of crusher dust, maximum amount shall be 1 percent.

d. Grading:
   1) Aggregate for Class A, B, C, and D concrete: In accordance with ASTM C 33, Size Number 57, except as otherwise specified or authorized in writing by the ENGINEER.
   2) Aggregate for Class CE concrete for encasement of electrical conduits:
      a) Graded in accordance with ASTM C 33, Size Number 8.

C. Conduit encasement coloring agent:
   1. Color: Red color concrete used for encasement of electrical ducts, conduits, and similar type items.
   2. Manufacturers: One of the following or equal:
      a. Davis Company, #100 Utility Red.
      b. I. Reiss Company, Inc., equivalent product.
      c. Euclid Chemical Company, Increte Division, “Colorcrete Brick Red.”
   3. Conduit encasement concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.

D. Evaporation retardant:
   1. Manufacturers: One of the following or equal:
      a. BASF, Cleveland, Ohio, Confilm.
      b. Euclid Chemical Company, Cleveland, Ohio, Eucobar.

E. Fly ash:
   1. Fly ash in accordance with ASTM C 618, Class F**,** may be used in concrete made with Type II portland cement.
   2. Maximum of 15 percent by weight of fly ash to total weight of cementitious materials.
      a. The total weight of cementitious materials shall not be less than minimum cementitious materials listed in Table A.
   3. Do not use in concrete made with portland-pozzolan cement.
   4. Loss on ignition: Not exceed 4 percent.

F. Keyway material: Steel, plastic, or lumber.

G. Non-slip abrasive:
   1. Aluminum oxide abrasive size 8/16, having structure of hard aggregate that is, homogenous, non-glazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.
   2. Manufacturers: One of the following or equal:
      a. Exolon Company, Tonawanda, New York.
      b. Abrasive Materials, Incorporated, Hillsdale, Michigan.
      c. “Non-Slip Aggregate”, Euclid Chemical Company, Cleveland, Ohio.

H. Portland cement:
   1. Conform to specifications and tests in accordance with ASTM C 150, Types II or III, low alkali, except as specified otherwise.
   2. Have total alkali containing not more than 0.60 percent.
   3. Exposed concrete in any individual structure: Use only one brand of portland cement.
   4. Cement for finishes or repairs: Provide cement from same source and of same type as concrete to be finished or repaired.

I. Sheet membrane for curing:
   1. Polyethylene film:
      a. In accordance with ASTM C 171.
      b. Color: White.
      c. Thickness: Nominal thickness of polyethylene film shall not be less than 0.0040 inches when measured in accordance with ASTM D 2103. Thickness of polyethylene film at any point shall not be less than 0.0030 inches.
      d. Loss of moisture: Not exceed 0.055 grams per square centimeter of surface when tested in accordance with ASTM C 156.

J. Sprayed membrane curing compound: Clear type with fugitive dye in accordance with ASTM C 309, Type 1D.

K. Surface sealant system: Manufacturers: One of the following or equal:
   1. Radcon Laboratories, Inc., Las Vegas, Nevada, Formula Number 7.
   2. IPA Systems, Philadelphia, Pennsylvania, Duripal.

L. Water:
   1. Water for concrete, Washing Aggregate, and Curing Concrete: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
   2. Chlorides and sulfate ions:
      a. Water for conventional reinforced concrete: Use water containing not more than 1,000 milligrams per liter of chlorides calculated as chloride ion, nor more than 1,000 milligrams per liter of sulfates calculated as sulfate ion.
      b. Water for prestressed or post-tensioned concrete: Use water containing not more than 650 milligrams per liter of chlorides calculated as chloride ion, or more than 800 milligrams per liter of sulfates calculated as sulfate ion.

2.02 EQUIPMENT

A. Mixing concrete:
   1. Mixers may be of stationary plant, paver, or truck mixer type.
   2. Provide adequate equipment and facilities for accurate measurement and control of materials and for readily changing proportions of material.
   3. Mixing equipment:
      a. Capable of combining aggregates, cementitious materials, and water within specified time into thoroughly mixed and uniform mass and discharging mixture without segregation.
      b. Maintain concrete mixing plant and equipment in good working order and operated at loads, speeds, and timing recommended by manufacturer or as specified.
      c. Proportion cementitious materials and aggregate by weight.

B. Machine mixing:
   1. Batch plant shall be capable of controlling delivery of all material to mixer within 1 percent by weight of individual material.

2. If bulk cementitious materials are used, weigh them on separate visible scale that will accurately register scale load at any stage of weighing operation from zero to full capacity.
3. Prevent cementitious materials from coming into contact with aggregate or with water until materials are in mixer ready for complete mixing with all mixing water.
4. Procedure of mixing cementitious materials with sand or with sand and coarse aggregate for delivery to project site, for final mixing and addition of mixing water will not be permitted.
5. Re-tempering of concrete will not be permitted.
6. Discharge entire batch before recharging.
7. Volume of mixed material per batch: Not exceed manufacturer's rated capacity of mixer.
8. Mixers:
   a. Perform mixing in batch mixers of acceptable type.
   b. Equip each mixer with device for accurately measuring and indicating quantity of water entering concrete, and operating mechanism such that leakage will not occur when valves are closed.
   c. Equip each mixer with device for automatically measuring, indicating, and controlling time required for mixing:
      1) Interlock device to prevent discharge of concrete from mixer before expiration of mixing period.

C. Transit-mixed concrete:
1. Mix and deliver in accordance with ASTM C 94.
2. Total elapsed time between addition of water at batch plant and discharging completed mix:
   a. Not to exceed 90 minutes.
   b. Elapsed time at project site shall not exceed 30 minutes.
3. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the ENGINEER.
4. Equip each truck mixer with device interlocked to prevent discharge of concrete from drum before required number of turns and furnish device that is capable of counting number of revolutions of drum.
5. Continuously revolve drum after it is once started until it has completely discharged its batch:
   a. Do not add water until drum has started revolving.
   b. Right is reserved to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. The CONTRACTOR will not be entitled to additional compensation because of such increase or decrease.

D. Other types of mixers: In case of other types of mixers, mixing shall be as follows:
1. Mix concrete until there is uniform distribution of materials, and discharge mixer completely before recharging.
2. Neither speed nor volume loading of mixer shall exceed manufacturer's recommendations.
3. Continue mixing for minimum of 1-1/2 minutes after all materials are in drum, and for batches larger than 1 cubic yard increase minimum mixing time 15 seconds for each additional cubic yard or fraction thereof.

2.03 MIXES

A. Measurements of materials:
   1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the ENGINEER.
   2. Furnish apparatus for weighing aggregates and cementitious materials that is suitably designed and constructed for this purpose.
   3. Accuracy of weighing devices: Furnish devices that have capability of providing successive quantities of individual material that can be measured to within 1 percent of desired amount of that material.
   4. Measuring or weighing devices: Subject to review by the ENGINEER. Shall bear valid seal of the Sealer of Weights and Measures having jurisdiction.
   5. Weighing cementitious materials:
      a. Weigh cementitious materials separately.
      b. Cement in unbroken standard packages (sacks): Need not be weighed.
      c. Weigh bulk cementitious materials and fractional packages.
   6. Measure mixing water by volume or by weight.

B. Concrete proportions and consistency:
   1. Provide concrete that can be worked readily into corners and angles of forms and around reinforcement without excessive vibration and without permitting materials to segregate or free water to collect on surface.
   2. Prevent unnecessary or haphazard changes in consistency of concrete.
   3. Ratio of coarse aggregate to fine aggregate: Not less than 1.0 or more than 2.0 for all concrete Classes, with exception of Class CE.
   4. Aggregate:
      a. Obtain aggregate from source that is capable of providing uniform quality, moisture content, and grading during any single day's operation.
   5. Maximum concrete mix water to cementitious materials ratio, minimum cementitious materials content, and slump range: Conform to values specified in Table A in this Section.
   6. Concrete batch weights: Control and adjust to secure maximum yield. At all times, maintain proportions of concrete mix within specified limits.
   7. Mix modification: If required, by the ENGINEER, modify mixture within limits set forth in this Section.

C. Concrete mixes:
   1. Proportioning of concrete mix: Proportion mixes based on required compressive strength f'_{cr}.
   2. Mixes:
      a. Adjusting of water: After acceptance, do not change mixes without acceptance by ENGINEER, except that at all times adjust batching of water to compensate for free moisture content of fine aggregate.
      b. Total water content of each concrete class: Not exceed those specified in Table A in this Section.
      c. Checking moisture content of fine aggregate: Furnish satisfactory means at batching plant for checking moisture content of fine aggregate.
   3. Change in mixes: Submit new mix design and perform new trial batch and test program as specified in this Section.

D. Classes of concrete:
   1. Provide concrete consisting of 5 classes: Classes A, B, C, D, and CE. Use where specified or indicated on the Drawings.
   2. Weight of concrete classes: Provide classes of concrete having minimum weight of 140 pounds per cubic foot.
   3. Class B concrete: Class B concrete may be substituted for Class A concrete, when high-early strength concrete is needed in areas specifically accepted by the ENGINEER and that do not require sulfate resistant concrete.
   4. Class C concrete: Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and where indicated on the Drawings.
   5. Class D concrete: Use Class D for precast concrete items.
   6. Class CE concrete: Use Class CE for electrical conduit encasements.
   7. All other concrete, unless specified or otherwise indicated on the Drawings: Use Class A concrete.

Table A
Concrete with Air Entrainment

Class	Specified Compressive Strength f'_c at 28 Days (psi)	Water-to-Cementitious Materials Ratio	Cementitious Materials per Cubic Yard of Concrete by Weight (lbs)	Slump Range (inches)
A	4,500	0.40 to 0.45	564 to 658	2 to 4
B (Type III cement)	4,500	0.40 to 0.45	564 to 658	2 to 4
C	2,500	Maximum 0.62	Minimum 423	3 to 6
D	4,500	0.40 to 0.45	564 to 658	2 to 4
CE	2,500	Maximum 0.62	Minimum 564	3 to 6

   8. Pumped concrete: Provide pumped concrete that complies with all requirements of this Section.
   9. Do not place concrete with slump outside limits indicated in Table A.
   10. Classes:
      a. Classes A, C, D, and CE concrete: Make with Type II low alkali portland cement.
      b. Class B concrete: Make with Type III low alkali portland cement.
      c. Admixtures: Provide admixtures as specified in this Section.

E. Air entraining admixture:
   1. Add agent to batch in portion of mixing water.
   2. Batch solution by means of mechanical batcher capable of accurate measurement.

2.04 SOURCE QUALITY CONTROL

A. Tests:
   1. Trial batches:
      a. After concrete mix designs have been accepted by ENGINEER, have trial batches of the accepted Class A, Class B, and Class D concrete mix designs prepared by testing laboratory acceptable to the ENGINEER.
      b. Prepare trial batches using cementitious materials and aggregates proposed to be used for the Work.

c. Prepare trial batches with sufficient quantity to determine slump, workability, consistency, setting time, and finishing characteristics, and to provide sufficient test cylinders.
d. Test cylinders: Provide cylinders having 6-inch diameter by 12-inch length and that are prepared in accordance with ASTM C 31 for tests specified in this Section.
e. Determine slump in accordance with ASTM C 143.
f. Test cylinders from trial batch:
    1) Test 8 cylinders for compressive strength in accordance with ASTM C 39:
        a) Test 4 cylinders at 7 days and 4 at 28 days.
        b) Establish ratio between 7 day and 28-day strength for mix. 7-day strength may be taken as satisfactory indication of 28-day strength provided effects on concrete of temperature and humidity between 7 day and 28 day are taken into account.
    2) Average compressive strength of 4 test cylinders tested at 28 days: Equal to or greater than required average compressive strength (f'_{cr}) on which concrete mix design is based.
g. Drying shrinkage:
    1) Prepare 5 drying shrinkage specimens in accordance with ASTM C 157, except as modified in this Section.
    2) Remove drying shrinkage specimens from molds at age of 23 hours within 1 hour after trial batching, then immediately place them in water at 73 degrees F within 3 degrees for at least 30 minutes and then measure specimens within 30 minutes thereafter to determine original length.
        a) Then submerge specimens in saturated limewater at 73 degrees F within 3 degrees for moist curing.
    3) Make measurement to determine expansion expressed as percentage of original length at age 7 days.
        a) Use length at age 7 days as base length for drying shrinkage calculations.
    4) Immediately store specimens in humidity controlled room maintained at 73 degrees F within 3 degrees and 50 percent within 4 percent relative humidity for remainder of test.
    5) Make and report measurements to determine shrinkage expressed as percentage of base length separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.
    6) Drying shrinkage deformation:
        a) Measure drying shrinkage deformation of each specimen as difference between base length and length after drying at each test age.
        b) Measure average drying shrinkage deformation of specimens to nearest 0.0001 inch at each test age.
        c) If drying shrinkage of any specimen departs from average of test age by more than 0.0004 inch, disregard results obtained from that specimen and test another specimen.
        d) Shrinkage of trial batch concrete at 28 days drying age shall not exceed 0.045 percent maximum.
    7) Modulus of elasticity:Tests: Test 2 cylinders at 28 days for static modulus of elasticity in compression in accordance with ASTM C 469.

h. Required results: Modulus of elasticity shall not be less than 54,000 times square root of the 28-day strength of the cylinders.If trial batch tests do not meet specified requirements for slump, strength, workability, consistency, modulus of elasticity, drying shrinkage, and finishing, change concrete mix design proportions and, if necessary, source of aggregate.
   1) Perform additional trial batches and tests until an acceptable trial batch is produced that meets requirements of this Section.

i. Perform test batches and tests required to establish trial batches and acceptability of materials without change in Contract Price.

j. Do not place concrete until the concrete mix design and trial batch have been accepted by ENGINEER.

2. Required average compressive strength:

a. Determine required average compressive strength (f'_{cr}) for selection of concrete proportions for mix design, for each class of concrete, using calculated standard deviation for its corresponding specified compressive strength (f'_c,) in accordance with ACI 318 and ACI 350.

b. When test records of at least 30 consecutive tests that span period of not less than 45 calendar days are available, establish standard deviation as in accordance with ACI 318 and ACI 350 and as modified in this Section.

c. Provide test records from which to calculate standard deviation that represent materials, quality control procedures, and conditions similar to materials, quality control procedures, and conditions expected to apply in preparation of concrete for the Work.

d. Provide test records with materials and proportions that are more restricted than those for the Work.

e. Specified compressive strength (f'_c) of concrete used in test records: Within 1,000 pounds per square inch of that specified for the Work.

f. When lacking adequate test records for calculation of standard deviation meeting requirements, determine required average compressive strength f'_{cr} from following Table B.

Table B
Required Average Compression Strength

Specified Compressive Strength f'_c (psi)	**Required Average Compressive Strength f'_{cr} (psi)**
Less than 3,000	f'_c + 1,000
3,000 to 5,000	f'_c + 1,200
Over 5,000	1.10f'_c + 700

3. Aggregate:

a. Testing of concrete aggregate is at CONTRACTOR's expense.

b. If there is change in aggregate source or if there is a significant change in aggregate quality or sieve analysis from same source, submit new set of design mixes covering each class of concrete and prepare new trial batches before further placing of concrete.

c. Sieves: Use sieves with square openings for testing grading of aggregates.

d. Sample aggregate in accordance with ASTM C 136 and D 75.

e. Fine aggregate:
   1) Provide fine aggregate that does not contain strong alkali nor organic matter that gives color darker than standard color when tested in accordance with ASTM C 40.

2) Provide aggregate having soundness in accordance with ASTM C 33 when tested in accordance with ASTM C 88.
3) Provide aggregate complying with reactivity requirements in accordance with ASTM C 33 when tested in accordance with ASTM C 289, C 1260, and C 1293.

f. Coarse aggregate:
1) Soundness when tested in accordance with ASTM C 88: Have loss not greater than 10 percent when tested with sodium sulfate.
2) Abrasion Loss: Not exceed 45 percent after 500 revolutions when tested in accordance with ASTM C 131.
3) Reactivity: Not exceed limits specified in Appendix of ASTM C 33 when tested in accordance with ASTM C 289, C 1260, and C 1293.
4) Fly ash:
a) Sampling and testing: Sample and test fly ash in accordance with ASTM C 311.
5) Portland cement:
a) Determination of alkali content: In accordance with ASTM C 114.

PART 3 EXECUTION

3.01 INSTALLATION

A. Liquid evaporation retardant:
1. Under conditions that result in rapid evaporation of moisture from the surface of the concrete, immediately after the concrete has been screeded, coat the surface of the concrete with a liquid evaporation retardant.
2. Apply the evaporation retardant again after each work operation as necessary to prevent drying shrinkage cracks.
3. Conditions which result in rapid evaporation of moisture may include one or more of the following:
a. Low humidity.
b. Windy conditions.
c. High temperature.

B. Surface sealant system:
1. Apply as recommended by manufacturer published instructions.
2. Where concrete continues to sweat or leak, apply additional coats of surface sealant until the sweating or leaks stop.

C. Joints and bonding:
1. As far as practicable construct concrete work as monolith.
2. Locations of contraction construction, expansion, and other joints are indicated on the Drawings or as specified in this Section.
3. Provide not less than 14 days between placements of concrete in adjacent concrete wall placements. Place concrete for slabs in checkerboard pattern with not less than 14 days between placements of concrete in adjacent concrete slab placements.
4. Construction joints:
a. Where construction joints are not indicated on the Drawings, provide construction joints in slabs and walls at intervals not greater than 35 feet.

b. In order to preserve strength and watertightness of structures, make no other joints, except as authorized by the ENGINEER.
c. At construction joints, thoroughly clean concrete of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of heavy sandblasting.
d. Cleaning of construction joints:
1) Wash construction joints free of sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
2) Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, use vacuum cleaner for their removal, after which flush cleaned surfaces with water.
3) Provide cleanout hole at base of each wall and column for inspection and cleaning.
e. At horizontal joints: As initial placement over cold joints, thoroughly spread bed of cement grout as specified in Section 03600 (with a thickness of not less than 1/2 inch nor more than 1 inch.

5. Keyways in joints:
a. Provide keyways in joints as indicated on the Drawings.
b. Treat lumber keyway material with form release coating, applied in accordance with manufacturer's instructions.
6. Take special care to ensure that concrete is well consolidated around and against waterstops and waterstops are secured in proper position.
7. Construction and expansion Joints:
a. Constructed where and as indicated on the Drawings.
b. Waterstops, expansion joint material, synthetic rubber sealing compound, and other similar materials: As specified in Sections 03150 and 07900.
8. Repair of concrete: Where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, first coat surface of set concrete with epoxy bonding agent as specified in Section 03071.

D. Conveying and placing concrete:
1. Convey concrete from mixer to place of final deposit by methods that prevent separation or loss of materials.
2. Use equipment for chuting, pumping, and conveying concrete of such size and design as to ensure practically continuous flow of concrete at delivery end without segregation of materials.
3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from chute or conveying device.
4. Keep equipment for conveying concrete thoroughly clean by washing and scraping upon completion of day's placement.

E. Placing concrete:
1. Place no concrete without prior authorization of the ENGINEER.
2. Do not place concrete until:
a. Reinforcement is secure and properly fastened in its correct position and loose form ties at construction joints have been retightened.

b. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
c. Forms have been cleaned and oiled as specified.

3. Do not place of concrete in which initial set has occurred, or that has been retempered.
4. Do not place concrete during rainstorms or high velocity winds.
5. Protect concrete placed immediately before rain to prevent water from coming in contact with such concrete or winds causing excessive drying.
6. Keep sufficient protective covering on hand at all times for protection of concrete.
7. After acceptance, adhere to proposed sequence of placing concrete, except when specific changes are requested and accepted by the ENGINEER.
8. Notify the ENGINEER in writing of readiness, not just intention, to place concrete in any portion of the work:
   a. Provide this notification in such time in advance of operations, and at least 24 hours in advance, as the ENGINEER deems necessary to make final inspection of preparations at location of proposed concrete placing.
   b. Place forms, reinforcement, screeds, anchors, ties, and inserts in place before notification of readiness is given to the ENGINEER.
   c. Depositing concrete:
      1) Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
      2) Do not deposit concrete in large quantities in one place and work along forms with vibrator or by other methods.
      3) Do not drop concrete freely into place from height greater than 5 feet.
      4) Use tremies for placing concrete where drop is over 5 feet.
      5) Commence placement of concrete on slopes, starting at bottom of slope.
9. Place concrete in approximately horizontal layers not to exceed 24 inches in depth and bring up evenly in all parts of forms.
10. Continue concrete placement without avoidable interruption, in continuous operation, until end of placement is reached.
11. After concrete placement begins, continue concrete placement without significant interruption. Plan and implement precautions to prevent any delay, between layers being placed, from exceeding 20 minutes.
12. If concrete is to be placed over previously placed concrete and more than 20 minutes has elapsed, spread layer of cement grout not less than 1/2 inch in thickness nor more than 1 inch in thickness over surface before placing additional concrete.
13. Placement of concrete for slabs, beams, or walkways:
    a. If cast monolithically with walls or columns, do not commence until concrete in walls or columns has been allowed to set and shrink.
    b. Allow set time of not less than 1 hour for shrinkage.

F. Consolidating concrete:
1. Place concrete with aid of acceptable mechanical vibrators.
2. Thoroughly consolidate concrete around reinforcement, pipes, or other shapes built into the work.
3. Provide sufficiently intense vibration to cause concrete to flow and settle readily into place and to visibly affect concrete over radius of at least 18 inches.

4. Vibrators:
    a. Keep sufficient vibrators on hand at all times to vibrate concrete as placed.
    b. In addition to vibrators in actual use while concrete is being placed, have on hand minimum 1 spare vibrator in serviceable condition.
    c. Do not place concrete until it has been ascertained that all vibrating equipment, including spares, are in serviceable condition.
5. Take special care to place concrete solidly against forms to leave no voids.
6. Take every precaution to make concrete solid, compact, and smooth. If for any reason, surfaces or interiors have voids or are in any way defective, repair such concrete in manner acceptable to the ENGINEER.

G. Footings and slabs on grade:
1. Do not place concrete on ground or compacted fill until subgrade is in moist condition acceptable to the ENGINEER.
2. If necessary, sprinkle subgrade with water not less than 6 or more than 20 hours in advance of placing concrete.
3. If subgrade becomes dry prior to concrete placement, sprinkle again, without forming pools of water.
4. Do not place concrete if subgrade is muddy or soft.

H. Loading concrete:
1. Green concrete:
    a. No heavy loading of green concrete will be permitted.
2. No backfill shall be placed against concrete walls, connecting slabs, or beams until the concrete has reached the specified strength.
3. Use construction methods, sequencing, and allow time for concrete to reach adequate strength to prevent overstress of the concrete structure during construction.

I. Curing concrete:
1. General:
    a. Cure concrete by methods specified in this Section.
    b. Keep concrete continuously moist and at a temperature of at least 50 degrees F for minimum of 7 days after placement.
    c. Cure concrete to be painted with water or sheet membrane.
    d. Do not use sprayed membrane curing or sealing compounds on concrete surfaces that are to receive paint or upon which any material is to be bonded.
    e. Water cure or sheet membrane cure concrete slabs that are specified to be sealed by concrete sealer.
    f. Cure other concrete by water curing or sprayed membrane curing compound at the CONTRACTOR's option.
    g. Floor slabs may be cured using sheet membrane curing.
2. Water curing:
    a. Keep surfaces of concrete being water cured constantly and visibly moist day and night for period of not less than 7 days.
    b. Each day forms remain in place count as 1 day of water curing.
    c. No further curing credit will be allowed for forms in place after contact has once been broken between concrete surface and forms.

d. Do not loosen form ties during period when concrete is being cured by leaving forms in place.
e. Flood top of walls with water at least 3 times per day, and keep concrete surfaces moist at all times during 7-day curing period.

3. Sprayed membrane curing compound:
   a. Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
   b. If more than 1 hour elapses after removal of forms, do not use curing compound, but use water curing for full curing period.
   c. If surface requires repairing or painting, water cure such concrete surfaces.
   d. Do not remove curing compound from concrete in less than 7 days.
   e. Curing compound may be removed only upon written request by CONTRACTOR and acceptance by ENGINEER, stating what measures are to be performed to adequately cure concrete.
   f. Take care to apply curing compound to construction joints. Apply to all surfaces along full profile of joints.
   g. After curing period is complete, remove curing compound placed within construction joint profile by heavy sandblasting prior to placing any new concrete.
   h. CONTRACTOR's Option: Instead of using curing compound for curing of construction joints, such joints may be water cured.
   i. Apply curing compound by mechanical, power operated sprayer and mechanical agitator that will uniformly mix all pigment and compound.
   j. Apply curing compound in at least 2 coats.
   k. Apply each coat in direction 90 degrees to preceding coat.
   l. Apply curing compound in sufficient quantity so that concrete has uniform appearance and that natural color is effectively and completely concealed at time of spraying.
   m. Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
   n. Thickness and coverage of curing compound: Provide curing compound having film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
   o. The CONTRACTOR is cautioned that method of applying curing compound specified in this Section may require more curing compound than normally suggested by manufacturer of curing compound and also more than is customary in the trade.
   p. Apply amounts specified in this Section, regardless of manufacturer's recommendations or customary practice.
   q. If the CONTRACTOR desires to use curing compound other than specified curing compound, coat sample areas of concrete wall with proposed curing compound and also similar adjacent area with specified compound in specified manner for comparison:
      1) If proposed sample is not equal or better, in opinion of the ENGINEER, in all features, proposed substitution will not be allowed.
   r. Prior to final acceptance of the work, remove, by sandblasting or other acceptable method, any curing compound on surfaces exposed to view, so that only natural color of finished concrete is visible uniformly over entire surface.

4. Sheet membrane curing:
   a. Install sheet membrane as soon as concrete is finished and can be walked on without damage.
   b. Seal joints and edges with small sand berm.
   c. Keep concrete moist under sheet membrane.

J. Cold weather concreting:
1. Preparation before concreting:
   a. Remove snow, ice, and frost from the surfaces, including reinforcement against which the concrete is to be placed.
   b. The subgrade shall be free of frost before concrete placing begins.
   c. Do not place concrete around any embedment that is at a temperature below freezing and is sufficiently massive as to cause the adjacent concrete to freeze.
2. Placement of concrete:
   a. Placement temperature:
      1) The minimum temperature of concrete immediately after placement shall be as specified in Table C.
      2) The temperature of concrete as placed shall not exceed the values shown in Table C by more than 20 degrees F.
   b. Protection temperature:
      1) Unless otherwise specified, the minimum temperature of concrete during the protection period shall be as shown Table C.
      2) Temperatures specified to be maintained during the protection period shall be those measured at the concrete surface, whether the surface is in contact with formwork, insulation, or air.
      3) Measure the temperature with a surface measuring device accurate to 2 degrees F.
      4) Measure the temperature of concrete in each placement at regular time intervals as specified in the contract documents.
   c. Termination of protection:
      1) The maximum decrease in temperature measured at the surface of the concrete in a 24-hour period shall not exceed the values listed in Table C.
      2) Do not exceed these limits until the surface temperature of the concrete is within 20 degrees F of the ambient temperature of surrounding temperatures.
      3) When the surface temperature of the concrete is within 20 degrees F of the ambient temperature, all protection may be removed.

Table C
Concrete Temperature Requirements

Least dimension of section (inches)	Minimum temperature of concrete as placed and maintained during the protection period (degrees F)	Maximum for gradual decrease in surface temperature during any 24-hour period after end of protection period (degrees F)
Less than 12	55	50
12 to less than 36	50	40
36 to 72	45	30
Greater than 72	40	20

3. Curing of concrete:
    a. Prevent concrete from drying during the required curing period. If water curing is used, terminate use at least 24 hours before any anticipated exposure of the concrete to freezing temperatures.
4. Protection of concrete:
    a. Combustion heaters: Vent flue gases from combustion heating units to the outside of the enclosures.
    b. Overheating and drying: Place and direct heaters and ducts to avoid areas of overheating or drying of the concrete surface.
    c. Maximum air temperature: During the protection period, do not expose the concrete surface to air having a temperature more than 20 degrees F above the values shown in Table C unless higher values are required by an accepted curing method.
    d. Protection against freezing:
        1) Cure and protect concrete against damage from freezing for a minimum of 3 days, unless otherwise specified.
            a) Maintain concrete surface temperature as specified in Table C.
        2) During periods not defined as cold weather, but when freezing temperatures may occur, protect concrete surfaces against freezing for the first 24 hours after placing.

3.02 CONCRETE FINISHING

A. Provide concrete finishes as specified in Section 03366.

B. Edges of joints:
    1. Provide joints having edges as indicated on the Drawings.
    2. Protect wall and slab surfaces at edges against concrete spatter and thoroughly clean upon completion of each placement.

3.03 FIELD QUALITY CONTROL

A. Testing of concrete:
    1. During progress of construction, the OWNER will have tests made to determine whether the concrete, as being produced, complies with requirements specified.
    2. Tests will be performed in accordance with ASTM C 31, ASTM C 39, and ASTM C 172.
    3. ENGINEER will make and deliver test cylinders to the laboratory and testing expense will be borne by OWNER.
    4. Furnish test equipment.
    5. Make provisions for and furnish concrete for test specimens, and provide manual assistance to ENGINEER in preparing said specimens.
    6. Assume responsibility for care of and providing of curing conditions for test specimens in accordance with ASTM C 31.

B. Compressive strength tests:
    1. Test no less than 3 cylinder specimens, 6-inch diameter by 12-inch long, for each 150 cubic yards of each class of concrete with minimum of 3 specimens for each class of concrete placed and not less than 3 specimens for each half-day's placement.
        a. One cylinder will be tested at 7 days for information, and 2 cylinders will be tested at 28 days for acceptance.

C. Slump tests:
   1. Test slump of concrete using slump cone in accordance with ASTM C 143.
   2. Do not use concrete that does not meet specification requirements in regards to slump.
      1) Remove such concrete from project site.
      b. Test slump at the beginning of each placement, as often as necessary to keep slump within the specified range, and when requested to do so by the ENGINEER.

D. Air entrainment tests:
   1. Test percent of entrained air in concrete at beginning of each placement, as often as necessary to keep entrained air within specified range, and when requested to do so by the ENGINEER.
   2. Do not use concrete that does not meet Specification requirements for air entrainment.
      a. Remove such concrete from project site.
   3. Test air entrainment in concrete in accordance with ASTM C 173.
   4. The ENGINEER may at any time test percent of entrained air in concrete received on project site.

E. Enforcement of strength requirement:
   1. Concrete is expected to reach higher compressive strength than that which is indicated in Table A as specified compressive strength (f'_c).
   2. Strength level of concrete: Will be considered acceptable if following conditions are satisfied:
      a. Averages of all sets of 3 consecutive strength test results is greater or equal to specified compressive strength(f'_c).
      b. No individual strength test (average of 2 cylinders) falls below specified compressive strength (f'_c) by more than 500 pounds per square inch.
   3. Non-compliant tests: Immediately forward copies of non-compliant test reports to all parties on the test report distribution list. Mark test reports to highlight that they represent non-complying results.
   4. Whenever one, or both, of 2 conditions stated above is not satisfied, provide additional curing of affected portion followed by cores taken in accordance with ASTM C 42, ACI 318, and ACI 350 and comply with following requirements:
      a. If additional curing does not bring average of 3 cores taken in affected area to at least specified compressive strength (f'_c), designate such concrete in affected area as defective.
      b. ENGINEER may require CONTRACTOR to strengthen defective concrete by means of additional concrete, additional reinforcement, or replacement of defective concrete, all of the CONTRACTOR's expense.

3.04 ADJUSTING

A. Repair of defective concrete:
   1. Remove and replace or repair defective work.
   2. Correct defective work as specified.
   3. Do not patch, repair, or cover defective work without inspection by the ENGINEER.
   4. Provide repairs having strength equal to or greater than specified concrete for areas involved.

5. Preparation of concrete for repair:
    a. Make no repair until ENGINEER has accepted method for preparing surface for repair.
    b. Chip out and key imperfections in the work and make them ready for repair.
    c. Surfaces of set concrete to be repaired: First coat with epoxy bonding agent as specified in Section 03071.
6. Methods of repair:
    a. Dry pack method:
        1) Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt holes, and for narrow slots cut for repair.
        2) Smooth holes: Clean and roughen by heavy sandblasting before repair.
    b. Mortar replacement method:
        1) Use for holes too wide to dry pack and too shallow for concrete replacement.
        2) Comparatively shallow depressions, large or small, which extend no deeper than nearest surface reinforcement.
    c. Concrete replacement method:
        1) Use when holes extend entirely through concrete section or when holes are more than 1 square foot in area and extend halfway or more through the section.

END OF SECTION

SECTION 03302

MASS CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Mass concrete.

B. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03300 - Cast-in-Place Concrete.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 207.1R - Guide to Mass Concrete.

B. ASTM International (ASTM):
   1. C 494 - Standard Specification for Chemical Admixtures for Concrete.

1.03 DEFINITIONS

A. Mass concrete: Concrete 3 feet or greater in thickness.

B. Cooling period: The time required for the interior temperature of the concrete placement to stabilize. Minimum of 14 days from the time of placement.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Thermal Control Plan:
      a. General:
         1) Submit a Thermal Control Plan signed by a licensed engineer, registered in the state where the project is located. Include the following as a minimum:
            a) Calculations for maximum concrete temperature and maximum differential concrete temperature for each mass concrete element.
            b) Concrete mix design.
            c) Duration and method of curing.

d) Procedures to control concrete temperature at time of placement.
e) Methods of controlling temperature differentials.
f) Temperature sensor types and locations.
g) Temperature monitoring and recording system.
h) Field measures to ensure conformance with the maximum concrete temperature and maximum temperature differential requirements.
i) Corrective measure to take if it appears the specified maximum temperature and differential temperature will be exceeded.

2) Have temperature control measures in place during the placement of concrete to limit the maximum initial concrete temperature rise to 20 degrees Fahrenheit.
3) Difference in temperature between concrete interior and surface temperatures shall not exceed 35 degrees Fahrenheit.
4) Allow the interior of the concrete to cool down and stabilize.
5) The maximum allowable concrete temperature: 145 degrees Fahrenheit.
6) Do not place mass concrete until the Engineer has accepted in writing, the Thermal Control Plan.

b. Pre-cooling of concrete:
1) Cooling of the concrete mix, prior to placement, may be attained by following means:
a) Cool batch water. Ice may be substituted for a portion of the batch water.
b) Continuously spray coarse aggregate with water to cool the aggregate. Adjust the water content of the concrete mix to account for the cooling water.
c) Alternative means proposed by the Contractor and acceptable to the Engineer.

c. Post-cooling of concrete:
1) At Contractor's option, use embedded thin walled piping for circulating water to control temperature gain in the previously cast concrete:
a) Clearly indicate in the Thermal Control Plan if cooling piping will be embedded in the concrete.
b) Do not install embedded piping within the top 20 inches of the slab or wall.
c) Operate cooling pipe system for the duration of the cooling period.
d) After use of cooling pipes to cool the concrete is complete, fill pipes with grout.

d. Misting concrete:
1) Use fog sprayers to reduce the ambient air temperature and increase the humidity during concrete placement.

e. Curing concrete:
1) Water cure or plastic membrane cure as soon as possible following placement of concrete as specified in Section 03300.
a) If water curing is used, use methods that minimize differential concrete temperature.
b) Consider the type of curing in the Thermal Control Plan.

2. Temperature monitoring program:
   a. Temperature monitoring and recording system:
      1) Consist of temperature sensors connected to a data acquisition system capable of printing, storing, and downloading data to a computer.
      2) Locate temperature sensors such that the maximum temperature difference within a mass concrete element can be monitored.
      3) As a minimum, monitor concrete temperatures at the calculated hottest location, on at least 2 outer faces, 2 corners, and top surfaces.
   b. Temperature readings:
      1) Automatically recorded on an hourly or more frequent basis.
      2) Hourly temperature recording may be discontinued when:
         a) Maximum internal temperature is falling.
         b) Difference between the interior concrete temperature and the average daily air temperature is less than the allowable temperature difference for 3 consecutive days.
         c) There are no mass concrete elements to be cast adjacent.
      3) Print and submit data to the Engineer daily.
   c. Methods of concrete consolidation: Prevent damage to the temperature monitoring and recording system.
      1) Protect wiring connected to temperature sensors cast into the concrete to prevent movement.
      2) Keep wire runs as short as possible.
      3) Do not allow ends of the temperature sensors to come into contact with either a support or concrete form, or reinforcing bar.
   d. When any equipment used in the temperature control and monitoring and recording system fails during the mass concrete construction operation, take immediate measures to correct the situation in accordance with Thermal Control Plan. Failure to conform to the temperature requirements will be cause for rejection of the concrete.

1.05 SUBMITTALS

A. Product data.

B. Thermal Control Plan.

C. Temperature Monitoring Program.

D. Temperature monitoring data:
   1. Tabular data of hourly temperature for each temperature sensor.
   2. Tabular data for hourly temperature differential for each temperature sensor.
   3. Plot of temperature and temperature differential for each temperature sensor.

E. Layout of cooling pipe system, if used, showing pipe sizes and material type, connections, location, spacing, method of support, and system for monitoring the temperature of the water in the cooling pipes.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection:
   1. Store coarse and fine aggregate in a covered area. Shade aggregates to prevent heating by direct sunlight.
   2. Store cementitious materials in covered, shaded silos to prevent heating by direct sunlight.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete admixtures:
   1. Air entraining admixture:
      a. As specified in Section 03300.
   2. Retarding admixture:
      a. At the Contractor's option, a set retarding admixture may be used to control set time and minimize premature setting of concrete and formation of cold joints.
      b. As specified in Section 03300.
      c. Dosage: In accordance with manufacturer's written requirements.
   3. Water reducing admixture:
      a. As specified in Section 03300.

B. Coarse aggregate:
   1. As specified in Section 03300.
   2. Maximum coarse aggregate size: 1-1/2 inches.
   3. Coarse aggregate grading: In accordance with of Table 2.5.8 of ACI 207.1R.

C. Fine aggregate:
   1. As specified in Section 03300.

D. Portland cement:
   1. Type II, except as modified in this Section.
   2. Contain no more than 12 percent Tricalcium Aluminate.
   3. Sum of Tricalcium Aluminate and Tricalcium Silicate: Less than 58 percent.

E. Pozzolan:
   1. As specified in Section 03300.

F. Water and ice:
   1. Mixing water: As specified in Section 03300.
   2. Water for making ice: Meet the requirements of mixing water as specified in Section 03300.
   3. Ice may be substitute for mixing water on a 1 to 1 ratio based on weight.

2.02 MIXES

A. As specified in Section 03300 for Class A concrete, except as modified by this Section.

B. Concrete mix for mass concrete:
   1. Water-cementitious material ratio: Not to exceed 0.45.
   2. Entrained air content range: 2 to 4 percent.
   3. Slump range: 2 inches to 4 inches.
   4. Pozzolan:
      a. Minimum of 15 percent pozzolan.
      b. Maximum of 25 percent pozzolan.

PART 3 EXECUTION

3.01 INSTALLATION

A. Concrete placement: As specified in to Section 03300 except as modified in this Section.

3.02 FIELD QUALITY CONTROL

A. Temperature Monitoring Program:
   1. Install a temperature monitoring system to measure temperatures in the interior and near the surface of the concrete.
   2. Continuously monitor the temperature of the interior of the concrete and surfaces of the concrete during the cooling period.
   3. Temperature monitoring data not conforming to requirements of this Section:
      a. Stop placing mass concrete.
      b. Concrete not conforming to temperature requirements of this Section will be rejected. Remove rejected mass concrete at Contractor's expense.
      c. Modify Thermal Control Plan and calculations to correct problem and resubmit.
      d. Do not place mass concrete until revised Thermal Control Plan and calculations have been accepted by Engineer.

END OF SECTION

SECTION 03366

TOOLED CONCRETE FINISHES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Tooled concrete finishes.

1.02 QUALITY ASSURANCE

A. Mock-ups:
   1. Test panels for concrete finishes:
      a. Prepare test panels for F4 and F5 finishes and tie-hole repairs for review by ENGINEER.
      b. Accepted test panels serve as standard of quality and workmanship for project.
   2. Prepare test panel showing horizontal and vertical joints proposed for project for review by the ENGINEER. Refer to finishes specified in this Section.
   3. Test panels indicating methods for making concrete repairs: Prepare test panels for proposed repairs at beginning of project for review by ENGINEER:
      a. Accepted test panels serve as standard for repairs during the project.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver and store packaged materials in original containers until ready for use.

PART 2 PRODUCTS

2.01 MIXES

A. Mortar mix for F4 finish: Consist of 1 part cement and 1-1/2 parts of fine sand passing Number 100 screen. Mix with enough water and emulsified bonding agent to have consistency of thick cream.

B. Mortar mix for F5 finish: Consist of 1 part cement to 1-1/2 parts of sand which passes Number 16 screen.

PART 3 EXECUTION

3.01 CONCRETE FINISHES

A. Cement for finishes:
   1. Addition of white cement may be required to produce finish which matches color of concrete to be finished.

B. Finish vertical concrete surfaces with one of the following finishes as indicated in the Finish Schedule:
   1. F1 finish: No special treatment other than repair defective work and fill depressions 1 inch or deeper and tie holes with mortar after removal of curing compound.
   2. F2 finish: No special treatment other than repair defective work, remove fins, fill depressions 1/2 inch or deeper and tie holes with mortar after removal of curing compound.
   3. F3 finish: Repair defective work, remove fins, offsets, and grind projections smooth. Fill depressions 1/4 inch or larger in depth or width and tie holes with mortar after removal of curing compound.
   4. F4 finish: Receive same finish as specified for F3 finish, and, in addition fill depressions and holes 1/16 inch or larger in width with mortar.
      a. "Brush-Off" sandblast surfaces prior to filling holes to expose all holes near surface of the concrete.
      b. Thoroughly wet surfaces and commence filling of pits, holes, and depressions while surfaces are still damp.
      c. Perform filling by rubbing mortar over entire area with clean burlap, sponge rubber floats, or trowels.
      d. Do not let any material remain on surfaces, except that within pits and depressions.
      e. Wipe surfaces clean and moist cure.
   5. F5 finish: Receive same finish as specified for F3 finish, and, in addition, receive special stoned finish, in accordance with following requirements:
      a. Remove forms and perform required repairs, patching, and pointing as specified in this Section.
      b. Wet surfaces thoroughly with brush and rub with hard wood float dipped in water containing 2 pounds of portland cement per gallon.
      c. Rub surfaces until form marks and projections have been removed.
      d. Spread grindings from rubbing operations uniformly over surface with brush in such manner as to fill pits and small voids.
      e. Moist cure brushed surfaces and allow to harden for 3 days:
         1) After curing, obtain final finish by rubbing with carborundum stone of approximately Number 50 grit until entire surfaces have smooth texture and are uniform in color.
         2) Continue curing for remainder of specified time.
      f. If any concrete surface is allowed to become too hard to finish in above specified manner, sandblast and wash related surfaces exposed to view, whether finished or not.
         1) While still damp, rub over surface, plastic mortar, as specified for brushed surfaces and handstoned with Number 60 grit carborundum stone, using additional mortar for brushed surfaces until surface is evenly filled without an excess of mortar.
         2) Continue stoning until surface is hard.
         3) After moist curing for 3 days, make surface smooth in texture and uniform in color by use of Number 50 or Number 60 grit carborundum stone.
         4) After stoning, continue curing until 7 day curing period is completed.

C. Finish horizontal concrete surfaces with one of the following finishes as indicated in the Finish Schedule after proper and adequate vibration and tamping:
   1. S1 finish: Screeded to grade and leave without special finish.
   2. S2 finish: Smooth steel trowel finish.
   3. S3 finish: Steel trowel finish free from trowel marks. Provide smooth finish free of all irregularities.
   4. S4 finish: Steel trowel finish, without local depressions or high points, followed by light hairbroom finish. Do not use stiff bristle brooms or brushes. Perform brooming parallel to slab-drainage. Provide resulting finish that is rough enough to provide nonskid finish. Finish is subject to review and acceptance by the ENGINEER.
   5. S5 finish: Nonslip abrasive: After concrete has been screeded level and hardened enough to support man standing on a board, sprinkle abrasive from shake screen into surface at uniform rate of 25 pounds for each 100 square feet of surface area, wood float into finish, then trowel abrasive into surface with steel trowel properly exposing abrasive in surface as required to provide nonslip surface.
   6. S6 finish: Roughened finish: After concrete has been screeded to grade, apply a roughened finish by use of a jitterbug roller or similar device.

D. Finish concrete floor surfaces to which surfacing material is applied: Finish smooth with tolerance within 1/8 inch in 10 feet in any direction from lines indicated on the Drawings.

3.02 CONCRETE FINISH SCHEDULE

A. Finish concrete surfaces as follows, unless indicated otherwise on the Drawings:
   1. F4 finish for following vertical surfaces:
      a. Concrete surfaces specified or indicated to be painted.
      b. Concrete surfaces, interior or exterior, exposed to view.
   2. Surfaces in open channels, basins, and similar structures:
      a. F3 finish for vertical surfaces which are normally below water surface.
      b. F4 finish for vertical surfaces located above normal water surface and exposed to view.
      c. Remove fins and fill tie holes from concrete surfaces located in closed boxes or channels where there is normally no access or passageway.
   3. S1 finish for following surfaces:
      a. Projecting footings which are to be covered with dirt.
      b. Slab surfaces which are to be covered with concrete fill.
   4. S2 finish for following surfaces:
      a. Tops of corbels.
      b. Tops of walls and beams not covered above in this Section.
      c. Tops of slabs not covered above in this Section.
      d. All other surfaces not specified to be finished otherwise.
   5. S3 finish for following surfaces:
      a. Building and machine room floors which are not covered with surfacing material: Provide floors that are free from trowel marks.
   6. S4 finish for following surfaces:
      a. Exterior walkways.
      b. Tops of exterior walls or beams which are to serve as walkways.

c. Tops of exterior walls or beams which are to support gratings.
d. Top surface of slabs for basins, channels, digesters, and similar structures.

7. S6 finish for following surfaces:
   a. Basin bottoms, or other similar slab surfaces, over which layer of basin bottom grout will be applied.

END OF SECTION

SECTION 03565

BASIN BOTTOM GROUT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Grouting basin bottom slabs.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03300 - Cast-in-Place Concrete.

1.02 REFERENCES

A. International Concrete Repair Institute (ICRI):
   1. 310.2 - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.

1.03 DEFINITIONS

A. When grouting basin bottom slabs:
   1. Grout that has not bonded: Is defined as grout that, after placing and setting, has hollow sound when tapped with 4-foot long, nominal, 2-inch by 4-inch piece of lumber.

B. Quality control submittals:
   1. Manufacturer's instructions:
      a. For equipment to be used in grouting basin bottom slabs:
         1) Submit grout placement instructions from manufacturer of equipment designated to operate in basin.
         2) Include in such instructions statements on limitations and precautions to be observed when using equipment for grout placement.

C. Jitterbug: an expanded metal or grate tamper designed for finishing concrete surfaces with a rough surface profile.

1.04 QUALITY ASSURANCE

A. Pre-installation conference for grouting basin bottom slabs: Schedule meeting with ENGINEER not less than 24 hours before planned grouting operations to discuss method of placement of grout.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials for grout:
   1. Cement, aggregate, sand, and water: As specified in Section 03300.
   2. Admixtures shall be as specified herein.

2.02 MIXES

A. Grout mix:
   1. Provide a grout mix that has a minimum 28-day compressive strength of 3,000 psi.
   2. Fly ash may be used in accordance with the provisions set forth in Section 03300.
   3. Aggregate shall not exceed size #4.
   4. Admixtures:
      a. Water-reducing admixture shall be included in the mix and shall be the following product or equivalent:
         1) Pozzolith 200N manufactured by BASF Construction Chemicals, Cleveland, OH.
            a) Dose at a minimum rate of 3.5 oz/cwt.
      b. Polypropylene fibers shall be included in the mix and shall be the following product or equivalent:
         1) MasterFiber M100 manufactured by BASF Construction Chemicals, Cleveland, OH.
            a) Dose at a minimum rate of 1.0 pound per cubic yard of grout.
   5. Water content:
      a. Sufficient to allow workability for spreading grout with screeds attached to arms of equipment mechanism.
      b. Not excessive, to prevent formation of surface water, laitance, segregation, and to allow grout to stay in place after screeding.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface preparation:
   1. Basin bottom slab surface preparation:
      a. Concrete slab surfaces shall have rough texture, suitable for bonding grout.
      a. During concrete placement: finish concrete surface with jitterbug. Do not provide a smooth troweled surface.
      b. Roughen top of slab surface to a ICRI 310.2 surface profile of CSP-5 or rougher using one of the following methods:
         1) Abrasive blasting.
         2) Steel shotblasting.
         3) High/ultra high-pressure water jetting.

c. Clean entire slab surface as required to remove dirt, oil, curing compound, laitance, dust, and other matter that may prevent proper grout bonding.
d. Saturate concrete slabs with water for minimum of 3 days just before placing grout. At time grout is placed, concrete shall be saturated and surface damp.

B. Equipment preparation:
1. Preparation of equipment for grouting basin bottom slabs:
a. Setting the screeds:
1) Bolt nominal 2-inch by 4-inch section of lumber blades on arms of equipment mechanism.
2) Locate leading edge of lumber approximately 2 inches in front of blade and cut it parallel to centerline of arm.
3) Securely nail nominal 2-inch by 6-inch screed board to ends of 2 by 4 lumber, in manner such that screed runs parallel to centerline of arm.
4) Nail bent sheet metal to lower edge of screed board.
5) Ensure that bottom of screed board is 1-1/2 inches below steel blades on arms of equipment mechanism.

3.02 APPLICATION

A. Grouting basin bottom slabs:
1. Placement, general:
a. Place grout in accordance with equipment manufacturer's instructions and in accordance with limitations and precautions given in such instructions.
b. Bring promptly to attention of the ENGINEER, conflicts between manufacturer's instructions and this Section.
2. Placing grout:
a. Use grouting equipment to apply grout for basin bottom slabs.
b. Perform grouting continuously without interruptions until basin slab is covered.
c. Place ring of grout approximately 3 feet wide on outer edge of slab and gradually widened towards center following spiral pattern until basin bottom slab is covered.
d. Unacceptable placing procedure: Following procedures will not be accepted:
1) Grouting by circular sectors or "pie" sections.
2) Grouting from center outward.
e. Use finishing workers to control area immediately in front of screed boards in manner so that:
1) Grout is installed to specified thickness.
2) No low areas occur.
3) No excessive amount of grout accumulates.
4) Grout surface has uniform wood trowel finish without ridges, gouges, or other defect.
f. Coordinate grout placement rate and number of finishing workers with travel speed of arms of equipment mechanism.
g. Last grout area to be grouted in center may be finished by worker operating from 1 of the arms.

3. Following grout placement:
    a. After completion of slab grouting, allow mechanism to run continuously until there is no more danger that grout sloughing may occur.
    b. Prevent dry clumps of grout or rocks from being caught under screed board and gouging finish surface of grout.
4. Corrections:
    a. Before grout has set:
        1) Where sloughing has occurred, remove grout from sloughed areas and place grout in low areas.
        2) Repair gouges in grouted surface.
5. Curing:
    a. After grout has set, water cure grout for 14 days.
    b. Keep grout surface continuously wet for duration of curing period.

B. Tolerances:
1. For grouting basin bottom slabs:
    a. Tolerance in elevation of finished grout surface: Plus or minus 1/8 inch.
        1) Specified tolerance is more exacting than customary industry standards for slab finish.
        2) Tolerance is required for proper operation of equipment.
    b. Thickness of grout layer:
        1) Not less than 1 inch at any point.
        2) Provide average thickness of grout as indicated on the Drawings.

3.03 FIELD QUALITY CONTROL

A. Inspection:
1. Verify grout elevation tolerance on basin bottom slabs as follows:
    a. After grout has set, operate grouting equipment with blades set to clear grout surface.
    b. Under these conditions, blades shall not clear grout surface by more than 1/4 inch at any point:
        1) Excess clearance: Correct as specified in article titled "Adjusting" in this Section.

3.04 ADJUSTING

A. Grouting basin bottom slabs:
1. After grout has set:
    a. Where clearance between blades and grouted surface exceeds tolerance specified in this Section, grind high points in grout surface using terrazzo machine until specified tolerance is met.
    b. Grout that has not bonded to concrete slab is not acceptable. Remove and replace such grout.

END OF SECTION

SECTION 03600

GROUTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cement grout.
   2. Cement mortar.
   3. Dry-pack mortar.
   4. Epoxy grout.
   5. Grout.
   6. Non-shrink epoxy grout.
   7. Non-shrink grout.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03071 - Epoxies.
      b. Section 03300 - Cast-in-Place Concrete.
      c. Section 15050 - Basic Mechanical Materials and Methods.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch or [50-millimeter] cube specimens).
   2. C 230 - Standard Specification for Flow Table for Use In Tests of Hydraulic Cement.
   3. C 531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   4. C 579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
   5. C 939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   6. C 942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
   7. C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
   8. C 1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

1.03 SUBMITTALS

A. Cement grout:
   1. Mix design.
   2. Material submittals.

B. Cement mortar:
   1. Mix design.
   2. Material submittals.

C. Non-shrink grout: Submit manufacturer's literature.

D. Non-shrink epoxy grout: Submit manufacturer's literature.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the jobsite in their original, unopened packages or containers, clearly labeled with the manufacturer's product identification and printed instructions.

B. Store materials in a cool dry place and in accordance with the manufacturer's recommendations.

C. Handle materials in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Non-shrink epoxy grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Fairfield, CT, Five Star Epoxy Grout.
      b. BASF Construction Chemicals, Shakopee, MN, Masterflow 648 CP Plus.
      c. L&M Construction Chemicals, Inc., EPOGROUT.
   2. Non-shrink epoxy grout shall be a 100 percent solid, premeasured, prepackaged system containing a 2-component thermosetting epoxy resin and inert aggregate.
   3. Maintain a flowable consistency for at least 45 minutes at 70 degrees Fahrenheit.
   4. Shrinkage or expansion (less than 0.0006 inches/inch) when tested in accordance with ASTM C 531.
   5. Minimum compressive strength: 10,000 pounds per square inch at 24 hours and 14,000 pounds per square inch at 7 days when tested in accordance with ASTM C 579, Method B.
   6. Compressive creep: Not exceed 0.0027 inches/inch when tested under a 400-pound-per-square-inch constant load at 140 degrees Fahrenheit in accordance with ASTM C 1181.
   7. Coefficient of thermal expansion: Not exceed 0.000018 inches per inch per degree Fahrenheit when tested in accordance with ASTM C 531, Method B.

B. Non-shrink grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Fairfield, CT, Five Star Grout.
      b. BASF Construction Chemicals, Shakopee, MN, Masterflow 928.
      c. L&M Construction Chemicals, Inc., Omaha, NE, CRYSTEX.
   2. In accordance with ASTM C 1107.
   3. Preportioned and prepackaged cement-based mixture:
      a. It shall contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings.
      b. It shall require only the addition of potable water.
   4. Water for pre-soaking, mixing, and curing: Potable water.
   5. Free from the emergence of mixing water from within or the presence of water on its surface.
   6. Remain at a minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit when tested in accordance with ASTM C 230.
      a. If at a fluid consistency, it shall be verified in accordance with ASTM C 939.
   7. Dimensional stability (height change):
      a. In accordance with ASTM C 1107, volume-adjusting Grade B or C at 45 degrees Fahrenheit to 90 degrees Fahrenheit.
      b. Have 90 percent or greater bearing area under bases.
   8. Have minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C 1107 for various periods from the time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C 109 as modified by ASTM C 1107.

2.02 MIXES

A. Cement grout:
   1. Consist of concrete mix with coarse aggregate removed and water quantity adjusted as required.
   2. Use the same materials for cement grout that are used for concrete.
   3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
   4. For spreading over the surfaces of construction or cold joints. Mix with no more water used than allowed by water-to-cementitious materials ratio specified for concrete.

B. Cement mortar:
   1. Consist of concrete mix with coarse aggregate removed and water quantity adjusted as required.
   2. Use the same materials for cement mortar that are used for concrete.
   3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
   4. At exposed concrete surfaces not to be painted or submerged in water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.

C. Dry-pack mortar:
   1. Mix in proportions by weight of 1 part portland cement to 2 parts of concrete sand.
      a. Portland cement: As specified in Section 03300.
      b. Concrete sand: As specified in Section 03300.
   2. Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.

D. Epoxy grout:
   1. Consist of mixture of epoxy or epoxy gel and concrete sand.
      a. Epoxy: As specified in Section 03071.
      b. Epoxy gel: As specified in Section 03071.
      c. Sand: Clean, bagged, graded, and kiln-dried silica sand.
   2. Proportioning:
      a. For horizontal work: Consist of mixture of 1 part epoxy with not more than 2 parts sand.
      b. For vertical or overhead work: Consist of 1 part concrete epoxy gel with not more than 2 parts sand.

E. Grout:
   1. Mix in proportions by weight of 1 part portland cement to 4 parts of concrete sand.
      a. Portland cement: As specified in Section 03300.
      b. Concrete sand: As specified in Section 03300.

F. Non-shrink epoxy grout: Mix in accordance with manufacturer's installation instructions.

G. Non-shrink grout: Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect concrete surfaces to receive grout or mortar and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and all loose material or foreign matter likely to reduce the bond or performance of grout or mortar.

3.02 PREPARATION

A. Surface preparation:
   1. Remove grease, oil, dirt, curing compounds, laitance, and other deleterious materials that may affect bond from concrete and bottoms of baseplates.
   2. Roughen concrete surfaces by heavy sandblasting, waterblasting, chipping, or other mechanical means.
      a. Remove loose or broken concrete.
   3. Metal surfaces: Sandblast to a 2 to 3 mil peak-to-valley profile.

3.03 PLACEMENT

A. General:
   1. Use mortar mixer with moving paddles for mixing grouts. For cement grouts, pre-wet the mixer and empty out excess water before beginning mixing.

B. Cement grout:
   1. Exercise particular care in placing cement grout since it is required to furnish structural strength, impermeable water seal, or both.
   2. Do not use cement grout that has not been placed within 30 minutes after mixing.

C. Epoxy grouts:
   1. Use where indicated on the Drawings.
   2. Wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.

D. Non-shrink grout:
   1. Add non-shrink cement grout to a premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
   2. Mix in accordance with manufacturer's instructions to uniform consistency.
   3. May be drypacked, flowed, or pumped into place. Do not overwork grouts.
   4. Do not retemper grout by adding more water after stiffening.

E. Non-shrink epoxy grout:
   1. Mix in complete units. Do not vary the ratio of components or add solvent to change the consistency of the mix.
   2. Pour the hardener into the resin and mix for at least 1 minute and until mixture is uniform in color. Pour the epoxy into a mortar mixer wheelbarrow and add the aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in the mix.
   3. Keep temperature of non-shrink epoxy grout from exceeding manufacturer's recommendations.

F. Curing:
   1. Cement based grouts:
      a. Non-shrink grout: Cure in accordance with manufacturer's recommendations. Keep grout wet for a minimum of 7 days. Use wet burlap, a soaker hose, sun shading, ponding, and in extreme conditions, a combination of methods.
      b. Maintain grout above 40 degrees Fahrenheit until it has attained a compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for a minimum of 24 hours to avoid damage from subsequent freezing.

G. Epoxy based grouts:
   1. Cure grouts in accordance with manufacturers' recommendations.
      a. Do not wet cure epoxy grouts.
   2. Do not allow any surface in contact with epoxy grout to fall below 50 degrees Fahrenheit for a minimum of 48 hours after placement.

H. Make arrangements to have a non-shrink grout manufacturer's representative present for preconstruction meeting and during initial grout placement.

I. Grouting equipment bases and baseplates: As specified in Section 15050.

J. Grouting other baseplates:
   1. General:
      a. All baseplate grouting shall take place from one side of a baseplate to the other in a continuous flow to avoid trapping air.
      b. Hydrostatic head pressure shall be maintained by keeping the level of the grout in the head box above the bottom of the baseplate. The head box should be filled to the maximum level and the grout worked down.
   2. Forms and head boxes:
      a. Build forms for grouts of material with adequate strength to withstand the placement of grouts.
      b. Forms shall be rigid and liquidtight. Caulk cracks and joints with an elastomeric sealant. Line forms with polyethylene for easy grout release. Forms carefully wax with 2 coats of heavy-duty paste wax will also be acceptable.
      c. Forms shall be 4 to 6 inches higher than the baseplate on one side of the baseplate configuration when using head pressure for placement.
   3. Non-shrink epoxy grout:
      a. Cut back epoxy grout after setting. Install epoxy grout with chamfer edges built into the formwork.

3.04 FIELD QUALITY CONTROL

A. Non-shrink grout: Test for 24-hour compressive strength in accordance with ASTM C 942.

B. Non-shrink epoxy grout: Test for 24-hour compressive strength in accordance with ASTM C 579, Method B.

END OF SECTION

SECTION 03926

STRUCTURAL CONCRETE REPAIR

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Repairing damaged structural concrete.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03071 - Epoxies.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 78 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
   2. C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens.
   3. C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
   4. C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
   5. C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

1.03 SYSTEM DESCRIPTION

A. General: Structural repair concrete composed of cementitious material capable of being placed in formed vertical and overhead applications, and on horizontal surfaces.

B. Design requirements:
   1. Provide material suitable for performing in environments subject to corrosive attack by chlorides and sulfates, freeze/thaw cycles, low permeability, and abrasion resistant.
   2. Provide concrete repair mortar cement that is placeable from 1 inch in depth and extendable in greater depths.
   3. Concrete repair mortar shall be capable of being poured in place or troweled in place to suit the conditions encountered.

1.02 SUBMITTALS

A. Product data: Submit manufacturer's data completely describing structural repair concrete materials.

B. Certificates of Compliance.

C. Manufacturer's Instructions.

1.03 QUALITY ASSURANCE

A. Manufacturer qualifications: The manufacturer of the specified product shall have been in existence, for a minimum of 10 years.

B. Allowable tolerances: Deviation from plumb or level shall not exceed 1/8 inch within 10 feet in any direction, as determined with a 10-foot straight edge.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver the specified product in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers.

B. Store and condition the specified product as recommended by the manufacturer.

C. Deliver, store, and handle packaged materials in the manufacturer's original, sealed containers, each clearly identified with the manufacturer's name, and name and type of product.

D. Store materials subject to damage by dirt and moisture in a clean, dry location, off the ground, and suitably protected.

1.05 PROJECT CONDITIONS

A. Existing conditions:
   1. Hot weather: ACI 305.
   2. Cold weather: ACI 306.
   3. Do not place concrete repair mortar during precipitation, unless adequate protection is provided.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural repair concrete:
   1. Manufacturers: One of the following or equal:
      a. Master Builders, “EMACO S66-CR.”
      b. Sika, "Sikatop 123 Plus."
   2. Compressive strength: As follows in accordance with ASTM C 109:
      a. 1 day: 2,500 pounds per square inch, minimum.
      b. 7 day: 6,000 pounds per square inch, minimum.
      c. 28 day: 8,000 pounds per square inch, minimum.

3. Bond strength: 2,200 pounds per square inch minimum at 28 days, in accordance with ASTM C 882 modified.
4. Slant shear bond strength: 3,300 pounds per square inch minimum at 28 days, in accordance with ASTM C 496.
5. Flexural strength: 770 pounds per square inch minimum at 28 days, in accordance with ASTM C 78.
6. Rapid freeze/thaw durability: in accordance with ASTM C 666; Procedure A.
   a. Relative durability factor at 300 cycles: 90 minimum.
7. Working time: 30 to 40 minutes.
8. Color: Concrete gray.

B. Water: Potable, clean, not detrimental to concrete.

C. Form materials:
   1. Smooth finish. Brace as required to maintain tolerances.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that concrete surfaces and exposed reinforcing are clean and free of contaminates.

3.02 PREPARATION

A. Prepare existing concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. Thoroughly clean reinforcement and other embedded items to remove loose rust and other objectionable matter.

C. Thoroughly wet wood forms, except coated plywood, and adjacent concrete at least 1 hour in advance of placing concrete; securely close cleanout end inspection ports; repeat wetting as necessary to keep forms damp.

3.03 PREPARATION

A. Damaged concrete:
   1. Areas to be repaired shall be clean, sound, and free of contaminants.
      a. Remove all loose and deteriorated concrete by mechanical means acceptable to the ENGINEER.
      b. Saw cut perimeter 1/2-inch maximum.
   2. Chip concrete substrate to obtain a surface profile of 1/16 inch to 1/8 inch in depth with a new fractured aggregate surface.
      a. The area to be repaired shall be not less than 1 inch in depth.
   3. Concrete removal shall extend along the reinforcing steel to locations along the bar free of bond inhibiting corrosion, and where the bar is well bonded to surrounding concrete.

B. Use the following procedures where reinforcing steel with active corrosion is encountered:
   1. Sandblast reinforcing steel to remove all contaminants and rust.

2. Determine section loss, splice new reinforcing steel where there is more than 15 percent loss as directed by the ENGINEER.
    a. If more than half the diameter of the reinforcing steel is exposed, chip out behind the reinforcing steel a minimum of 1/2 inch. The distance chipped behind the reinforcing steel must also equal or exceed the minimum placement depth of the accepted material.

C. Treat cracks in the substrate at the area of patching or overlay work as directed by the ENGINEER.

D. Extend existing control and expansion joints through any concrete repair.

E. Apply an epoxy-bonding agent to area to be repaired, as specified in Section 03071, prior to patching concrete with polymer-modified portland cement mortar.

3.04 MIXING

A. Mix in accordance with manufacturer's mixing instructions.

3.05 INSTALLATION

A. Formed surface finishes:
    1. Smooth finish:
        a. Obtain by the use of plywood, sheet metal, or lined wood forms; no fins, pockmarks, or other irregularities shall be present in the exposed surfaces of concrete.
        b. Place no structural repair concrete without prior authorization of ENGINEER.

B. Verify that form materials are in place and ready to receive installation of concrete repair material.

C. Install in accordance with manufacturer's installation instructions.

D. In accordance with ACI recommendations, apply concrete repair material only when ambient conditions of moisture, temperature, humidity, and wind are favorable for curing.

E. Scrub mortar into substrate, filling all cracks, voids, and pores.

F. For new construction, finish of repaired area shall match required finish for concrete being repaired.

G. For existing concrete, finish of repair area shall match finish of concrete being repaired.

H. During the curing process, protect concrete repair from rain, wind, or freezing as required.
    1. Keep sufficient covering on hand at all times for protection of repair concrete.

3.06 CLEANING

A. Remove debris and excess material. Leave work site in a neat, clean condition.

END OF SECTION

SECTION 03931

EPOXY INJECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Epoxy injection system.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 638 - Standard Test Method for Tensile Properties of Plastics.
   2. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
   3. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SUBMITTALS

A. Product data:
   1. Submit manufacturer's data completely describing epoxy injection system materials.

B. Quality control submittals:
   1. Certificates of Compliance.
   2. Manufacturer's Instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturers: One of the following or equal:
   1. Master Builders, Inc., Concressive Standard LVI.
   2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.

B. Epoxy:
   1. Use epoxy materials that are new and use them within shelf-life limitations set forth by manufacturer.
   2. Water-insensitive 2-part type low viscosity epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified:

Physical Characteristic	Test Method	Required Results
Tensile Strength	ASTM D 638	8,000 pounds per square inch at 14 days.
Flexure Strength	ASTM D 790	11,000 pounds per square inch at 14 days.
Compressive Strength	ASTM D 695	11,000 pounds per square inch at 24 hours.
Bond Strength	--	Concrete shall fail before failure of epoxy.
Gel Time for 5 Mil Film	--	4 hours maximum.
Elongation	ASTM D 638	1 percent minimum at 14 days.

2.02 EQUIPMENT

A. Injection pump:
   1. Use positive displacement injection pump with interlock to provide in-line mixing and metering system for 2-component epoxy.
   2. Use pressure hoses and injection nozzle designed to properly mix of 2 components of epoxy.
   3. Standby injection unit may be required.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface preparation:
   1. Sweep or clean area in vicinity of cracks that will be injected with epoxy. Leave area in generally clean condition after epoxy injection is complete.
   2. Clean cracks so they are free from dirt, laitance, and other loose matter.

3.02 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Mix epoxy in accordance with manufacturer's installation instructions.

C. Do not use solvents to thin epoxy.

D. Crack injection:
   1. Apply adequate surface seal to crack to prevent leakage of epoxy.
   2. Establish injection points at distance along crack not less than thickness of cracked member.
   3. Crack injection sequence:
      a. Inject epoxy into crack at first port with sufficient pressure to advance epoxy to adjacent port.
      b. Seal original port and shift injection to port where epoxy appears.
      c. Continue port-to-port injection until crack has been injected for its entire length.
      d. For small amounts of epoxy, or where excessive pressure developed by injection pump might further damage structure, premixed epoxy and use hand caulking gun to inject epoxy if acceptable to the ENGINEER.
      e. Seal ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out.
      f. After epoxy injection is complete, remove surface seal material and refinish concrete in area where epoxy was injected to match existing concrete.

END OF SECTION

SECTION 04055

EPOXY BONDING REINFORCING BARS AND ALL THREAD RODS IN MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bonding reinforcing bars and all thread rods in masonry using epoxy adhesive.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.
      b. Section 03200 - Concrete Reinforcing.
      c. Section 05120 - Structural Steel.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

B. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC58 - Acceptance Criteria for Adhesive Anchors in Masonry Elements.

C. Society for Protective Coatings (SSPC):
   1. Surface Preparation Standards (SP).
      a. SP-1 - Solvent Cleaning.

1.03 SUBMITTALS

A. Product Data: Furnish technical data for epoxy adhesives, including:
   1. Installation instructions.
   2. Independent laboratory test results.
   3. Handling and storage instructions.

B. Quality control submittals:
   1. Epoxy manufacturer's past project experience data on at least 3 similar projects supplied with proposed products within the last 3 years.

2. Special inspection: Provide detailed step-by-step instructions for the special inspection procedure in accordance with the building code as specified in Section 01410.
3. ICC Evaluation Service, Inc., Evaluation Services Report in compliance with the AC58-Acceptance Criteria for Adhesive Anchors in Masonry Elements.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection.
1. Store epoxy components on pallets or shelving in a covered-storage area.
2. Control temperature above 60 degrees F and dispose of product if shelf life has expired.
3. If stored at temperatures below 60 degrees F, test components prior to use to determine if they still meet specified requirements.

1.05 PROJECT CONDITIONS

A. Seismic design category: D.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

2.02 EPOXY ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

A. Epoxy adhesive shall have a current ICC Evaluation Service report documenting acceptance under AC58 for use with masonry and for the seismic design categories specified.

B. Materials:
1. In accordance with ASTM C 881, Type IV, Grade 3, Class B or C depending on site conditions.
2. 2-component, 100 percent solids, insensitive to moisture, and gray in color.
3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

C. Packaging.
1. Furnished in side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer’s static mixing nozzle. Nozzle designed to thoroughly blend the components for injection from the nozzle directly into prepared hole.
2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

D. Manufacturers: One of the following or equal:
1. Hilti, Inc., Tulsa, OK: HIT HY 150 Max Adhesive Anchor Systems.
2. Simpson Strong-Tie Company, Inc., Pleasanton, CA: SET Adhesive Anchor Systems.

2.03 ALL THREAD RODS

A. Materials: As specified in Section 05120.

2.04 REINFORCING BARS

A. As specified in Section 03200.

PART 3 EXECUTION

3.01 GENERAL

A. Provide Epoxy Adhesive Packaged as Follows:
   1. Disposable, self-contained cartridge system capable of dispensing both epoxy components in the proper mixing ratio, and fit into a manually or pneumatically operated caulking gun.
   2. Dispense components through a mixing nozzle that thoroughly mixes components.

3.02 HOLE SIZING AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device, and mark locations with construction crayon on the surface of the masonry.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing masonry without acceptance by ENGINEER.

B. Hole drilling equipment:
   1. Electric or pneumatic rotary impact type with medium or light impact.
   2. Drill bits: Carbide-tipped in accordance with ANSI B212-15 unless otherwise recommended by the manufacturer or required as a “condition of use” in the ICC Evaluation Report submitted.
   3. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.
   4. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and masonry spalling during drilling process.

C. Hole diameter: Reinforcing bar diameter or all thread rod diameter plus 1/8 inch.

D. Obstructions in drill path:
   1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling hole and fill the hole with drypack mortar. Relocate the hole to miss the obstruction and drill another hole. Repeat the above until the hole has been drilled to the required depth.
   2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the structural member and endanger the stability of the structure. Drypack holes which hit obstructions and allow drypack to reach strength equal to the existing masonry before drilling adjacent holes. Epoxy grout may be substituted for drypack when acceptable to ENGINEER.

3. When existing reinforcing steel is encountered during drilling and if acceptable to ENGINEER, enlarge hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.
4. Bent bar reinforcing bars: Where edge distances are critical, and striking reinforcing steel is likely, and if acceptable to ENGINEER, drill hole at 10-degree angle or less from axis of reinforcing bar or all thread rod being installed.

E. Install reinforcing bars and all thread rods to depth, spacings, and locations as indicated on the Drawings.
1. Do not install epoxy bonded all-thread rods or reinforcing bars in overhead applications.

F. Cleaning holes:
1. Insert long air nozzle into hole and blow out loose dust. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
2. Dislodge compacted drilling dust by vigorously brushing with a stiff bristle brush.
3. Repeat step 1.
4. Repeat above steps as required to remove drilling dust or other material that will reduce bond. The hole shall be clean and dry.

G. Cleaning reinforcing bars and all thread rods:
1. Solvent clean reinforcing bar and all thread rods over the embedment length in accordance with SSPC SP-1 Solvent Cleaning. Provide an oil and grease free surface to promote bonding of adhesive to steel.
2. Clean reinforcing bars and all thread rods over embedment length to bare metal. The reinforcing bars and all thread rods shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.

H. Filling hole with epoxy:
1. Fill hole with epoxy before inserting reinforcing bar or all thread rod. Fill hole with epoxy starting from bottom of hole. Fill hole without creating air voids.
2. Fill hole with sufficient epoxy so that excess epoxy is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.
3. Do not install epoxy prior to receiving epoxy manufacturer's onsite training.

3.03 MANUFACTURERS' SERVICES

A. Furnish manufacturer's representative to conduct jobsite training for proper installation, handling, and storage of epoxy, for personnel who will perform actual installation. ENGINEER may attend training sessions.

3.04 FIELD QUALITY CONTROL

A. Testing laboratory hired by OWNER will:
1. Review epoxy manufacturer’s recommended special inspection procedures.
2. Periodically inspect hole-drilling operations for conformance with Contract Documents and manufacturer’s recommendations.
3. Certify in writing to the ENGINEER that depth and location of holes conform to the requirements in the Contract Documents prior to placement of epoxy.
4. Continuously inspect placement of epoxy and reinforcing bars installation.

END OF SECTION

SECTION 04090

MASONRY ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Control joint filler.
   2. Reinforcing bars.
   3. Sheet metal ties.
   4. Water repellent.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 03102 - Concrete Formwork.
      b. Section 04220 - Concrete Unit Masonry.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   4. A 641 - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   5. A 951 - Standard Specification for Masonry Joint Reinforcement.
   6. C 549 - Standard Specification for Perlite Loose Fill Insulation.
   7. D 2000 - Standard Classification System for Rubber Products in Automotive Applications.
   8. D 2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

1.03 SUBMITTALS

A. Shop drawings.

B. Product data.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Control joint filler: The key shall be of the width and shape as indicated on the Drawings. In accordance with ASTM D 2000 or ASTM D 2287.
   1. Manufacturers: One of the following or equal:
      a. AA Wire Products, Inc., AA2000 Blok-Tite.
      b. Dur-O-Wall, Rapid Poly-Joint.
      c. Vert-A-Joint Co., Vert-A-Joint.

B. Reinforcing bars: In accordance with ASTM A 615, Grade 60, deformed billet steel bars.

C. Sheet metal ties: Minimum 22 gauge corrosion resistant corrugated sheet metal, minimum 7/8 inch wide by 7 inches long, pre-punched for wire ties to wire joint reinforcement.

D. Water repellent: Water based, methacrylate polymer with aqueous polysiloxane.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products as specified in Section 04220.

END OF SECTION

SECTION 04100

MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Mortar and grout for masonry construction.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 144 - Standard Specification for Aggregate for Masonry Mortar.
   2. C 150 - Standard Specification for Portland Cement.
   3. C 207 - Standard Specification for Hydrated Lime for Masonry Purposes.
   4. C 270 - Standard Specification for Mortar for Unit Masonry.
   5. C 404 - Standard Specification for Aggregates for Masonry Grout.
   6. C 476 - Standard Specification for Grout for Masonry.
   7. C 780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
   8. C 1019 - Standard Test Method for Sampling and Testing Grout.

1.03 DEFINITIONS

A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.

1.04 PERFORMANCE REQUIREMENTS

A. Compressive strength:
   1. Mortar: Minimum 1,800 pounds per square inch at 28 days.
   2. Grout: Minimum 2,000 pounds per square inch at 28 days.

1.05 SUBMITTALS

A. Product data.

B. Shop drawings.

C. Design Mixes for mortar and grout.

D. Test reports:
   1. Mortar Strength Test Results.
   2. Grout Strength Test Results.

1.06 QUALITY ASSURANCE

A. Materials for mortar and grout: Do not change source of materials which will affect the appearance of finished work after the work has started unless acceptable to ENGINEER.

1.07 PROJECT CONDITIONS

A. Environmental requirements:
   1. Cold weather requirements:
      a. Cold Weather Construction: In accordance with the building code as specified in Section 01410.
      b. Provide adequate equipment for heating mortar and grout materials when air temperature is below 40 degrees Fahrenheit.
         1) Temperatures of separate materials, including water, shall not exceed 140 degrees Fahrenheit when placed in mixer.
         2) Maintain mortar temperature on boards above freezing.
   2. Hot weather requirements:
      a. Wet mortar board before loading and cover mortar to retard drying when not being used.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland cement:
   1. Type II, low alkali, containing maximum 0.6 percent total alkal in accordance with ASTM C 150.

B. Hydrated lime:
   1. Type S in accordance with ASTM C 207.

C. Aggregate for mortar:
   1. Fine aggregate: Sand in accordance with ASTM C 144.

D. Aggregate for grout:
   1. Fine aggregate: Size Number 2 in accordance with ASTM C 404.
   2. Coarse aggregate: Size Number 8 in accordance with ASTM C 404.

E. Admixtures:
   1. Grout admixture:
      a. Manufacturers: One of the following or equal:
         1) Sika Corp., Sika Grout Aid, Type II.
         2) Concrete Emulsions, Grout Aid GA-II.

2. Mortar water repellent admixture:
   a. Manufacturers: One of the following or equal:
      1) Sika Corp., Sikaproof 85.
      2) W.R. Grace, Dry Block Mortar.
      3) BASF, Rheopel Plus Mortar Admixture.
3. Other admixtures:
   a. Prohibited, unless accepted by the ENGINEER.

F. Water: Clean, clear, potable, free of oil, soluble salts, chemicals, and other deleterious substances.

G. Other materials:
   1. Prohibited, unless acceptable to ENGINEER.

2.02 MIXES

A. Mortar mix:
   1. Portland cement-lime mortar.
   2. Mortar mix proportions by volume: As indicated in the following table:

Mortar Type	Parts by Volume of Portland Cement	Parts by Volume of Hydrated Lime	Aggregate Measured in a Damp Loose Condition
S	1	Greater than 1/4 to 1/2	Not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials
N	1	Greater than 1/2 to 1 1/4	Not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials

   3. Mortar mixing:
      a. Mix on jobsite in accordance with ASTM C 270.
      b. Mix in mechanical mixer and only in quantities needed for immediate use.
      c. Mix for minimum 3 minutes, and maximum of 5 minutes after materials have been added to mixer.
   4. Measurement by volume: Measurement of constituents shall be accomplished by the use of a container of known capacity.
   5. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units.
      a. Use no mortar which has been standing for more than 1 hour after being mixed.
   6. Whenever 90 minutes has elapsed since last batch was mixed, completely empty mixer drum of materials and wash down before placing next batch of materials.

B. Grout mix:

1. Grout mix proportions by volume: As indicated in the following table:

Type of Grout	Parts by Volume of Portland Cement	Parts by Volume of Hydrated Lime	Aggregate Measured in a Damp Loose Condition	
			Fine Aggregate	Coarse Aggregate
Fine grout	1	0-1/10	2-1/4 to 3 times the sum of the volumes of the cementitious materials	-
Coarse grout	1	0-1/10	2-1/4 to 3 times the sum of the volumes of the cementitious materials	1 to 2 times the sum of the volumes of the cementitious materials

2. Grout mixing:
   a. Mix on jobsite or in a transit mix in accordance with ASTM C 476
   b. Slump: 8 to 11 inches, unless otherwise accepted by the ENGINEER.
   c. Use within 90 minutes after addition of mixing water.
   d. Mix for minimum of 5 minutes after ingredients are added and until uniform mix is attained. Grout shall have sufficient water added to produce pouring consistency without segregation.
3. Use coarse grout for hollow cell masonry units with minimum 4-inch cell dimensions in both horizontal directions.
   a. Calculate cell dimension for this criterion by subtracting diameter(s) of any horizontal reinforcement crossing the cell from clear cell dimensions of the masonry unit.

2.03 SOURCE QUALITY CONTROL

A. Tests:

1. Trial batches:
   a. Have trial batches of mortar and grout prepared by testing laboratory acceptable to ENGINEER.
   b. Prepare trial batches with sufficient quantity to determine slump, workability, and consistency and to provide sufficient material for tests.
2. Mortar trial batch strength testing:
   a. Compressive strength tests on trial batches of mortar: In accordance with ASTM C 780, Annex A7 by an independent testing laboratory acceptable to the ENGINEER.
   b. Cost of tests and trial batches shall be paid by the CONTRACTOR.
3. Grout trial batch strength testing:
   a. Compressive strength tests of trial batches of grout: In accordance with ASTM C 1019 by an independent testing laboratory acceptable to the ENGINEER.
   b. Cost of tests and trial batches shall be paid by the CONTRACTOR.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Testing of grout and mortar:
   1. During progress of construction, the OWNER will have tests made to determine whether the grout and mortar, as being produced, complies with Specifications.
   2. Compressive strength tests for mortar: In accordance with ASTM C 780, Annex A7 as modified in the following paragraphs.
      a. Spread mortar on the masonry units in a layer 1/2 to 5/8 inch thick.
      b. Allow mortar to stand for one minute, then remove and place in a 2-inch by 4-inch cylinder mold. Place mortar in two layers compressing the mortar using the flat end of a stick or fingers. Lightly tap the mold on opposite sides. Level off and immediately cover molds, keeping them damp until taken to the laboratory.
      c. After 48 hour set, remove mortar specimens from molds and store in a fog room until tested. Water curing (curing in tanks) is not permitted.
      d. Test specimens in damp condition.
   3. Compressive strength test for grout: In accordance with ASTM C 1019.
   4. The ENGINEER will make and deliver test specimens to the laboratory and testing expense will be borne by the OWNER.
   5. Required number of tests:
      a. At least 2 test specimens of grout and mortar will be made per week.
   6. Do not use grout and mortar that does not meet specification.
      a. Remove such mortar and grout from Project site.
   7. Make provisions for and furnish grout and mortar for test specimens, and provide manual assistance to the ENGINEER in preparing test specimens.
   8. Assume responsibility for care of and providing proper curing conditions for test specimens.

3.02 ADJUSTING

A. Repair of defective masonry:
   1. Remove and replace or repair defective work.
   2. Do not patch, repair, or cover defective work without inspection by the ENGINEER.
   3. Provide repairs having strength equal to or greater than specified strength for areas involved.

END OF SECTION

SECTION 04220

CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete masonry units and accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01312 - Project Meetings.
      b. Section 01410 - Regulatory Requirements.
      c. Section 01455 - Special Tests and Inspections.
      d. Section 04090 - Masonry Accessories.
      e. Section 05120 - Structural Steel.
      f. Section 07190 - Water Repellents.
      g. Section 07900 - Joint Sealants.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 90 - Standard Specification for Loadbearing Concrete Masonry Units.
   2. C 140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   3. C 426 - Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

1.03 DEFINITIONS

A. Standard Level of Quality: High quality, but conventional, nearly free of chips, cracks, or other imperfections detracting from appearance when discernible and identified from distance of 20 feet under diffused lighting. When level of quality is not specified, Standard Level of Quality shall be assumed.

1.04 SUBMITTALS

A. Product data: Submit manufacturer's product data for split face block.

B. Shop drawings: Include elevations of each wall indicating type and layout of units, including type of mortar joints, bond pattern, reinforcing steel, connecting dowels, joint reinforcement, grouted cells, and control joints.

C. Samples: Include samples of stretcher units in sufficient quantity to illustrate color range.

D. Test reports:
   1. Compressive strength.
   2. Linear shrinkage.
   3. Moisture content as a percentage of total absorption.
   4. Total absorption.
   5. Unit weight.

1.05 QUALITY ASSURANCE

A. Mock-up:
   1. Prior to starting construction of masonry, construct minimum 4-foot square mock-up.
   2. Use accepted materials containing each different kind and color of concrete masonry units to illustrate wall design.
   3. When not accepted, construct another mock-up.
   4. When accepted, mock-up will be standard of comparison for remainder of masonry work.
   5. Upon completion of Project, dispose of mock-ups in legal manner at offsite location.

B. Pre-installation conference: Conduct as specified in Section 01312.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle concrete masonry units as required to prevent discoloration, chipping, and breakage.

B. Store masonry units off the ground in a dry location, covered and protected from absorbing moisture. Locate storage piles, stacks, and bins to protect materials from heavy traffic.

C. Remove chipped, cracked, and otherwise defective units from jobsite upon discovery.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Cold weather requirements:
   1. In accordance with building code as specified in Section 01410, provide adequate equipment for heating masonry materials when air temperature is below 40 degrees F.

B. Hot weather requirements:
   1. In accordance with building code as specified in Section 01410, when ambient air temperature exceeds 100 degrees F, or when ambient air temperature exceeds 90 degrees F and wind velocity is greater than 8 miles per hour, implement hot weather protection procedures.
   2. Wet mortarboard before loading and cover mortar to retard drying when not being used.

3. Do not spread mortar beds more than 48 inches ahead of placing masonry units.
4. Place masonry units within one minute of spreading mortar.

1.08 SEQUENCING AND SCHEDULING

A. Order concrete masonry units well before start of installation to ensure adequate time for manufacturing and minimum 28 days for curing and drying before start of installation. Protect from weather after curing period to avoid moisture increase.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Hollow load bearing concrete masonry units:
   1. Type: Type 1, moisture controlled.
   2. Class: Class 2, medium weight, in accordance with ASTM C 90**,** Standard Level of Quality with minimum compressive strength of 1,900 pounds per square inch.
   3. Surface texture: Standard and split face.
   4. Color: Integral, Natural gray of concrete.
   5. Typical size: 8-inch wide by 8-inch high by 16-inch long, unless otherwise indicated on the Drawings or other sizes as needed to minimize cutting.
   6. Special sizes and shapes: As required for window and door openings, bond beams, piers, lintels, control joints, and other special applications to minimize cutting.
   7. Manufacturers: One of the following or equal:
      a. Angelus Block Co., Inc. - Fontana, CA.
      b. ORCO Block Co., Inc. - Stanton, CA.
      c. AirVol Block Inc. - San Luis Obispo, CA

B. Anchor bolts: As specified in Section 05120.

C. Steel reinforcement: As specified in Section 04090.

D. Wall ties: As specified in Section 04090.

E. Wire joint reinforcement: As specified in Section 04090.

F. Loose fill insulation: As specified in Section 04090.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection:
   1. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of concrete masonry units.

B. Surface preparation:
   1. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other matter that will reduce bond.

3.02 INSTALLATION

A. Forms and shores:
   1. Where required, construct forms to the shapes indicated on the Drawings:
      a. Construct forms sufficiently rigid to prevent deflection which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout.
      b. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support safely its weight and any construction loads to which it may be subjected.
         1) Wait at least 24 hours after grouting masonry columns or walls before applying uniform loads.
   2. Wait at least 72 hours before applying concentrated loads.

B. Concrete masonry units:
   1. Provide Standard Level of Quality.
   2. Lay concrete masonry units dry.
   3. Lay units in uniform and true courses, level, plumb, and without projections or offset of adjacent units.
   4. Lay units to preserve unobstructed vertical continuity of cells to be filled with grout or insulation.
   5. Align vertical cells to be filled with grout to maintain clear, unobstructed continuous vertical cell measuring not less than 2 by 3 inches.
   6. Place mortar with full coverage of joints at webs of all cells and face shells.
   7. Butter vertical head joints for thickness equal to face shell thickness of units, and shove joints tightly together so that mortar bonds to both masonry units.
   8. Solidly fill joints from face of units to inside face of cells.
   9. Lay units to desired height with joints of uniform thickness.
   10. Bond shall be plumb throughout.
   11. Lay units to avoid formation of cracks when units are placed. Keep cells of units as free of mortar as possible as masonry wall height increases.
   12. When positions of units shift after mortar has stiffened, bond is broken, or cracks are formed, relay units in new mortar.
   13. Remove mortar, mortar droppings, debris, and other obstructions and materials from inside of cell walls.
   14. Seal cleanouts after inspection and before grouting.

C. Bond pattern:
   1. Lay concrete masonry units in running bond pattern, unless otherwise indicated on the Drawings.

D. Mortar joints:
   1. Make joints straight, clean, smooth, and uniform in thickness.
   2. Tool exposed joints, slightly concave. Strike concealed joints flush.
   3. Make vertical and horizontal joints 3/8-inch thick.
   4. Where fresh masonry joins totally or partially set masonry, clean and roughen set masonry before laying new units.

E. Grouting and reinforcement:
   1. Where horizontal and vertical bars are spliced and adjacent lap splices are separated by more than 3 inches, the lap splice length shall be 72 bar diameters. Where adjacent lap splices are separated by 3 inches or less, the lap splice length shall be increased by 1.3 times or the lap splices shall be staggered at least 24 bar diameters with no increase in length.
   2. Hold vertical reinforcing bars in position at top and bottom and at intervals not exceeding 200 bar diameters. Use steel wire bar positioners to position bars. Tie reinforcing bars to dowels with wire ties.
   3. Obtain acceptance of reinforcement placement before grouting.
   4. Fill all spaces and cells solidly with grout:
      a. Low-lift grouting:
         1) Hollow unit masonry to be grouted by the low lift method shall be constructed and grouted in lifts not exceeding 4 feet.
         2) Slushing with mortar will not be permitted.
      b. High-lift grouting:
         1) Hollow unit masonry shall be allowed to cure at least 24 hours before grouting.
         2) Grout shall be placed in lifts not to exceed 6 feet in depth.
         3) Each lift shall be allowed to set for 10 minutes after initial consolidation of grout before successive lift is placed.
         4) The full height of each section of wall shall be grouted in 1 day.
   5. Grout in cells shall have full contact with surface of concrete footings.
   6. When grouting stops for 1 hour or longer, form horizontal construction joints by stopping grout placement 1-1/2 inches below top of uppermost unit containing grout.
   7. After placement, consolidate grout using mechanical immersion vibrators designed for consolidating grout.
   8. Placement:
      a. Use a hand bucket, concrete hopper, or grout pump.
      b. Place grout in final position within 1-1/2 hours after mixing. Place grout so as to completely fill the grout spaces without segregation of the aggregates.
      c. Do not insert vibrators into lower grout placements that are in a semi-solidified state.

F. Cutting concrete masonry units:
   1. When possible, use full units of the proper size in lieu of cut units. Cut units as required to form chases, openings, for anchorage, and for other appurtenances.
   2. Cut and fit units with power-driven carborundum or diamond disc blade saw.

G. Control joints:
   1. Provide in masonry walls at locations indicated on the Drawings.
   2. Make full height and continuous in appearance.
   3. Run bond beams and bond beam reinforcing bars continuously through control joints.
   4. Insert control joint filler in joints as wall is constructed.
   5. Apply sealant as specified in Section 07900.

H. Steel door frames:
   1. Anchor and fully grout jambs and head of steel doorframes connected to concrete unit masonry.
   2. Fill frames with grout as each 2 feet of concrete unit masonry is laid.

I. Anchor bolts:
   1. Hold anchor bolts in place with template during grouting to ensure precise alignment.
   2. Do not cut or ream members being anchored or use other means to accommodate misaligned anchor bolts in roof deck support angles.

J. Enclosures:
   1. Where concrete masonry units enclose conduit, pipes, stacks, ducts, and similar items, construct chases, cavities, and similar spaces as required, whether or not such spaces are indicated on the Drawings.
   2. Point openings around flush mounted electrical outlet boxes with mortar, including flush joints above boxes.
   3. Do not cover enclosures until inspected and when appropriate, tested.

K. Other embedded items:
   1. Build in wall plugs, accessories, flashings, pipe sleeves, and other items required to be built-in as the masonry work progresses.

L. Patching:
   1. Patch exposed concrete masonry units at completion of the Work and in such manner, that patching will be indistinguishable from similar surroundings and adjoining construction.

M. Water curing:
   1. Protect concrete masonry units from drying too rapidly by frequently fogging or sprinkling so walls will always be visibly damp for minimum 3 days.

N. Miscellaneous:
   1. Build in required items, such as anchors, flashings, sleeves, frames, structural steel, lintels, anchor bolts, and metal fabrications, as required for complete installation.

O. Water repellent:
   1. Apply water repellent as specified in Section 07190.

P. Anti-graffiti coating:
   1. Apply anti-graffiti coating as specified in Section 07190.

Q. Grouting equipment:
   1. Grout pumps:
      a. Do not pump grout through aluminum tubes.
      b. Operate pumps to produce a continuous stream of grout without air pockets.
      c. Upon completion of each days pumping, eject grout from pipeline without contamination or segregation of the grout:
         1) Remove waste materials and debris from the equipment.
         2) Dispose of waste materials, debris, and all flushing water outside the masonry.

2. Vibrators:
    a. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout.
    b. Maintain at least 1 spare vibrator, at the site at all times.
    c. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine.
    d. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.03 CONSTRUCTION

A. Site tolerances: Lay masonry plumb, true to line, and with courses level. Keep bond pattern plumb throughout. Lay masonry within the following tolerances:
    1. Maximum variation from the plumb in the lines and surfaces of columns, walls, and in the flutes and surfaces of fluted or split faced blocks:
        a. In adjacent masonry units: 1/8 inch.
        b. In 10 feet: 1/4 inch.
        c. In any story or 20 feet maximum: 3/8 inch.
        d. In 40 feet or more: 1/2 inch.
    2. Maximum variations from the plumb for external corners, expansion joints, and other conspicuous lines:
        a. In any story or 20 feet maximum: 1/4 inch.
        b. In 40 feet or more: 1/2 inch.
    3. Maximum variations from the level or grades indicated on the Drawings for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
        a. In any bay or 20 feet maximum: 1/4 inch.
        b. In 40 feet or more: 1/2 inch.
    4. Maximum variations of the linear building lines from established position in plan and related portion of columns, walls, and partitions:
        a. In any bay or 20 feet maximum: 1/2 inch.
        b. In 40 feet or more: 3/4 inch.
    5. Maximum variation in cross sectional dimensions of columns and in thickness of walls:
        a. Minus: 1/4 inch.
        b. Plus: 1/2 inch.

3.04 FIELD QUALITY CONTROL

A. Site tests:
    1. OWNER will have tests performed by an independent laboratory.
    2. Have minimum 3 concrete masonry units of each type proposed for Project tested in accordance with ASTM C 90, C 140, and C 426 to verify conformance to Specifications.
    3. Tests shall include compressive strength, linear shrinkage, moisture content as percent of total absorption, total absorption, and unit weight.

B. Special inspection:
    1. Special inspection shall be as specified in Section 01455.
    2. OWNER will employ a qualified masonry special inspector for continuous special inspection of the masonry work. Acceptance by a state or municipality having a program of examining and certifying masonry inspectors will be

considered adequate qualifications. The masonry inspector shall be at the site during all masonry construction and perform the following duties:

a. Review Drawings and Specifications and meet with the CONTRACTOR to discuss requirements before work commences.
b. Before masonry work commences, CONTRACTOR and the CONTRACTOR's Quality Control Representative shall attend meeting with ENGINEER to review the requirements for surveillance and quality control of the masonry work.
c. Check brand and type of cement, lime (if used), and source of sand.
d. Verify that foundation is clean, rough, and ready to receive units.
e. Check reinforcing steel dowels for correct location, straightness, proper alignment, spacing, size, and length.
f. Observe field proportioning of mortar. Visually check aggregate to determine uniformity of grading, cleanliness, and moisture.
g. Verify that joints are full of mortar and kept tight during work. Inspect grout cells to verify that fins will not interfere with grouting. Verify that masons keep grout cells clean of mortar droppings and inspect to determine compliance.
h. Continuously observe placing of grout.
i. Perform or supervise performance of required sampling and testing.

3. Keep complete record of inspections. Report daily to the Building Official, CONTRACTOR's Quality Control Representative, ENGINEER, and OWNER the progress of the masonry inspection.

3.05 CLEANING

A. Exercise extreme care to prevent mortar splotches.

B. Do not attach construction supports to concrete masonry walls.

C. Wash off concrete scum and grout spills before scum and grout set.

D. Remove grout stains from walls.

E. Clean exposed masonry. Remove scaffolding and equipment. Dispose of debris, refuse, and surplus material offsite legally.

F. Remove efflorescence on exposed surfaces with commercially prepared cleaning solution acceptable to masonry unit manufacturer:

1. Apply cleaning solution in accordance with cleaning solution manufacturer's printed instructions.
2. Do not use muriatic acid as cleaning solution.
3. Do not use high pressure cleaning equipment.

3.06 PROTECTION

A. Provide temporary protection for exposed masonry corners subject to damage.

B. Bracing:
   1. Unless wall is adequately supported by permanent supporting elements so wall will not overturn or collapse, adequately brace masonry walls over 8 feet in height to prevent overturning and to prevent collapse.
   2. Keep bracing in place until permanent supporting elements of structure are in place.

C. Limited access zone:
   1. Establish limited access zone prior to start of masonry wall construction.
   2. Zone shall be immediately adjacent to wall and equal to height of wall to be constructed plus 4 feet by entire length of wall on the side without scaffolding.
   3. Limit access to zone to workers actively engaged in constructing wall. Do not permit other persons to enter zone.
   4. Keep zone in place until wall is adequately supported or braced by permanent supporting elements to prevent overturning and collapse.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Structural steel shapes and plate.
   2. Fasteners:
      a. All thread rods.
      b. Anchor bolts.
      c. Assembly bolts.
      d. Chemical anchors.
      e. Concrete anchors.
      f. Concrete inserts.
      g. Deformed bar anchors.
      h. Eyebolts.
      i. Flush shells.
      j. High strength bolts.
      k. Powder actuated fasteners.
      l. Sleeve anchors.
      m. Welded studs.
   3. Isolation sleeves and washers.
   4. Thread coating.
   5. Welding.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01455 - Special Tests and Inspections.
      b. Section 03055 - Epoxy Bonding Reinforcing Bars and All Thread Rods in Concrete.
      c. Section 09910 - Painting.
      d. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. Specification for Structural Steel Buildings.

B. American National Standards Institute (ANSI):
   1. B212-15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.

C. American Welding Society (AWS):
   1. A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
   3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
   4. D1.1 - Structural Welding Code - Steel.
   5. D1.6 - Structural Welding Code - Stainless Steel.

D. ASTM International (ASTM):
   1. A 6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   2. A 29 - Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for.
   3. A 36 - Standard Specification for Carbon Structural Steel.
   4. A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
   5. A 108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
   6. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   7. A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   8. A 193 - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications.
   9. A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   10. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
   11. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   12. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   13. A 489 - Standard Specification for Carbon Steel Lifting Eyes.
   14. A 490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
   15. A 496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
   16. A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   17. A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   18. A 992 - Standard Specification for Structural Steel Shapes.
   19. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   20. F 959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
   21. F 1554 – Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.

E. International Code Council Evaluation Service, Inc. (ICC-ES):
   1. AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements.
   2. AC58 - Acceptance Criteria for Adhesive Anchors in Masonry Elements.
   3. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.
   4. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

1.03 DEFINITIONS

A. Anchor bolt:
   1. Straight steel rod or bar embedded in concrete and having 1 headed end and 1 threaded end.
   2. Installed with headed end cast into concrete with embedment as indicated on the Drawings or specified, leaving threaded end projecting clear of concrete face as required for connection to be made.

B. Anchor rod:
   1. Straight steel rod or bar embedded in concrete and having threads on each end.
   2. Threaded end to be embedded in concrete fitted with nuts or plates as indicated on the Drawings or specified, and cast into concrete with embedment as indicated on the Drawings or specified, leaving threaded end projection clear of the concrete as required for connection to be made.

1.04 SUBMITTALS

A. Product data:
   1. Post-installed anchors for use in concrete and masonry.
      a. Manufacturer’s data including catalog cuts showing materials of construction, finishes, and details of installation for each anchor type.

B. Quality control submittals:
   1. Submit shop drawings of members to be fabricated before starting their fabrication.
   2. Welder’s certificates.
   3. Submit steel fabricator's certification.

C. Test reports:
   1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.
   2. Current ICC-ES Report for each type of post-installed anchors to be used.
   3. Concrete anchor installation test report.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Perform welding of structural metals with welders who have current AWS certificate for the type of welding to be performed.
   2. Steel fabricators shall be certified by the AISC or other certification as recognized and accepted by the local building official having jurisdiction.
   3. Notify Engineer 24 hours minimum before starting shop or field welding.

4. Engineer may check materials, equipment, and qualifications of welders.
5. Remove welders performing unsatisfactory Work, or require to requalification.
6. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
7. Contractor shall bear costs of retests on defective welds.
8. Contractor shall also bear costs in connection with qualifying welders.
9. Special inspection for the installation of chemical anchors as specified in Section 01455 is required.

B. Certification:
1. Steel fabricators shall be certified by the AISC or other certification acceptable to the local building official having jurisdiction.

C. Concrete anchor installation test:
1. Prior to installation or use of concrete anchors, perform the following test:
   a. Furnish not less than four 5/8-inch diameter Type 304 or Type 316 stainless steel concrete anchors of type proposed for use, and install anchors in a test block of concrete to specified embedment length.
   b. Furnish and install one 5/8-inch nut on each concrete anchor and tighten each with an applied torque of 10 foot-pounds.
   c. Loosen each nut and then retighten with an applied torque load of 10 foot-pounds.
   d. Visible evidence of turning by a concrete anchor will be cause for Engineer to reject concrete anchors.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.

B. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

PART 2 PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified or indicated on the Drawings, materials shall conform to the following:

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Steel		
Plate, bars, rolled shapes (except W and WT shapes), and miscellaneous items	A 36	-
Rolled W and WT shapes	A 992	Grade 50
Hollow structural sections (HSS): Round, square, or rectangular	A 500	Grade B
Tubing, hot-formed	A 501	-
Round HSS	A 500	Grade B
Steel pipe	A 53	Grade B

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Stainless Steel		
Plate, sheet, and strip	A 240	Type 304(1) or 316(2)
Bars and shapes	A 276	Type 304(1) or 316(2)
Notes: (1) Use Type 304L if material will be welded. (2) Use Type 316L if material will be welded.		

B. Where stainless steel is welded, use low-carbon stainless steel.

2.02 FASTENERS

A. General: Furnish threaded fasteners, except high strength bolts, with flat washers, and self-locking nuts, or lock washers and nuts.
   1. Bolt heads and nuts: Hex-type.
   2. Bolts, nuts, and washers: Of domestic manufacture.
   3. Where bolts, including anchor bolts, nuts, washers, and similar fasteners are specified to be galvanized, galvanize in accordance with ASTM A 153.

B. All thread rods:
   1. Type 316 stainless steel in accordance with ASTM F 593 where indicated on the Drawings and for use in wet and moist locations, including:
      a. Water-containing structures:
         1) Below and at water level.
         2) Above water level:
            a) Below top of walls of water-containing structures.
            b) Under the roof, slab, beam, or walkway of enclosed water-containing structures.
         3) Dry side of walls of water-containing structures.
      b. Pump bases.
   2. Type 304 or Type 316 stainless steel in accordance with ASTM F 593 for aluminum assemblies.
   3. Hot-dip galvanized ASTM A 307 steel, or ASTM A 36 meeting the mechanical requirements of ASTM A 307, for galvanized assemblies and for applications other than those specified.

C. All thread rods bonded with epoxy in holes drilled in concrete: As specified in Section 03055 and as indicated on the Drawings.
   1. Type 316 stainless steel in accordance with ASTM F 593 where indicated on the Drawings and for use in wet and moist locations, including:
      a. Water-containing structures:
         1) Below and at water level.
         2) Above water level:
            a) Below top of walls of water-containing structures.
            b) Under the roof, slab, beam, or walkway of enclosed water containing structures.
         3) Dry side of walls of water-containing structures.
      b. Pump bases.

2. Type 304 or 316 stainless steel in accordance with ASTM F 593 for fastening aluminum to concrete or steel.
3. Hot-dip galvanized ASTM A 307 steel, or ASTM A 36 to meet mechanical requirements of ASTM A 307, for galvanized assemblies and for applications other than those specified.

D. Anchor bolts:
1. Forged steel bolt with straight shaft and integral heavy hex head.
   a. Rods or bars with angle bend for embedment into and anchoring in concrete are not allowed.
2. Anchor bolts, nuts, and washers: Type 316 stainless steel in accordance with ASTM F 593 where indicated on the Drawings and for use in wet and moist locations, including:
   a. Water-containing structures:
      1) Below and at water level.
      2) Above water level:
         a) Below top of walls of water-containing structures.
         b) Under roof, slab, beam, or walkway of enclosed water-containing structures.
      3) Dry side of walls of water-containing structures.
   b. Pump bases.
3. Anchor bolts, nuts, and washers: Type 304 or 316 stainless steel for fastening aluminum to concrete or steel.
4. Anchor bolts, nuts, and washers: Hot-dip galvanized ASTM F 1554, Grade 36 for applications other than those specified.

E. Anchor rods:
1. Steel rod with straight shaft, threaded ends, and anchoring nuts or plates as indicated on the Drawings or specified.
2. Anchor bolts, nuts, and washers: Type 316 stainless steel in accordance with ASTM F 593 where indicated on the Drawings and for use in wet and moist locations, including:
   a. Water-containing structures:
      1) Below and at water level.
      2) Above water level:
         a) Below top of walls of water containing structures.
         b) Under roof, slab, beam, or walkway of enclosed water-containing structures.
         c) Dry side of walls of water-contained structures.
   b. Pump bases:
      1) Anchor bolts, nuts, and washers: Type 304 or Type 316 stainless steel for fastening aluminum to concrete or steel.
3. Anchor bolts, nuts, and washers: Hot-dip galvanized ASTM F 1554, Grade 36 for applications other than those specified.

F. Assembly bolts:
1. Bolts, nuts, and washers for wood baffles, collectors, and other field-assembled construction: Type 316 stainless steel in accordance with ASTM F 593 where indicated on the Drawings and for use in wet and moist locations, including:
   a. Water-containing structures:
      1) Below and at water level.

2) Above water level:
a) Below top of walls of water-containing structures.
b) Under the roof, slab, beam, or walkway of enclosed water-containing structures.
c) Dry side of walls of water-containing structures.

b. Pump bases.

2. Type 304 or Type 316 stainless steel in accordance with ASTM F 593 for aluminum assemblies.
3. Hot-dip galvanized ASTM A 307 steel for galvanized assemblies and for applications other than those specified.

G. Epoxy-bonded anchors:
1. Concrete: As specified in Section 03055.
2. Masonry: As specified in Section 04055.

H. Chemical anchors:
1. Use epoxy bonded anchors as specified here in Article 2.02 Paragraph G where chemical anchors are indicated elsewhere in the Specifications and on the Drawings.

I. Concrete anchors:
1. Concrete anchors for anchorage to concrete:
a. Concrete anchors shall have current ICC-ES Report that demonstrates compliance with ICC-ES AC193 for cracked concrete.
b. Manufacturers: One of the following or approved equal:
1) Hilti Incorporated, Kwik Bolt TZ Expansion Anchor.
2) Simpson Strong Tie, Strong Bolt Wedge Anchor.
2. Concrete anchors for anchorage to masonry:
a. Concrete anchors shall have current ICC-ES Report that demonstrates compliance with ICC-ES AC01.
b. Manufacturers: One of the following or approved equal:
1) Hilti Incorporated, Kwik Bolt 3 Expansion Anchor.
2) Simpson Strong Tie, Wedge-All Anchor.
3. Concrete anchor's integral threaded stud, wedge, washer, and nut: Type 304 or Type 316 stainless steel in accordance with ASTM F 593 where indicated on the Drawings and for use in wet and moist locations, including:
a. Water-containing structures:
1) Below and at water level.
2) Above water level:
a) Below top of walls of water-containing structures.
b) Under the roof, slab, beam, or walkway of enclosed water-containing structures.
3) Dry side of walls of water-containing structures.
b. Pump bases.
4. Concrete anchor's integral threaded stud, wedge, washer, and nut: Type 304 or 316 stainless steel in accordance with ASTM F 593 where indicated on the Drawings and for fastening aluminum to concrete or steel.
5. Concrete anchor's integral threaded stud, wedge, washer, and nut: Hot-dip galvanized carbon steel, for applications other than those specified.
6. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials in order to develop holding power.

J. Concrete inserts: 1 piece, hot-dip galvanized, integrally hot forged unit fabricated from steel in accordance with ASTM A 29 Hot Rolled Grade 1045 requirement. Manufacturers: One of the following or approved equal:
   1. Dayton Superior, F-54 Ductile Embedded Insert.

K. Deformed bar anchors: In accordance with ASTM A 496:
   1. Manufacturers: One of the following or approved equal:
      a. Nelson Stud Welding Company, D2L Deformed Bar Anchors.
      b. Stud Welding Products, DBA (Deformed Bar) Anchors.

L. Eyebolts:
   1. Welded or forged, when manufactured of materials other than carbon steel.
   2. Having geometric and strength characteristics of eyebolts in accordance with ASTM A 489, Type 1. The strength characteristics include proof load requirements, breaking strength requirements, tensile strength requirements, bend test, and impact strength.

M. Flush shells:
   1. Use concrete anchors as specified here in Article 2.02 Paragraph I where flush shells are indicated elsewhere in the Specifications and on the Drawings.

N. High strength bolts: High strength bolts, nuts, and hardened flat washers shall be in accordance with ASTM A 325 or ASTM A 490, as indicated on the Drawings.

O. Powder actuated fasteners:
   1. For installation in concrete or steel: Zinc coated, heat-treated, alloy steel.
   2. Fasteners not sufficiently protected against corrosion from exposure to corrosive conditions: Coat as necessary to make suitable for such conditions.
   3. Pins: Furnish with head or threaded stud capable of transmitting loads to shank.
   4. Pins connected to steel: Furnish with longitudinal serrations around circumference of shank.

P. Sleeve anchors:
   1. Sleeve anchors for anchorage to concrete:
      a. Sleeve anchors shall have current ICC-ES Report that demonstrates compliance with ICC-ES AC193 for cracked concrete.
      b. Manufacturers: One of the following or approved equal:
         1) Hilti Incorporated, HSL-3 Heavy Duty Sleeve Anchor.
   2. Sleeve anchors for anchorage to masonry:
      a. Sleeve anchors shall have current ICC-ES Report that demonstrates compliance with ICC-ES AC01.
      b. Manufacturers: One of the following or approved equal:
         1) Hilti Incorporated, HSL-3 Heavy Duty Sleeve Anchor.
   3. Use stainless material for aluminum and stainless attachments and carbon steel for steel attachments.
   4. Where indicated on the Drawings and for use in wet and moist locations, including locations listed below. Use Type 304 stainless steel in accordance with ASTM F 593 for sleeve anchor's internal bolt, expansion sleeve, extension sleeve, and washer. Use Type 303 stainless steel in accordance with ASTM F 593 for sleeve anchors expansion cone.
      a. Water-containing structures:
         1) Below and at water level.

2) Above water level:
a) Below top of walls of water-containing structures.
b) Under the roof, slab, beam, or walkway of enclosed water-containing structures.
3) Dry side of walls of water-containing structures.
b. Pump bases.
5. For fastening aluminum to concrete or steel, use Type 304 stainless steel in accordance with ASTM F 593 for sleeve anchor's internal bolt, expansion sleeve, extension sleeve. Use Type 303 stainless steel in accordance with ASTM F 593 for sleeve anchor's expansion cone.
6. For applications other than those specified above, use hot-dip galvanized carbon steel for sleeve anchor's internal bolt, expansion sleeve, expansion cone, extension sleeve, and washer.
7. The sleeve anchor shall have a nylon compression ring which compresses to ensure that the material being fastened is tightly secured against the concrete.
8. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials in order to develop holding power.

Q. Welded studs:
1. ASTM A 108 with 50,000-psi minimum yield strength, and 65,000-psi minimum tensile strength.
2. Headed studs: Manufacturers: One of the following or approved equal:
a. Nelson Stud Welding Company, S3L Shear Connectors or H4L Concrete Anchors.
b. Stud Welding Products, Headed Concrete Anchors or Shear Connectors.

2.03 ISOLATING SLEEVES AND WASHERS

A. Manufacturers: One of the following or approved equal:
1. Central Plastics Company, Shawnee, Oklahoma.
2. Corrosion Control Products, PSI Inc., Gardena, CA.

B. Sleeves: Mylar, 1/32 inch thick, 4,000 volts per mil dielectric strength, of proper size to fit bolts and extending half way into both steel washers.
1. 1 sleeve required for each bolt.

C. Washers: The inside diameter of all washer shall fit over the isolating sleeve and both the steel and isolating washers shall have the same inside diameter and outside diameter.
1. Proper size to fit bolts. Two insulating washers are required for each bolt.
2. Two 1/8-inch thick steel washers for each bolt.
3. G3 Phenolic:
a. Thickness: 1/8 inch.
b. Base material: Glass.
c. Resin: Phenolic.
d. Water absorption: 2 percent.
e. Hardness (Rockwell): 100.
f. Dielectric strength: 450 volts per mil.
g. Compression strength: 50,000 psi.
h. Tensile strength: 20,000 psi.
i. Maximum operating temperature: 350 degrees F.

2.04 GALVANIZED SURFACE REPAIR

A. Manufacturers: One of the following or approved equal:
   1. Galvinox.
   2. Galvo-Weld.

2.05 THREAD COATING

A. Manufacturers: One of the following or approved equal:
   1. Never Seez Compound Corporation, Never-Seez.
   2. Oil Research, Inc., WLR No. 111.

2.06 SUPPLEMENTARY PARTS

A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.07 FABRICATION

A. Shop assembly:
   1. Fabricate structural steel in accordance with AISC "Specification for the Structural Steel Buildings - Allowable Stress Design and Plastic Design," unless otherwise specified or modified by applicable regulatory requirements.
   2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
   3. For Structural members such as W shapes, S shapes, channels, angles, and similar rolled shapes not available in quantity, size, and type of stainless steel specified or indicated on the Drawings:
      a. Make full penetration welds between pieces of plate to attain same or higher section modulus and moment of inertia as members indicated on the Drawings.
      b. Fabricate shapes using laser-fused full penetration joints. Fabricate shapes from dual grade stainless steel; fabricate beams and channels to ASTM A 6 tolerances.
         1) Manufacturers: The following, or equal:
            a) Stainless Structurals, LLC, Jacksonville, FL.
   4. Where galvanizing is required, hot-dip galvanize structural steel after fabrication in accordance with ASTM A 123:
      a. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by Engineer.
      b. Restraighten galvanized items that bend or twist during galvanizing.
   5. Round off sharp and hazardous projections and grind smooth.
   6. Take measurements necessary to properly fit work in field. Take responsibility for and be governed by measurements and proper working out of all details.
   7. Take responsibility for correct fitting of all metalwork.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

A. General:
   1. Fabricate structural and foundry items to true dimensions without warp or twist.
   2. Form welded closures neatly, and grind off smooth where weld material interferes with fit or is unsightly.
   3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
   4. Do not cock out of alignment, redrill, reshape, or force fit fabricated items.
   5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
   6. Rigidly support and brace structural items needing special alignment to preserve straight, level, even, and smooth lines. Keep structural items braced until concrete, grout, or dry pack mortar has hardened for 48 hours minimum.
   7. Erect structural steel in accordance with AISC "Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design," unless otherwise specified or modified by applicable regulatory requirements.
   8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
   9. Round off sharp or hazardous projections and grind smooth.
   10. Paint or coat steel items as specified in Sections 09910 and 09960.

B. Welding - General:
   1. Make welds full penetration type, unless otherwise indicated on the Drawings.
   2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.

C. Welding stainless steel:
   1. General: Comply in accordance with AWS D1.6.

D. Welding carbon steel:
   1. General: Comply in accordance with AWS D1.1:
      a. Weld ASTM A 36 and A 992 structural steel, ASTM A 500 and A 501 structural tubing, and ASTM A 53 pipe with electrodes conforming in accordance with AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes:
         1) Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.

E. Interface with other products:
   1. Where steel fasteners come in contact with aluminum or other dissimilar metals, bolt with stainless steel bolts and separate or isolate from dissimilar metals with isolating sleeves and washers.
      a. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

F. Fasteners:
   1. General:
      a. Install bolts, including anchor bolts and concrete anchors, to project 2 threads minimum, but 1/2 inch maximum beyond nut.
      b. For bolts identified as ASTM A 325 and A 490, see tightening requirements under “High Strength Bolts.”
      c. Unless otherwise specified, tighten bolts, including anchor bolts and concrete anchors, to the "snug-tight" condition, defined as tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.
   2. All thread rods bonded in drilled holes in concrete with epoxy: As specified in Section 03055 and as indicated on the Drawings.
   3. Anchor bolts:
      a. Cast-in-place when concrete is placed.
      b. Accurately locate anchor bolts embedded in concrete with bolts perpendicular to surface from which they project.
      c. Do not allow anchor bolts to touch reinforcing steel.
      d. Where anchor bolts are within 1/4 inch of reinforcing steel, isolate with a minimum of 4 wraps of 10-mil polyvinyl chloride tape in area adjacent to reinforcing steel.
      e. In anchoring machinery bases subject to heavy vibration, use 2 nuts, with 1 serving as a locknut.
      f. Where bolts are indicated on the Drawings for future use, first coat thoroughly with non-oxidizing wax, then turn nuts down full depth of thread and neatly wrap exposed thread with waterproof polyvinyl tape.
      g. Furnish anchor bolts with standard hex bolt head or an equivalent head acceptable to Engineer unless otherwise indicated on the Drawings. “L” or “J” anchor bolts are not equivalent to an anchor bolt with a hex bolt head.
      h. Minimum anchor bolt embedment: 10-bolt diameters, unless longer embedment is indicated on the Drawings.
      i. Where indicated on the Drawings, set anchor bolts in metal sleeves having inside diameter approximately 2 inches greater than bolt diameter and minimum 10-bolt diameters long. Fill sleeves with grout when a machine or other equipment is grouted in place.
      j. Anchor bolts may be cast in concrete in lieu of using concrete anchors.
   4. Concrete anchors:
      a. Do not use concrete anchors in lieu of anchor bolts.
      b. Install anchors in accordance with approved ICC-ES Report. Where conflict exists between the approved ICC-ES Report and the requirements in this Section, the requirements of the Evaluation Service Report shall control.
      c. Accurately locate concrete anchors and set perpendicular to surfaces from which they project.

d. Minimum embedment lengths:

Diameter (inches)	Embedment Length (inches)
1/4	2
3/8	2-1/2
1/2	4-1/8
5/8	4-1/2
3/4	6-1/2

e. Drilling holes:
   1) Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
   2) Determine location of reinforcing bars, or other obstructions with a non-destructive indicator device.
   3) Remove dust and debris from hole using compressed air.

f. Hole drilling equipment:
   1) Electric or pneumatic rotary type with light or medium impact.
   2) Drill bits: Carbide-tipped in accordance with ANSI B212-15.
   3) Hollow drills with flushing air systems are preferred.
   4) Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

5. Deformed bar anchors:
   a. Butt weld with automatic stud welding gun as recommended by manufacturer.
   b. Ensure butt weld develops full strength of the anchor.
6. High strength bolts:
   a. Consider connections with high strength bolts to be slip critical structural connections, unless otherwise indicated on the Drawings.
   b. Connections with high strength bolts shall conform in accordance with AISC Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.
   c. Furnish hardened flat washer:
      1) Under element, nut, or bolt head, turned in tightening.
      2) On outer plies for short slotted holes.
   d. Verify adequate tightening of bolts by means of tension indicator washers placed as indicated in ASTM F 959, Figure 1.
7. Powder actuated fasteners: Use powder actuated fasteners only for applications indicated on the Drawings or specified.
8. Sleeve anchors:
   a. Do not use sleeve anchors in lieu of anchor bolts.
   b. Install anchors in accordance with approved ICC-ES Report. Where conflict exists between the approved ICC-ES Report and the requirements in this Section, the requirements of the Evaluation Service Report shall control.
   c. The sleeve anchor bolt shall be removable and the expansion sleeve shall be flush with the concrete surface when installed.
   d. Accurately locate sleeve anchors and set perpendicular to surfaces from which they project.

e. Minimum embedment lengths:

Diameter millimeters (inches)	Embedment Length millimeters (inches)
12 (0.47)	80 (3-1/8)
16 (0.63)	105 (4-1/8)
20 (0.79)	130 (5-1/8)

f. Drilling holes:
   1) Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
   2) Determine location of reinforcing bars, or other obstructions with a non-destructive indicator device.
   3) Remove dust and debris from hole using compressed air.

g. Hole drilling equipment:
   1) Electric or pneumatic rotary type with light or medium impact.
   2) Drill bits: Carbide-tipped in accordance with ANSI B212-15.
   3) Hollow drills with flushing air systems are preferred.
   4) Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.

9. Welded studs:
   a. Butt weld with automatic stud welding gun as recommended by the manufacturer.
   b. Ensure butt weld develops full strength of the stud.

END OF SECTION

SECTION 05140

STRUCTURAL ALUMINUM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Structural aluminum products, including sheet, pipe, extrusions, and associated accessories.

B. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 05120 - Structural Steel.
      b. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   2. B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   3. B 308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

B. American Welding Society (AWS):
   1. A5.10 - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods.
   2. D1.2 - Structural Welding Code - Aluminum.

1.03 SUBMITTALS

A. Quality control submittals:
   1. Test Reports: Certified copies of mill tests or reports from a recognized commercial laboratory including chemical and tensile properties of each shipment of structural metal or part thereof having common properties. Tests and analyses shall be made in accordance with applicable ASTM Standards.
   2. Welder's certificates.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Perform welding of structural metals with welders who have current AWS certificate for the type of welding to be performed.
   2. Notify ENGINEER 24 hours minimum before starting shop or field welding.
   3. ENGINEER may check materials, equipment, and qualifications of welders.
   4. Remove welders performing unsatisfactory work, or require to requalify.
   5. ENGINEER may use gamma ray, magnetic particle dye penetrant, or other aids to visual inspection to examine any part of welds or all welds.
   6. CONTRACTOR shall bear costs of retests on defective welds.
   7. CONTRACTOR shall bear costs in connection with qualifying welders.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural sheet aluminum: ASTM B 209, Alloy 6061-T6.

B. Structural aluminum: ASTM B 308, Alloy 6061-T6.

C. Extruded aluminum: ASTM B 221, Alloy 6063-T42.

D. Miscellaneous materials:
   1. Furnish supplementary parts necessary to complete each item even where such work is neither definitely indicated on the Drawings nor specified.
   2. Size, form, attachment, and location shall conform to the best of current practice.
   3. Conform to applicable ASTM Standards for materials not otherwise specified.

2.02 FABRICATION

A. Aluminum layout:
   1. Center punch hole centers, and punch or scribe cutoff lines, except where marks would remain on fabricated material.
   2. Apply temperature correction where necessary in layout of critical dimensions. Use a coefficient of expansion of 0.000013 per degree of Fahrenheit.

B. Cutting aluminum:
   1. Material 1/2-inch thick or less: Shear, saw, or cut with a router.
   2. Material more than 1/2-inch thick: Saw or rout.
   3. Make cut edges true and smooth, free from excessive burrs or ragged breaks.
   4. Avoid reentrant cuts wherever possible. Where used, fillet by drilling prior to cutting.
   5. Do not flame cut aluminum alloys.
   6. Punch or drill rivet or bolt holes to finished size before assembly:
      a. Make finished diameter of holes for bolts 1/16-inch maximum larger than nominal bolt diameter.
      b. Make holes cylindrical and perpendicular to principal surface.
      c. Do not permit holes to drift in a manner to distort metal.

C. Aluminum forming and assembly:
   1. Do not heat structural aluminum, except as follows:
      a. Heat aluminum to 400 degrees Fahrenheit for 30 minutes maximum, to facilitate bending or welding.
      b. Heat only when proper temperature controls and supervision can ensure that limitations on temperature and time are observed.

D. Before assembly, remove chips lodged between contacting surfaces.

E. Welding aluminum:
   1. Perform welding of aluminum in accordance with AWS D1.2.
   2. Weld aluminum in accordance with the following:
      a. Preparation:
         1) Remove dirt, grease, forming or machining lubricants, and organic materials from areas to be welded by cleaning with a suitable solvent or by vapor degreasing.
         2) Additionally, etch or scratch brush to remove oxide coating just prior to welding when inert gas tungsten arc welding method is used.
         3) Oxide coating may not need to be removed if welding is performed by automatic or semi-automatic inert gas shielded metal arc.
         4) Suitably prepare edges to assure 100 percent penetration in butt welds by sawing, chipping, machining, or shearing. Do not cut with oxygen.
      b. Filler metal: Aluminum alloys conforming to the requirements of AWS A5.10 and AWS classification ER 4043, ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.
      c. Perform welding of structures which are to be anodized using filler alloys which will not discolor when anodized, AWS ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.
      d. Perform welding by using a non-consumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG).
      e. Do not use welding process that requires use of a welding flux.
      f. Neatly make welded closures.
      g. Where weld material interferes with fit or is unsightly in appearance, grind it smooth.
      h. Make welds full penetration welds unless otherwise indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION

A. Install structural aluminum products as indicated on the Drawings and specified.

B. Install structural aluminum products accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.

C. Do not cock out of alignment, redrill, reshape, or force fit fabricated items.

D. Place anchor bolts or other anchoring devices accurately and make surfaces which bear against structural items smooth and true to level.

E. Rigidly support and brace structural products needing special alignment to preserve straight, level, even, smooth lines, and keep braced until concrete, grout, or dry pack mortar has hardened for a minimum 48-hour period.

F. Interface with other products:
   1. Where aluminum comes in contact with dissimilar metals, bolt it with stainless steel bolts and separate or isolate it from dissimilar metals as specified in Section 05120.
   2. Coat those parts of aluminum which will be cast into concrete or which will be in contact with concrete, grout, masonry, wood, or other materials that will cause the aluminum to corrode, as specified in Section 09960.

END OF SECTION

SECTION 05216

OPEN WEB STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Open web steel joists.

1.02 REFERENCES

A. American Welding Society (AWS):
   1. A2.4 - Standard symbols for Welding, Brazing, and Non-Destructive Examination.
   2. D1.1 - Structural Welding Code - Steel.

B. ASTM International (ASTM):
   1. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   2. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   3. A 490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.

C. International Conference of Building Officials (ICBO).

D. Occupational Safety and Health Administration (OSHA):
   1. 29CFR-1926.751(c)2.

E. Research Council on Structural Connections (RCSC)
   (published by American Institute of Steel Construction – AISC):
   1. Specification for Structural Joints Using ASTM A325 or A490 Bolts.

F. Steel Joist Institute (SJI):
   1. K-1.1 – Standard Specifications for Open Web Steel Joists, K-Series.
   2. LH/DLH-1.1 – Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series.
   3. JG-1.1 – Standard Specifications for Joist Girders.
   4. Code of Standard Practice fo Steel Joists and Joist Girders.
   5. Standard Load Table, Open Web Steel Joists, K-Series (LRFD and ASD).
   6. Standard Load Table, Longspan Steel Joists, LH-Series (LRFD and ASD).
   7. Standard Load Table, Deep Longspan Steel Joists, DLH Series (LRFD and ASD).

1.03 SUBMITTALS

A. Product data: Submit manufacturer's specifications and installation instructions for each type of joist and accessories. Include manufacturer's certification that comply with SJI specifications.

B. Shop drawings: Submit detailed erection/shop drawings showing layout of joist units, connections, and accessories. Include mark, type, number, location, and spacing of joist and bridging:
   1. Indicate standard designations, configuration, sizes, spacing and locations of joists, joist leg extensions, attachments, shop and erection details, including cuts, codes, connections, holes, threaded fasteners, rivets, and welds. Include cambers and loads, locations, markings, quantities, materials, and shapes; and methods of connecting, anchoring, fastening, bracing, bridging, and attachment to Work of other Sections.
   2. Indicate shop and field welds by welding symbols in accordance with AWS A2.4. Indicate net weld lengths.
   3. To facilitate erection of CMU walls that parallel the joist, show dead load and total joist load deflections separate. Also show joist camber.
   4. Show joist connections that support the diesel generator exhaust pipe.

C. Calculations: Submit calculations for each joist type, cross bridging, and connections. Provide calculations stamped by a professional civil or structural engineer registered in the state where the Project is located.

D. Certificates:
   1. Manufacturer's mill certificate: Submit certificate that products meet or exceed specified requirements.

E. Test reports:
   1. Mill test reports: Submit manufacturer's certificates, indicating structural strength, destructive and non-destructive test analysis.
   2. Welders' certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualifications within the previous 12 months.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Open web steel joists: The steel joists shall be designed for the deflection, loadings, and camber indicated on the Drawings.
      a. Maximum deflection: L/240 of span under total dead and live load.
      b. Minimum design loads as indicated on the Drawings:
         1) Dead load.
         2) Live load.
         3) Wind load (including uplift).
         4) Axial tension and compression forces applied to the truss at end connections.

1.05 QUALITY ASSURANCE

A. Provide joist fabrication in compliance with the following and as specified:
   1. SJI Standard Specifications, Load Tables, and Weight Tables for K, KCS, LH, & DLH series, Longspan Steel Joists.

B. Manufacturer qualifications: Manufacturer shall be a recognized fabricator of structural steel building components by the ICBO and have a current report on file.

C. Qualification of field welding: Qualified processes and welding operators in according with AWS D1.1.

D. Inspection: Inspect joists in accordance with SJI specifications.

E. To facilitate erection of CMU walls that parallel the joist, fabricate joist camber within 1/4” of joist roof dead load deflection.

1.06 DELIVER, STORAGE, AND HANDLING

A. Deliver, storage, and handling: Deliver, store, and handle steel joists as recommended in SJI specifications. Handle and store joists in a manner to avoid excessive stresses.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel: Comply with SJI specifications.

B. Threaded fasteners: ASTM A 307, Grade A, regular hexagon type, low carbon steel.

C. High-strength threaded fasteners: ASTM A 325 and A 490 heavy hexagon structural bolts with nuts and hardened washers.

2.02 FABRICATION

A. Open web steel joists:
   1. Fabricate steel joist in accordance with SJI specifications to sizes indicated on the Drawings.
   2. Furnish ceiling and soffitt extensions as required.

B. Cross bridging: Provide horizontal or diagonal type bridging for joists and joist girders as indicated on the Drawings and in accordance with SJI specifications.

C. End anchorage: Provide end anchorage's including bearing plates, to secure joists to adjacent construction in accordance with SJI specifications unless otherwise indicated on the Drawings.

D. Fabricate joist with web reinforcement required to support the diesel generator exhaust pipe.

PART 3 EXECUTION

3.01 INSTALLATION

A. Erection:
   1. Place and secure steel joists in accordance with SJI specifications, final erection drawings, and as specified.

2. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment until completion of erection and installation of permanent bridging and bracing.

B. Installation of joist and bridging:
   1. Do not start placement of steel joists until supporting work is in place and secured.
   2. Place joists on supporting bearing surfaces, adjust, and align in accurate locations and spacing before permanently fastening.
   3. Where open web joist lengths are 40 feet and longer, install a minimum of 1 center row of bolted bridging in accordance with OSHA 29CFR-1926.751(c)2 or SJI specifications to provide lateral stability for the joists before slacking of hoisting lines. Quantity of bolted diagonal erection bridging shall be in accordance with SJI specifications.
   4. Install bridging simultaneously with joist erection, and before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams. Quantity, size, and sequence for installing bridging shall be in accordance with SJI specifications.
   5. Erection stability and handling shall be in accordance with SJI Specifications.

C. Fastening joists:
   1. Each joist must be attached at a minimum of one end immediately upon placement in the final erection position and before additional joists are placed.
   2. When field welding joists, weld to supporting steel framework in accordance with SJI specifications for K and LH joist and as indicated on the Drawings. Coordinate welding sequence and procedure with placing of joists.

END OF SECTION

SECTION 05310

STEEL DECKING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Steel deck for floors and roofs, and associated accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. American Welding Society (AWS):
   1. D1.3 - Structural Welding Code - Sheet Steel.

1.03 SUBMITTALS

A. Product data.

B. Shop drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection:
   1. Store steel deck at the site stacked on platforms or pallets and covered with tarpaulins or other suitable weathertight covering.
   2. Do not use steel deck for storage or working platform.
   3. Remove damaged, unlabeled, untagged, rusty, and deteriorated steel deck material from the job site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. ASC Profiles (Formerly IMSA Building Products).
   2. Verco Manufacturing Company.

2.02 MATERIALS

A. Sheet steel: ASTM A 653, G 90 minimum coating designation.

2.03 FABRICATION

A. Steel deck shall be formed:
   1. So every sheet is identical and will register perfectly with adjacent sheets.
   2. In accordance with building code as specified in Section 01410.

B. Decking used with concrete fill shall be deformed to develop composite action between the deck and the concrete.

C. Furnish minimum gauge, deck thickness, section modulus, moment of inertia, and allowable diaphragm shear per foot of deck width that is not less than for type deck sections indicated on the Drawings.

D. Treat exposed roof deck with phosphate.

E. Furnish roof deck ready to receive field painting without further pretreatment. Paint exposed roof deck in accordance with Contract Documents.

F. Accessories:
   1. Furnish all accessories indicated on the Drawings or needed to completed work.
   2. Minimum required gauges:
      a. Sump pans: 14 gauge.
      b. All other accessories: 20 gauge unless otherwise indicated on the Drawings.

G. Welding and electrodes: In accordance with AWS D1.3.

H. Furnish roof decking in lengths to minimize number of splices.

I. Furnish steel deck complete, including cutting, shaping, fitting, drilling, welding, ridge plates, valley plates, reinforcing plates for openings, and miscellaneous pieces necessary for proper installation.

J. When deck make-up sections are required, install such sections in the center one-third of the diaphragm, and not adjacent to the shear walls.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine work in place to verify that it is satisfactory to receive the work of this Section. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

A. Decking shall span over at least 3 spans wherever possible. Where 2 spans are required, place them in the center third of the diaphragm.

B. Do not damage or overload roof deck during installation.

C. Do not use steel deck for storage or as a working platform until sheets have been welded in position.

D. Do not exceed maximum uniformly distributed load of 20 pounds per square foot.

E. Install decking in straight and continuous rows as far as practicable, with ribs at right angles to supporting members.

F. For each end of deck section, provide 3 inches minimum bearing on supports. For sections that abut each other, each piece shall bear a minimum of 3 inches on the support. This requires a 6-inch minimum flange width. For cases where the minimum bearing cannot be obtained, notify the ENGINEER.

G. Electric arc weld deck sections to bearing plates, supports at butt joints, at intermediate supports, side supports, and at end supports as indicated on the Drawings. Do not burn through the deck. Remove all slag.

H. Fasten the longitudinal joints between deck sections together by the method indicated on the Drawings.

I. Neatly cut and fit openings in roof deck, and reinforce with structural steel members as indicated on the Drawings.

J. Paint welds as specified.

K. Install roof deck free of dents and bent members.

L. Reinforce all holes and openings in steel deck as indicated on the Drawings.

M. Piping, conduit, equipment, and other services: Do not hang from decking.

N. Install all accessories required to complete work.

3.03 REPAIR OF GALVANIZING AND COATING

A. Touch-up damage to galvanized surfaces, including cut edges and holes, with zinc rich primer.

B. Repair damage to factory-applied coating system in accordance with the manufacturer's printed recommendations.

3.04 CLEANUP

A. After erection, remove weld spatter, grease, and oil from decking.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Aluminum grating stair tread.
   2. Aluminum stair nosing.
   3. Concrete inserts.
   4. Handrails and guardrails.
   5. Ladders.
   6. Manhole frames and covers.
   7. Metal gratings.
   8. Metal tread plate.
   9. Preformed channel pipe supports.
   10. Stairs.
   11. Miscellaneous metals.
   12. Associated accessories to the above items.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 02084 - Common Work Results for Utility Structures.
      b. Section 09960 - High Performance Coatings.
      c. Section 15061 - Pipe Supports.
      d. Section 15062 - Preformed Channel Pipe Support System.

1.02 REFERENCES

A. Aluminum Association (AA):
   1. DAF-45: Designations from Start to Finish.
      a. M12-C22-A41.

B. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

C. ASTM International (ASTM):
   1. A 36 - Standard Specification for Carbon Structural Steel.
   2. A 48 - Standard Specification for Gray Iron Castings.
   3. A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.

4. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
5. A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications.
6. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
7. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
8. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
9. A 380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
10. A 489 - Standard Specification for Carbon Steel Lifting Eyes.
11. A 490 - Standard Specification for Structural Bolts, Alloy Steel, Heat-Treated, 150 ksi Minimum Tensile Strength.
12. A 500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
13. A 501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. A 635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
15. A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
16. A 992 - Standard Specification for Structural Steel Shapes.
17. B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
18. B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
19. B 308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
20. B 429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
21. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

D. American Welding Society (AWS):
1. A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

E. National Association of Architectural Metal Manufacturers (NAAMM):
1. Metal Finishes Manual.

F. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. Passivation: Removal of exogenous iron or iron compounds from the surface of a stainless steel by means of chemical dissolution resulting from treatment with an acid solution that removes the surface contamination but does not significantly affect the stainless steel itself.

1.04 SUBMITTALS

A. Product Data:
   1. Aluminum grating stair tread.
   2. Aluminum stair nosing.
   3. Handrail and guardrail.
   4. Manhole frames and covers.
   5. Metal grating.

B. Shop drawings:
   1. Handrails and guardrails:
      a. Including details on connection attachments, gates, kick plates, ladders, and angles.
      b. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
      c. Include erection drawings, elevations, and details where applicable.
      d. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Ladders.
   3. Metal grating.
   4. Metal tread plate.
   5. Stairs.
   6. Miscellaneous metals.

C. Samples:
   1. Guardrails with specified finishes.

D. Quality control submittals:
   1. Design data.
   2. Test reports:
      a. Guardrails: 3 copies of certified tests performed by an independent testing laboratory certifying that guardrails meet current State and OSHA strength requirements.
      b. Gratings:
         1) Grating manufacturers' calculations showing that gratings will meet specified design load, stress, and deflection requirements for each size grating for each span.
         2) Reports of tests performed.
      c. Planks:
         1) Plank manufacturers' calculations showing that planks will meet specified load-bearing and deflection requirements for each size plank for each span.
         2) Reports of tests performed.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Unless otherwise specified or indicated on Drawings, structural and miscellaneous metals in accordance with ASTM standards, including the following:

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Cast Iron		
Cast Iron	A 48	Class 35B or 40B
Steel		
Galvanized sheet iron or steel	A 653	Coating G90
Coil (plate)	A 635	--
Structural plate, bars, rolled shapes, and miscellaneous items (except W shapes)	A 36	--
Rolled W shapes	A 992	Grade 50
Standard bolts, nuts, and washers	A 307	--
High strength bolts, nuts, and hardened flat washers	A 325 A 490	--
Eyebolts	A 489	Type 1
Tubing, cold-formed	A 500	--
Tubing, hot-formed	A 501	--
Steel pipe	A 53	Grade B
Stainless Steel		
Plate, sheet, and strip	A 240	Type 304* or 316**
Bars and shapes	A 276	Type 304* or 316**
Bolts (Type 304)	F593	Group 1 Condition CW
Bolts (Type 316)	F593	Group 2 Condition CW
Aluminum		
Flashing sheet aluminum	B 209	Alloy 5005-H14, 0.032 inches minimum thickness
Structural sheet aluminum-	B 209	Alloy 6061-T6
Structural aluminum	B 209 B 308	Alloy 6061-T6
Extruded aluminum	B 221	Alloy 6063-T42
* Use Type 304L if material will be welded. Provide Type 304 or 304L only where specifically indicated. ** Use Type 316L if material will be welded. Provide Type 316 or 316L unless noted otherwise.		

1. Stainless steels are designated by type or series defined by ASTM.
2. Where stainless steel is welded, use low-carbon stainless steel.

2.02 MANUFACTURED UNITS

A. Aluminum grating stair tread:
   1. Manufacturers: One of the following or equal:
      a. IKG Borden Industries, Aluminum Grating Stair Tread with Mebac nosing.
      b. McNichols Co., Type A-Standard with Corrugated Angle Nosing.
   2. Material: Welded aluminum grating tread with non-slip nosing and integral end plates for bolt on attachment to stair stringers
   3. Size:
      a. Tread width: To equal tread spacing plus 1 inch minimum.
      b. Tread length: Length to suit stringer-to-stringer dimension indicated on the Drawings.
      c. Depth: 1-3/4 inches.
   4. Bolts: Type 316 stainless steel.

B. Aluminum stair nosing:
   1. Manufacturers: One of the following or equal:
      a. Wooster Products, Inc., Type 101 Nosing.
      b. American Safety Tread Co., Inc., Style 801 Nosing.
   2. Material: Cast aluminum abrasive nosings with aluminum oxide granules integrally cast into metal, forming permanent, nonslip, long-wearing surface.
   3. For installation in cast-in-place stairs.
   4. Configuration: 4 inches wide, fabricated with integrally cast stainless steel anchors at approximately 12-inch centers. Length to extend within 3 inches of stair edge on each side.

C. Concrete inserts:
   1. Concrete inserts for supporting pipe and other applications are specified in Section 15061.

D. Handrails and guardrails:
   1. General:
      a. Design and fabricate assemblies to conform to current local, State, and OSHA standards and requirements.
      b. Coordinate layout of assemblies and post spacings to avoid conflicts with equipment and equipment operators.
         1) Indicate on the shop drawings locations of such equipment.
         2) Highlight locations where railings cannot be made continuous, and obtain Engineer's directions on how to proceed before fabricating or installing railings.
   2. Aluminum handrails and guardrails (nonwelded pipe):
      a. Rails, posts, and fitting-assembly spacers:
         1) In accordance with ASTM B 429, 6005, 6063, or 6105, minimum Schedule 40, extruded aluminum pipe of minimum 1.89-inch outside diameter and 0.14-inch wall thickness.
      b. Kick plates: 6061 aluminum alloy.
      c. Fastenings and fasteners: As recommended or furnished by the manufacturer.
      d. Other parts: 6063 extruded aluminum, or F214 or F514.0 aluminum castings:
         1) Fabrications: In accordance with ASTM B 209 or ASTM B 221 extruded bars:
            a) Bases: 6061 or 6063 extruded aluminum alloy.

2) Plug screws or blind rivets: Type 305 stainless steel.
a) Other parts: Type 300 series stainless steel.

e. Finish of aluminum components:
1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting. Aluminum Association Specification M12-C22-A41, mechanical finish non-specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.
2) Pretreat aluminum for cleaning and removing markings before anodizing.

f. Fabrication and assembly:
1) Fabricate posts in single, unspliced pipe length.
2) Perform without welding.
3) Do not epoxy bond the parts.
4) Maximum clear opening between assembled railing components as indicated on the Drawings.

g. Manufacturers: One of the following or equal:
1) Moultrie Manufacturing Company, Wesrail.
2) Golden Railings, Golden, CO, Riveted System.
3) Craneveyor Corporation Enerco Metals, C-V Rail.

3. Picket railing: Manufacturers: One of the following or equal:
a. Reynolds Metals Company, Architectural and Building Products Division, No. 05-733.
b. Julius Blum and Company, equivalent product.
c. Craneveyor Corporation, equivalent product.

4. Guardrail gates:
a. Supplied by guardrail manufacturer:
1) Of same material, quality, and workmanship as specified for guardrail system in which they will be installed.
2) Of design similar to that of handrail or railing system in which they will be installed.

b. Components: Gate frame, stainless steel self-closing device, hinges, gate stops, and durable self-locking type latch. Fabricate components in conformance with OSHA minimum strength requirements.

5. Fastenings and fasteners: As recommended or furnished by guardrail manufacturer for use with this system.

E. Ladders:
1. General:
a. Type: Safety type conforming to local, State, and OSHA standards as minimum. Furnish guards for ladder wells.
b. Size: 18 inches wide between side rails of length, size, shape, detail, and location indicated on the Drawings.

2. Aluminum ladders:
a. Materials: 6063-T5 aluminum alloy.
b. Rungs:
1) 1-inch minimum solid square bar with 1/8-inch grooves in top and deeply serrated on all sides.
2) Capable of withstanding 1,000-pound load without failure.

c. Side rails: Minimum 4-inch by 1/2-inch flat bars.
d. Finish of aluminum components:
1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting. Aluminum Association Specification M12-C22-A41,

mechanical finish non-specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.

2) Pretreat aluminum for cleaning and removing markings before anodizing.

e. Fabrication:

1) Welded construction, of size, shape, location, and details indicated on the Drawings.

2) For ladders over 20 feet high, furnish standard ladder cages or fall prevention system designed in accordance with State and OSHA requirements.

f. Fall prevention system: Include but not limit to railing, brackets, clamps, 2 sleeves, and 2 belts, satisfying OSHA safe climbing requirements:

1) Manufacturers: One of the following or equal:

a) North Consumer Products, Saf-T-Climb.

b) Swager Communications, Climbers Buddy System.

F. Manhole frames and covers:

1. Material: Gray iron castings, in accordance with ASTM A 48, Class 30-B.
2. Type: Heavy-duty traffic type, with combined minimum set weight of 265 pounds.
3. Machine horizontal and vertical bearing surfaces to fit neatly, with easily removable cover bearing firmly in frame without rocking.
4. Frame:

a. Bottom flange type.

b. Approximately 4-1/2 inches frame height.

c. Dimensions as indicated on the Drawings.

1) Minimum inside clear dimension may not be smaller than nominal diameter minus 2 inches.

5. Cover:

a. Skid-resistant grid pattern design stamped with name of utility service provided by manhole, such as "ELECTRICAL," "SEWER," "TELEPHONE," or "WATER."

b. Solid type without ventilation holes.

6. Finish: Unpainted.

G. Metal gratings:

1. General:

a. Fabricate grating to cover areas indicated on the Drawings.

b. Unless otherwise indicated on the Drawings, grating over an opening shall cover entire opening.

c. Make cutouts in grating where required for equipment access or protrusion, including valve operators or stems, and gate frames.

d. Band ends of grating and edges of cutouts in grating:

1) End banding: 1/4 inch less than height of grating, with top of grating and top edge of banding flush.

2) Cutout banding: Full-height of grating.

3) Use banding of same material as grating.

4) Panel layout: Enable installation and subsequent removal of grating around protrusions or piping.

5) Openings 6 inches and larger: Lay out grating panels with edges of 2 adjacent panels located on centerline of opening.

6) Openings smaller than 6 inches: Locate opening at edge of single panel.
7) Where an area requires more than 1 grating section to cover area, clamp adjacent grating sections together at 1/4-points with fasteners acceptable to Engineer.
8) Fabricate steel grating sections in units weighing not more than 50 pounds each.
9) Fabricate aluminum grating sections in units of weighing not more than 50 pounds each.

e. When requested by Engineer, test 1 section of each size grating for each span length involved on the job under full load:
   1) Furnish a suitable dial gauge for measuring deflections.

f. Grating shall be aluminum, unless otherwise specified or indicated on the Drawings.

2. Aluminum grating:
   a. Material for gratings, shelf angles, and rebates: 6061-T6 or 6063-T6 aluminum alloy, except crossbars may be 6063-T5 aluminum alloy.
   b. Shelf angle concrete anchors: Type 304 or Type 316 stainless steel.
   c. Grating rebate rod anchors: 6061-T6 or 6063-T6 aluminum alloy.
   d. Bar size and spacing: As determined by manufacturer to enable grating to support design load.
   e. Design live load: A minimum of 100 pounds per square foot uniform live load on entire grating area, but not less than the live load indicated on the Drawings for the area where grating is located.
   f. Maximum fiber stress for design load: 12,000 pounds per square inch.
   g. Maximum deflection due to design load: 1/240 of grating clear span.
   h. Maximum spacing of main grating bars: 1-1/8 inches clear between bars.
   i. Minimum grating height: 1-1/2 inches.
   j. Manufacturers: One of the following or equal:
      1) IKG Borden Industries, grooved aluminum I-bar.
      2) Brodhead Steel Products, Inc., grooved aluminum I-bar.

3. Aluminum grating planks:
   a. Materials: Meet requirements previously specified for aluminum grating.
   b. Fabrication:
      1) Meet requirements previously specified for aluminum grating.
   c. Have unpunched surface with cross hatched anti-skid surface.
   d. Minimum weight of 3-1/4 pounds per square foot.
   e. Provide 1-inch diameter hole with smooth edges at each end for each plank.
   f. Furnish planks in 2-foot widths.
   g. Manufacturers: One of the following or equal:
      1) IKG, Heavy Duty Aluminum Plank Grating HD-P.
   h. Planks shall not lock with adjacent planks allowing the removal of individual planks without disturbing the adjacent planks.

4. Heavy-duty steel grating:
   a. Heavy-duty type, fabricated from structural steel and designed in accordance with AASHTO Standard Specifications for Highway Bridges, using H-20 loading.

b. Hot-dip galvanized after fabrication in accordance with ASTM A 123.
c. Manufacturers: One of the following or equal:
1) Reliance Steel Products Company, Heavy-Duty Steel Grating.
2) Seidelhuber Metal Products, Inc., equivalent product.

5. Cast iron H-20 rated grating:
a. Gray cast iron conforming to ASTM A 48 Class 35B, or ductile iron conforming to ASTM A 536 Grade 80-55-06.
b. Heavy duty and suitable for general highway traffic service and AASHTO H-20 loading conditions.
c. Gratings as manufactured by East Jordan Iron Works, Inc, or equal.

H. Metal tread plate:
1. Plate having a raised figured pattern on 1 surface to provide improved traction.

I. Preformed channel pipe supports:
1. Preformed channel pipe supports for pipe supports and other applications are specified in Section 15062.

J. Stairs:
1. Aluminum stairs:
a. Stringers: 6061-T6 aluminum alloy.
b. Stair treads:
1) Aluminum of same type specified under Aluminum Grating.
2) Of sizes indicated on the Drawings, and 1-3/4 inch minimum depth with cast abrasive type safety nosings.
c. Handrails and guardrails: Aluminum pipe specified under Aluminum Handrails and Guardrails (Nonwelded Pipe).
d. Fasteners: Type 304 or Type 316 stainless steel.

K. Miscellaneous aluminum:
1. Fabricate aluminum products, not covered separately in this Section, in accordance with the best practices of the trade and field assemble by riveting or bolting.
2. Do not weld or flame cut.

L. Miscellaneous cast iron:
1. General:
a. Tough, gray iron, free from cracks, holes, swells, and cold shuts.
b. Quality such that hammer blow will produce indentation on rectangular edge of casting without flaking metal.
c. Before leaving the foundry, clean castings and apply 16-mil dry film thickness coating of coal-tar epoxy, unless otherwise specified or indicated on the Drawings.

M. Miscellaneous stainless steel:
1. Provide miscellaneous stainless steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
a. Fabricate and install in accordance with the best practices of the trade.
2. Cleaning and passivation.
a. Following shop fabrication of stainless steel members, clean and passivate fabrications.

b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a passive finished surface.
c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
    1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
d. Pre-clean, chemically descale (pickle), and final clean fabrications in accordance with the requirements of ASTM A 380 to remove deposited contaminants before shipping.
    1) Passivation by citric acid treatment is not allowed.
        a) If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are permissible; however, these treatments shall be followed by inorganic cleaners such as nitric-hydrofluoric acid.
    2) Provide acid descaling (pickling) in accordance with Table A1.1 of Annex A1 of ASTM A 380.
    3) After pickling, final cleaning of stainless steel shall conform to Part II of Table A2.1 of Annex A2 of ASTM A 380.
e. After cleaning, inspect using methods specified for “gross inspection” in ASTM A 380.
f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the job site.

N. Miscellaneous structural steel:
    1. Provide miscellaneous steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
        a. Fabricate and install in accordance with the best practices of the trade.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
    1. Examine work in place to verify that it is satisfactory to receive the work of this Section.
    2. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

A. General: Install products as indicated on the Drawings, and in accordance with shop drawings and manufacturer's printed instructions, as applicable except where specified otherwise.

B. Aluminum stair nosing:
    1. Install stair nosings on treads of concrete stairs, including top tread on upper concrete slab.
    2. Omit stair nosings where concrete is submerged.
    3. Coat aluminum surfaces in contact with concrete as specified in Section 09960.
    4. Cast stair nosings in fresh concrete, flush with tread and riser faces. Install nosing in center of step approximately 3 inches from each stair edge.

C. Handrails and guardrails:
   1. General:
      a. Fasten pipe rails to fittings with Series 300 stainless steel pop rivets or flush set screws.
      b. Make pipe cuts clean and straight, free of burrs and nicks, and square and accurate for minimum joint-gap.
      c. Drill and countersink holes to proper size, as required for a tight flush fit of screws and other component parts.
      d. Space attachment brackets as indicated in manufacturer's instructions.
   2. Aluminum pipe handrails and guardrails:
      a. During construction, keep exterior surfaces of handrails and guardrails covered with 0.4 millimeters, minimum, heat shrink polyethylene film.
      b. Do not remove protective film before handrails and guardrails have been accepted by Engineer nor before other work in proximity of handrails and guardrails has been completed.
      c. Discontinue handrails and guardrails at lighting fixtures.
      d. Provide 1/8-inch diameter weep hole at base of each post.
      e. Where protection is applied for prevention of dissimilar materials electrolysis, make application such that none of the protective material is visible in the completed assembly.
      f. Space posts as indicated on the Drawings.
      g. Anchor posts into concrete by grouting posts into formed holes in concrete, into stainless steel sleeves cast in concrete; or bracket mount to face of concrete surfaces as specified and indicated on the Drawings.
      h. Space rails as indicated on the Drawings.
      i. Make adequate provision for expansion and contraction of kick plates and rails.
         1) Make provisions for removable sections where indicated on the Drawings.
      j. Make lower rails a single, unspliced length between posts, or continuous.
      k. Make top rails continuous whenever possible, and attach single, unspliced lengths to 3 posts minimum.
      l. Draw up fasteners tight with hand wrench or screw driver.
      m. Space attachment brackets as indicated on shop drawings or in manufacturer's installation instructions.
      n. Completed installation shall have handrails and railings rigid and free of play at joints and attachments.
      o. Protect handrail and guardrail finish from scratches, gouges, dents, stains, and other damage.
      p. Replace damaged or disfigured handrails and guardrails with new.
      q. Shortly before final acceptance of the work, and after removal of protective polyethylene film, clean handrails and guardrails with mild detergent or with soap and water.
         1) After cleaning, thoroughly rinse handrails and guardrails and wipe with soft cloth.
      r. Erect guardrail straight, level, plumb, and true to the positions as indicated on the Drawings. Correct deviations from true line of grade, which are visible to the eye.
   3. Guardrail gates:
      a. Install gate to be a vertical plane with the guardrail when in the closed position.

b. Install hinges so that each gate can swing 180 degrees from the closed position to the fully open position.
c. Install so that the gates swing to the walkway side of the guardrail only.
1) Install gate stops on the stationary railing posts to prohibit gates from swinging in the wrong direction.
d. Install gate frames, hinges, stops, and latches in conformance with OSHA minimum strength requirements.

D. Ladders:
1. Secure to supporting surface with bent plate clips providing minimum 8 inches between supporting surface and center of rungs.
2. Where exit from ladder is forward over top rung, extend side rails 3 feet 3 inches minimum above landing, and return the rails with a radius bend to the landing.
3. Where exit from ladder is to side, extend ladder 5 feet 6 inches minimum above landing and rigidly secure at top.
4. Erect rail straight, level, plumb, and true to position indicated on the Drawings.
a. Correct deviations from true line or grade which are visible to the eye.

E. Manhole frames and covers:
1. Installation: As specified in Section 02084.

F. Metal gratings:
1. General:
a. Allow 1/8-inch maximum clearance between ends of grating and inside face of vertical leg of shelf angles.
b. Horizontal bearing leg of shelf angles shall be 2 inches minimum.
c. Install aluminum plate or angles where necessary to fill openings at changes in elevation and at openings between equipment and grating.
d. Install angle stops at ends of grating.
e. Installed grating shall not slide out of rebate or off support.
f. Weld stops in place, unless otherwise specified or indicated on the Drawings.
g. Top surfaces of grating sections adjacent to each other shall lie in same plane.
2. Aluminum grating:
a. Coat surfaces of aluminum shelf angles, rebates, and rod anchors in contact with concrete as specified in Section 09960.
b. Aluminum grating: Support on aluminum shelf angles or rebates.
3. Aluminum grating planks:
a. Support and install planks as specified for aluminum grating.
4. Heavy-duty steel grating:
a. Support on hot-dip galvanized structural steel rebates embedded and anchored in concrete.
b. Use for roadways, traffic areas, and where indicated on the Drawings.

G. Stairs:
1. General:
a. Install guard railings around stair wells as indicated on the Drawings or specified.

H. Stainless Steel:
   1. Welding.
      a. Passivate field-welded surfaces.
         1) Provide cleaning, pickling and passivating as specified in this Section.
         2) Clean using Derustit Stainless Steel Cleaner, or equal.

END OF SECTION

SECTION 06072

PRESERVATIVE PRESSURE TREATED WOOD

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preservative pressure treatment of wood for protection against decay and termites, including:
   1. Wood in direct contact with soil.
   2. Floor joists or structural flooring closer than 18 inches to exposed ground.
   3. Girders closer than 12 inches to exposed ground.
   4. Framing, including wood sheathing, that rests on exterior foundation walls less than 8 inches from exposed earth.
   5. Sills, sleepers, posts or columns in contact with concrete or masonry that is in direct contact with earth.
   6. Girder ends entering exterior masonry or concrete walls with less than 1/2-inch clear space on the top, sides, and end.
   7. Siding on the exterior of a building less than six inches from exposed ground.
   8. Wood subject to alternate wet and dry cycles.

1.02 REFERENCES

A. Federal Specifications (FS):
   1. TT-W-571 - Wood Preservation: Treating Practices.

B. American Wood Preservers' Association (AWPA):
   1. C1 - All Timber Products - Preservative Treatment by Pressure Processes.
   2. C2 - Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes.
   3. C9 - Plywood - Preservative Treatment by Pressure Processes.
   4. M4 - Standard for the Care of Pressure-Treated Wood.
   5. P5 - Standard for Waterborne Preservatives.

1.03 SUBMITTALS

A. Product data: Include identification of preservative properties, method of treatment, and expected service life.

B. ICC Evaluation Service, Inc., Evaluation Report meeting AC78-Acceptance Criteria for Copper-Quaternary Wood Preservative Treatment Systems.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Keep materials dry during delivery and storage. Protect materials against exposure to weather and from contact with damp or wet surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Preservative treatment materials: One of the following or equal:
   1. Chemical Specialties, Inc., Charlotte, North Carolina.
   2. Osmose, Inc., Griffin, Georgia.

2.02 PRESERVATIVE TREATMENT MATERIALS

A. Arsenic and chromium free ammonium copper quaternary preservative produced in accordance with ACQ Preserve Standard ACQ - 94 and in accordance with AWPA Standard P5:
   1. Waterborne, non-staining, non-blooming; free from crystals, flame-supporting residue, and properties detrimental to subsequent finishes when applied.

B. Cut members to shape or size prior to pressure treating whenever possible.

C. Apply preservative treatment in accordance with AWPA C1 and C2 to achieve penetration of minimum 1/4 inch with retainage of minimum treatment material in accordance with AWPA C2 for service conditions.

D. When pressure treated wood is cut, apply minimum of 2 saturating coats of same preservative as used in original pressure treatment on cut surface.

2.03 PRESERVATIVE TREATMENT

A. Shop pressure treat wood materials to FS TT-W-571.

B. Shop pressure treat materials requiring preservative treatment in closed cylinder in accordance with AWPA C2 for lumber and AWPA C9 for plywood. Retention of ACQ shall be as follows:
   1. For wood subject to alternate wet-dry cycles: 0.25 pounds per cubic foot.
   2. For wood in contact with concrete or masonry: 0.25 pounds per cubic foot.
   3. For wood within 18-inches of the ground: 0.25 pounds per cubic foot.
   4. For wood in constant contact with ground or water: 0.40 per cubic foot.

C. Redry wood to maximum moisture content of 19 percent.

PART 3 EXECUTION

3.01 SITE TREATMENT OF WOOD MATERIALS

A. Apply preservative treatment in accordance with manufacturer's instructions. Redry to 19 percent moisture content.

B. Treat site-sawn ends in accordance with AWPA M4. Allow preservative to cure prior to placing members.

C. Redry wood to maximum 19 percent moisture content.

D. Allow preservative to cure prior to placing members.

3.02 INSTALLATION

A. Install wood in accordance with related work.

B. Discard treated wood that might impair quality of carpentry.

C. Do not rip or mill fire retardant treated lumber. Permit end cuts and drilling of holes adjoining cuts only.

END OF SECTION

SECTION 06074

FIRE RETARDANT TREATED WOOD

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Fire retardant treated treatment for wood framing, decking, sheathing, and miscellaneous wood.

1.02 REFERENCES

A. American Wood Preservers' Association (AWPA):
   1. C20 - Structural Lumber-Fire Retardant Treatment by Pressure Processes.
   2. C27 - Plywood-Fire Retardant Treatment by Pressure Processes.

B. ASTM International (ASTM):
   1. E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. D 3201 -Standard Test Method of Hygroscopic Properties of Fire Retardant Wood and Wood Base Products.

C. Federal Specifications (FS):
   1. MIL-L-19140E - Lumber and Plywood, Fire Retardant Treated.

D. National Fire Protection Association (NFPA):
   1. 255 - Standard Test Method for Surface Burning Characteristics of Building Materials.

E. Underwriters' Laboratory, Inc. (UL):
   1. 723 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Product data: Include National Evaluation Service Report discussing fire-retardant, strength, corrosion, and hygroscopic properties.

B. Manufacturer's Installation Instructions.

1.04 QUALITY ASSURANCE

A. Employ services of treatment plant that is currently licensed by manufacturer of treatment material.

B. Carbon steel, galvanized steel, aluminum, copper, and red brass in contact with fire retardant treated wood shall not corrode more than 1 mil per year when tested in accordance with FS MIL-L-19140E.

C. Fire performance and strength properties of fire retardant treated wood shall be recognized by issuance of National Evaluation Service Report.

D. Fire-retardant treatment shall provide UL FR-S Classification.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Keep materials dry during delivery and storage. Protect materials against exposure to weather and from contact with damp or wet surfaces.

PART 2 PRODUCTS

2.01 MATERIALS

A. Manufacturer: One of the following or equal:
   1. Koppers Company or Koppers Company's licensed producer.
   2. Type: Dricon, registered for use as wood preservative by U.S. Environmental Protection Agency, and free of halogens, sulfates, ammonium phosphate, and formaldehyde.

2.02 FIRE RETARDANT TREATMENT

A. Treat wood in accordance with instructions of fire retardant treatment materials manufacturer, and AWPA C20 for structural lumber or AWPA C27 for plywood.

B. After treatment, kiln dry lumber to maximum moisture content of 19 percent and plywood to maximum moisture content of 15 percent so that fire retardant treated wood has equilibrium moisture content of not more than 25 percent when tested in accordance with ASTM D 3201 procedures at 95 percent relative humidity and 80 degrees Fahrenheit.

C. Stamp fire-retardant lumber and plywood with UL FR-S rating stamp certifying 25 or less flame spread and smoke developed value, when tested in accordance with UL 723, ASTM E 84, or NFPA 255.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wood in accordance with related work.

B. Discard treated wood that might impair quality of carpentry.

C. Do not rip or mill fire retardant treated lumber. Permit end cuts and drilling of holes adjoining cuts only.

END OF SECTION

SECTION 06076

LAMINATED VENEER LUMBER

PART 1 GENERAL

1.01 SCOPE

A. This work includes the complete furnishings and installation of all laminated veneer lumber (LVL), as shown on the drawings herein specified and necessary to complete the work.

1.02 CODE APPROVALS

A. These products shall be designed and manufactured to the standards set forth in the ICC ES Report No. ESR-2993.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Carpentry and Millwork.

B. Glu-Laminated Members.

1.04 DESIGN

A. Products:
   1. RedLam™ LVL or equal.
   2. Specifically designed to fit the dimensions and loads indicated on the plans.

B. Design Calculations: Submit a complete set of design calculations.

1.05 SUBMITTALS

A. Drawings: Submit drawings showing layout and detail necessary for determining fit and placement in the building.

B. Production: Fabrication and/or cutting shall not proceed until the architect and/or engineer have approved the submittal package.

PART 2 PRODUCTS

2.01 MATERIALS

A. Code Reports: Materials shall comply with ICC ES Report No. ESR-2993.

B. Adhesives: Adhesives shall be of the waterproof type conforming to the requirements of ASTM D-2559.

2.02 FABRICATION

A. LVL shall be manufactured in a plant listed in the report referred to above and under the supervision of an approved third-party inspection agency. It shall be manufactured in a continuous process, with all grain parallel with the length of the members. All members are to be free of finger joints, scarf joints, or mechanical connections in full-length members.

2.03 TOLERANCES

A. Finished Length (as specified): ± 1/8 inch.

B. Depth: ± 1/16 inch.

C. Width: ± 1/16 inch.

2.04 IDENTIFICATION

A. LVL shall be identified by a stamp indicating the product type and grade, ICC-ES evaluation report number, manufacturer's name, plant number, date of fabrication, and the independent inspection agency’s logo.

2.05 HARDWARE

A. Not applicable.

PART 3 EXECUTION

3.01 INSTALLATION

A. LVL, if stored prior to installation, shall be protected from the weather. It shall be installed in accordance with the plans, and any manufacturer drawings and installation suggestions. Temporary construction loads that cause stresses beyond design limits are not permitted. Safety bracing is to be provided by the installer to keep the LVL straight and plumb as required, and to ensure adequate lateral support for the individual LVL members and the entire system until the sheathing material is applied.

3.02 INSTALLATION REVIEW

A. Prior to enclosing LVL, the contractor shall give notification to the manufacturer representative to provide an opportunity for review of the installation.

3.03 PERFORMANCE STANDARDS

A. Products shall be proven by testing and evaluation in accordance with the provisions of ASTM D-5456.

3.04 FIRE RATING

A. LVL is permitted as a substitute for conventional wood framing in fire-resistive assemblies. LVL shall be sized for the same load-carrying capacity as the sawn

lumber specified in the assembly, and its dimensions shall be equal to or greater than those specified for the sawn lumber.

3.05 WARRANTY

A. The products delivered shall be free from manufacturing errors or defects in workmanship and material. The products, when correctly installed and maintained, shall be warranted to perform as designed for the normal and expected life of the building.

END OF SECTION

SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Carpentry normally not exposed to view, related metal items, and connectors.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.
      b. Section 01600 - Product Requirements.
      c. Section 05120 - Structural Steel.
      d. Section 06072 - Preservative Pressure Treated Wood.
      e. Section 06074 - Fire Retardant Treated Wood.
      f. Section 07840 - Firestopping.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B18.2.1 - Square and Hex Bolts and Screws.
   2. B18.6.1 - Wood Screws.

B. American Softwood Lumber Standard (ASLS):
   1. PS 20 -Softwood Lumber, Product Standard.

C. ASTM International (ASTM):
   1. D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
   2. F 1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

D. California Redwood Association (CRA):
   1. Standard Specification for Grades of California Redwood Lumber.
   2. Redwood Inspection Service (RIS).

E. U.S. Department of Commerce (DOC):
   1. Voluntary Product Standard PS 1-07 - Structural Plywood.

F. West Coast Lumber Inspection Bureau (WCLIB):
   1. Standard No. 17 - Grading Rules for West Coast Lumber.

G. Western Wood Products Association (WWPA):
   1. Western Lumber Grading Rules.

1.03 SUBMITTALS

A. Shop drawings.

B. Product Data.

1.04 QUALITY ASSURANCE

A. Grade lumber in accordance with following:
   1. Douglas Fir and Larch Lumber:
      a. WCLIB Grading Rules.
      b. WWPA Grading Rules.
      c. ASLS PS 20.
   2. Redwood Lumber: CRA and RIS grading rules.

B. Stamp each piece of lumber with grade, species, and size.

C. Identify each panel of softwood plywood with appropriate APA grade-trademark. Plywood shall meet requirements DOC PS 1-07.

D. Grade lumber 2 inches, 3 inches, and 4 inches thick in accordance with ASLS PS 20. Identify with grade name and species only without reference to paragraph numbers.

E. Grade lumber 6 inches and larger under provisions of WWPA. Identify with grade, species, and size. Equivalent members graded by WCLIB will be accepted unless specifically excluded.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Cover products for protection from damage and moisture.

B. Stack lumber to permit good air drying. Position separators at each layer and between soil and first layer.

PART 2 PRODUCTS

2.01 WOOD

A. Minimum lumber grade requirements for framing and sheathing:

Classification	Nominal Size	Species and Minimum Grade
Studs	1-3/4 by 5-1/2 inches	Redlam 2.DE LVL
	1-3/4 by 7-1/4 inches	Redlam 2.DE LVL
Roof Joists	1-3/4 by 14 inches	Redlam 2.DE LVL

Classification	Nominal Size	Species and Minimum Grade
Floor Joists and Planking	2 by 6 through 2 by 14	DF-L Number 2
Headers, Beams, and Stringers	4 by 4 through 4 by 14 6 by 6 through 6 by 14	DF-L Number 1 DF-L Number 1 (WWPA 70-11)
Posts and Timbers	6 by 6 and larger	DF-L Number 1
Boards	1 by	DF-L Construction
Framing Lumber	All sizes	DF-L Number 2
Blocking and Bridging	2 by 3 through 2 by 14	DF-L Number 3
Exposed Beams and Posts	4X or 6X	DF-L Number 1, S-Dry, Free of Heart Center (FOHC)
Miscellaneous	All sizes	DF-L Number 2
DF-L = Douglas Fir - Larch (North) Grouping		

B. Species shall be as specified, or any combination of species allowed by grading rules.

C. Lumber 4 inches thick and less: Seasoned or kiln-dried with maximum 19 percent moisture.

D. Lumber thicker than 4 inches: Seasoned to minimize warping and twisting.

E. Lumber surfaces: Surfaced four sides (S4S), unless otherwise specified or indicated on the Drawings.

F. Lumber shall be free of bow, warp, or twist. Pieces with serious defects will be discarded regardless of grading.

G. Sills, cants, and nailers for fascia for roofing: Preservative pressure-treated Number 2 or better Douglas Fir.

H. Roof nailers: Use preservative pressure-treated Number 2 or better Douglas Fir nailers for gravel stops at edges of roof and at roof expansion joints. Match thickness of nailers and roof insulation.

I. Redwood:
   1. Redwood for baffles and stop logs: Select Heart.

J. Wood in contact with concrete or masonry: Pressure treated as specified in Section 06072.

K. Fire-retardant treatment: As specified in Section 06074.

2.02 PLYWOOD

A. Plywood:
   1. DOC PS 1-07 for softwood plywood.

B. Plywood with edges or surfaces permanently exposed to weather: Exterior type with exterior type glue, Grade A-C.

C. Plywood roof sheathing: Exterior type with exterior type glue, of thickness and grade as indicated on the Drawings.

D. Plywood sheathing exposed at overhangs: Exterior type plywood with exterior type glue, Grade A-C or better.

E. Miscellaneous plywood: Exterior type plywood of thickness indicated on the Drawings, Grade A-C, or as otherwise indicated on the Drawings.

F. Plywood for roof diaphragms and shear walls: As indicated on the Drawings.

2.03 ROUGH HARDWARE

A. Fasteners:
   1. Nails: ASTM F 1667 common wire nails or spikes with full head.
   2. Bolts, nuts, and studs: ASME B18.2.1, hot-dip galvanized.
   3. Washers: Hot-dip galvanized square or round steel plate washers, or malleable iron washers with following dimensions:
      a. Hot-dip galvanized square steel washers:

Bolt Diameter	Washer Dimensions
1/2 inch	2-1/2 by 2-1/2 by 1/4 inches
5/8 inch	2-1/2 by 2-1/2 by 1/4 inches
3/4 inch	2-3/4 by 2-3/4 by 5/16 inches
7/8 inch	3-1/4 by 3-1/4 by 5/16 inches
1 inch	3-3/4 by 3-3/4 by 3/8 inches

      b. Hot-dip galvanized round steel washers:

Bolt Diameter	Washer Dimensions
1/2 inch	2-1/2 inch diameter by 1/4 inch
5/8 inch	2-3/4 inch diameter by 1/4 inch
3/4 inch	3 inch diameter by 5/16 inch
7/8 inch	3-1/2 inch diameter by 3/8 inch
1 inch	4 inch diameter by 7/16 inch

      c. Round malleable iron washers:

Bolt Diameter	Washer Dimensions
1/2 inch	2-1/2 inch diameter by 1/4 inch
5/8 inch	2-3/4 inch diameter by 5/16 inch
3/4 inch	3 inch diameter by 7/16 inch
7/8 inch	3-1/2 inch diameter by 7/16 inch
1 inch	4 inch diameter by 1/2 inch

4. Lag screws: ASME B18.2.1, hot-dip galvanized.
5. Wood screws: ASME B18.6.1.
6. Nails, screws, bolts, plates, and other fasteners exposed to weather or on building exteriors shall be hot-dip galvanized or of Series 300 stainless steel.
7. Anchor bolts, concrete anchors, flush shells, and powder actuated fasteners: As specified in Section 05120.
8. Sheet metal connectors:
   a. Manufacturers: One of the following or equal:
      1) Simpson Strong-Tie Company, Inc.
      2) USP Structural Connectors.
   b. Material: Sheet steel, hot-dip galvanized after fabrication.
   c. Model numbers: As indicated on the Drawings.
   d. Nails, typical: Common, hot-dip galvanized.
   e. Nails, joist hanger: Special, hot-dip galvanized, providing full building code as specified in Section 01410, lateral load resistance values for common nails.

B. Miscellaneous hardware:
   1. Clamps, expansion screws, anchors, and plates: Standard products of established manufacturers of proper size and strength to adequately fasten, support, and maintain members in place.
   2. Hardware exposed to weather or on building exteriors: Hot-dip galvanized.

C. Building paper: ASTM D 226; unperforated; No. 15 unless otherwise indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for installation of products as specified in Section 01600.

3.02 GENERAL

A. Notch, cope, and miter meeting members so meeting members have full bearing without overcutting or undercutting.

B. Accurately cut, fit, and frame lumber.

3.03 SILLS AND PLATES

A. Install 2 layers of building paper under sills and members fasten to concrete or masonry.

B. Secure sills to foundation as indicated on the Drawings. When not indicated on the Drawings, anchor sills with 1/2-inch diameter hot-dip galvanized anchor bolts at 4-foot centers and within a minimum of 6 inches from each end of each member.

C. Set plates on top of masonry and concrete walls level and in same plane.

D. Anchor plates to masonry or concrete with anchor bolts of size and spacing indicated on the Drawings. Install anchor bolt within 6 inches of member ends.

E. Use cement grout, when necessary, to assure full bedding and leveling of plates.

3.04 WALLS

A. Erect walls plumb and true to line.

B. Frame walls and partitions with studs of sizes and spacing indicated on the Drawings and at not greater than 16 inches on center.

C. Provide double studs at openings and triple studs at corners unless otherwise indicated on the Drawings.

D. Provide double plates at top of wall studs, arranging to form continuous horizontal ties. Splice individual plates and stagger ends of double plates as detailed on the Drawings.

E. Provide two 2-by-6 lintels for openings up to 48 inches and two 2-by-8 lintels for openings from 48 inches to 72 inches unless otherwise indicated on the Drawings.

F. Frame openings for large pipes and ducts and for receiving recessed Work in partitions without cutting structural members.

G. Place nailing blocks and backing necessary for attachment of ground, trim, fixtures, and miscellaneous items. Cut, fur, and install backing required for plumbing and heating pipes, fixtures, and electrical work.

H. Provide fire retardant pressure-treated wood within metal-framed partitions and furring.

I. Provide blocking for attaching paneling, trim, and similar items to framing.

J. Do not cut wood beams or joists and plates in bearing walls for passage of pipes.

K. Coordinate requirements for sleepers for mechanical equipment and curb openings with work of other Sections for locations and sizes.

L. Firestopping:
   1. Where required by governing codes, install continuous row of fire stop blocking in stud walls and partitions at ceilings and floor levels and at maximum 10 feet spacing. Form complete and effective separation for entire width of wall or partition.
   2. Use fire stop blocking with minimum 2 inches nominal thickness and same width as studs.
   3. Fill openings in firestops with other firestopping materials specified in Section 07840.

3.05 ROUGH HARDWARE

A. Provide nailing as indicated on the Drawings or in accordance with Fastening Schedule specified in building code, as specified in Section 01410, whichever is more stringent. Do not use box and sinker nails.

B. Install bolts and other fastenings as indicated on the Drawings or in accordance with building code as specified in Section 01410, whichever is more stringent.

C. Prebore nail holes where required to avoid splitting of wood members. Remove and replace split pieces.

D. Prebore holes for screws and lag screws, then screw into place. When wood screws and lag screws are defective because they have been driven into place with hammer, replace wood members involved with new members.

E. Drill holes for bolts 1/32-inch larger than bolt shank unless otherwise indicated on the Drawings.

F. Perform final bolting after structural members have been properly aligned.

G. Place washers under heads of bolts and nuts and heads of lag screws bearing on wood. Align exposed bolts.

H. Provided installation does not mar or damage wood members, power nailing will be permitted where nails are as specified. Nails shall have full head. Do not overdrive nails.

I. Drive nail heads for plywood diaphragms flush with plywood surface. Where nails have been overdriven in plywood panel, remove and replace plywood, nails, and damaged supporting members.
   1. Use common nails unless otherwise indicated on the Drawings.

END OF SECTION

SECTION 06174

SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Wood trusses, including bridging, temporary and permanent bracing, associated components, and accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01600 - Product Requirements.

1.02 REFERENCES

A. American Forest and Paper Association (AF&PA):
   1. National Design Specification for Wood Construction.

B. ASTM International (ASTM):
   1. A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.

C. Truss Plate Institute (TPI):
   1. Design Specifications for Metal Plate Connected Wood Trusses.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:
   1. Design and fabricate of wood trusses in accordance with:
      a. National Design Specifications for Wood Construction.
      b. Design Specifications for Metal Plate Connected Wood Trusses.

1.04 SUBMITTALS

A. Shop drawings: For each type and size truss, include:
   1. Species and grades of lumber used.
   2. Design loadings.
   3. Design calculations for trusses and connections.
   4. Pitch, span, and spacing of trusses.
   5. Metal plate connectors, gauges, sizes, and name of manufacturer.
   6. Bearing and anchorage details.

7. Truss supports.
8. Camber.
9. Permanent bracing and bridging.
10. Details of field splice connections of subcomponents.

B. Product Data.

C. Handling and erection instructions.

D. Design Data.

E. Certificates.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of wood trusses for minimum 5 years with satisfactory performance record.

B. Lumber shall bear grade mark stamp of recognized grading association or licensed lumber inspection agency.

C. Fabricate trusses and other roof structural components in properly equipped manufacturing facility of permanent nature.

D. Employ only experienced workmen, using precision cutting and truss fabricating equipment, under direct supervision of qualified foreman.

E. Fabricate trusses under strict rules of inspection and quality control.

F. Erector qualifications: Erector of wood trusses on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle fabricated trusses and subassemblies with care so trusses are not subject to damage.

B. When trusses are stockpiled or stored prior to erection, set trusses in vertical positions, resting upon temporary bearing supports and braced so trusses will not be subject to unusual bending or tip over.

C. Provide means for adequate distribution of concentrated loads so carrying capacity of trusses are not exceeded.

PART 2 PRODUCTS

2.01 LUMBER

A. Species and grades: In accordance with stress ratings for species and grades in grading rules of appropriate lumber association or as listed in referenced quality assurance standards, unless otherwise indicated on the Drawings.

B. Moisture content: Within limits as stipulated in quality assurance standards, but not exceeding 19 percent or less than 7 percent at time of fabrication.

C. Nominal sizes: As indicated on the Drawings.

2.02 LIGHT METAL PLATE CONNECTORS

A. Connector plate shall have series of nail-like projections.

B. Practically parallel side throughout their length.

C. No offsets except at ends. Ends shaped to blunt points or wedges.

D. Lengths not less than 5 times their greater width.

E. Form which permits projections to separate rather than to cut wood fibers in accordance with accepted nailing techniques.

F. Minimum 20 gauge, ASTM A 653, Grade 33, sheet steel, hot-dip galvanized in accordance with ASTM A 653, G60 coating designation.

G. Yield strength: Minimum 33,000 pounds per square inch.

H. Ultimate tensile strength: Minimum 48,000 pounds per square inch.

I. Corrosion-resistant coating: Minimum 1.25 ounces per square foot.

J. Stamp manufacturer's name on each plate connector.

2.03 FIELD CONNECTIONS:

A. One of the following as required for trusses:
   1. Nail-on splice plates.
   2. Plates bolted connections with steel side

2.04 TRUSS FABRICATION

A. Cut truss members accurately to length, angle, and true to line to assure tight joints for finished truss.

B. Brush apply 2 coats of wood preservative on members in contact with sheet metal and cementitious materials.
   1. Protect sawn ends.

C. Place truss members jigs with members tightly clamped in place until.
   1. For trusses fabricated using 2x members: Plate connectors have been pressed into lumber simultaneously on both sides of joints.
   2. For trusses fabricated using 3x and thicker members: Steel side plates and bolts are secured.

D. Do not allow open joints which depend on stiffness of metal connector plates to transmit stresses of improperly fitted joints.

E. Build camber into trusses, as indicated on the shop drawings, by properly positioning members in fabrication jigs.

F. Permanently stamp each truss with name and address of truss fabricator.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for erection of products as specified in Section 01600.

3.02 PREPARATION

A. Where field assembly of truss subcomponents is necessary, make approved connections.

3.03 ERECTION

A. Set and secure wood trusses level, plumb, and in correct locations.

B. Install erection bracing to hold trusses true and plumb and in safe condition until permanent truss bracing and bridging can be solidly fastened in place.

C. Keep horizontal bending of trusses to minimum.

D. Ensure truss ends have sufficient bearing area.

E. Install permanent bracing and bridging, and permanently fasten components before application of live loads.

F. Connect continuous lines of 2x minimum bridging to trusses at chord members during erection stage. Provide 1 line along top and 1 line along bottom chord.

G. Erect trusses with top and bottom chords in true vertical alignment.

H. Align top chords of trusses parallel to each other and straight with no point in plane on top chords more than 3/8 inch out of true horizontal line.

I. Do not cut or alter truss members.

END OF SECTION

SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Field fabricated finish carpentry items with hardware and attachment accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 09910 - Painting.

1.02 REFERENCES

A. Architectural Woodwork Institute (AWI):
   1. 600 - Architectural Woodwork Quality Standards - Closet and Utility Shelving.

B. Federal Specifications (FS):
   1. MM-L-736 - Lumber - Hardwood.

C. U.S. Department of Commerce (DOC):
   1. Voluntary, Product Standards (PS):
      a. PS 1 - Structural Plywood.
      b. PS 20 - American Softwood Lumber Standard.

1.03 SHOP DRAWINGS, PRODUCT DATA

A. Submit shop drawings, product data, and samples.

B. Include dimensions, materials finishes, fabrication details, description of products, and installation instructions.

C. Submit minimum 6-inch long trim and molding samples, and minimum 2-inch square plastic laminate samples showing colors and patterns.

1.04 QUALITY ASSURANCE

A. Perform finish carpentry work in accordance with AWI Quality Standards, custom grade.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver wood products when storage area temperature has been permanently maintained above 62 degrees Fahrenheit with low enough humidity so wood products will not be damaged by excessive change in moisture content.

PART 2 PRODUCTS

2.01 LUMBER MATERIALS

A. Softwood lumber:
   1. Type: PS 20.
   2. Species for transparent finish: Mahogany.
   3. Species for opaque finish:
      a. Of grain type sufficient to receive opaque finish.
      b. No knots.
   4. Sizes: As indicated on the Drawings.
   5. Moisture content for interior application: Maximum 6 percent.
   6. Moisture content for exterior application: Maximum 10 percent.

B. Hardwood lumber:
   1. Type: FS MM-L-736.
   2. Species for transparent finish: Mahogany.
   3. Species for opaque finish: Of grain type sufficient to receive opaque finish.
   4. Sizes: As indicated.
   5. Moisture content: Maximum 6 percent.

2.02 SHEET MATERIALS

A. Softwood plywood:
   1. Type: PS 1.
   2. Cores: Veneer, lumber, or particleboard.
   3. Face veneer species: Douglas Fir.
   4. Thickness: As indicated on the Drawings.

B. Hardwood plywood:
   1. Type: PS 1.
   2. Cores: Veneer, lumber, or particleboard.
   3. Face veneer species: Mahogany.
   4. Thickness: As indicated on the Drawings.

C. Wood particleboard:
   1. Material: Wood chips, shaving, or flakes with waterproof resin binders or water resistant adhesive.
   2. Density: 45 pounds per cubic foot.
   3. Faces: Sanded.
   4. Thickness: As indicated on the Drawings.

D. Hardboard:
   1. Material: Pressed wood fiber with resin binder.
   2. Grade: Standard or tempered service.
   3. Thickness: 1/8 inch.

E. Pegboard:
   1. Material: Pressed wood fiber with resin binder.
   2. Grade: Standard or tempered service.
   3. Thickness: 1/8 inch.
   4. Holes: 3/16-inch diameter at 1 inch on center each way.
   5. Pegboard:
   6. Material: Pressed wood fiber with resin binder.
   7. Grade: Standard or tempered service.
   8. Thickness: 1/4 inch.
   9. Holes: 9/32-inch diameter at 1 inch on center each way.
   10. Shelving: AWI 600, Custom Quality Grade.
   11. Sheet goods: APA AC INT, Douglas fir plywood, 3/4 inches thick.
   12. Edge treatment: Solid softwood, 3/8 by 3/4 inch.

2.03 PLASTIC LAMINATE

A. General purpose plastic laminate:
   1. Manufacturer: As selected.
   2. Thickness: 0.050 inch.
   3. Color/pattern/surface finish: As selected.

B. Vertical grade plastic laminate:
   1. Manufacturer: Formica.
   2. Thickness: 0.028 inch.
   3. Color/pattern/surface finish: As indicated on the Drawings.

2.04 ADHESIVE

A. Contact adhesive: water base, or solvent release type.

2.05 ACCESSORIES

A. Nails: Size and type to suit application.

B. Bolts, nuts, washers, lags, and screws:
   1. Size and type: To suit application.
   2. Finish for exterior, high humidity and treated wood application: Noncorrosive.
   3. Finish for interior, low humidity application: Plain.

C. Plastic edge trim:
   1. Shape: Extruded convex head with self-locking serrated tongue.
   2. Width: To match plywood or particleboard thickness.
   3. Finish: Smooth.
   4. Color: As indicated on the Drawings.

D. Aluminum edge trim:
   1. Shape: Extruded convex head with self-locking serrated tongue.
   2. Width: To match plywood or particleboard thickness.
   3. Surface texture: Smooth or ridged.
   4. Finish: bronze anodized.

E. Shelf standards and rests:
   1. Manufacturer: Knape and Vogt.
   2. Type: No. 255.

F. Shelf brackets:
   1. Manufacturer: Knape and Vogt.
   2. Type: No. 256.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for installation of products.

B. Verify that mechanical, electrical, and building items affecting finish carpentry are placed and ready to receive finish carpentry.

C. Verify that wood's moisture content is below maximum specified with moisture meter.

3.02 INSTALLATION

A. Install carpentry plumb, level, true to line, and firmly secured to grounds or backing. Scribe and fit accurately to adjacent work, taking care not to injure finished surfaces.

B. Distribute defects allowed in quality grades specified to minimize their effect on finished work.
   1. Fit joints tight, flush, and even.
   2. Erase sharp edges.

C. Attach work to assure firm, secure support, with concealed fastenings.

D. Blind nail where possible.
   1. Where not possible to blind nail, locate, drive, and set surface nails for putty stopping to not be conspicuous in finish.
   2. Surface nail plain casings and bases in pairs at 24-inch centers.
   3. Drill lead holes for screws.

E. Apply adhesives in accordance with manufacturer's directions. Supplement adhesives with nailing as required to securely adhere surfaces.

F. Install standing trim in single lengths without splices.

G. Install running trim in as long as possible lengths.
   1. Join ends only where solid fastenings can be made.
   2. Distribute end joints in built-up members well.
   3. Miter external corners and cope internal corners.

H. Prime paint surfaces of items or assemblies in contact with cementitious materials as specified in Section 09910.

I. Apply laminates where indicated on the Drawings.
   1. Adhere with adhesives over entire surface.
   2. Make joints and corners hairline.
   3. Match patterns.
   4. Cap exposed edges with laminate of same finish and pattern.

3.03 PROTECTION

A. Protect work after erection, repairing or replacing damaged work as directed.

END OF SECTION

SECTION 06400

ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Architectural woodwork, including casework.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 06200 - Finish Carpentry.
      b. Section 09910 - Painting.

1.02 REFERENCES

A. Architectural Woodwork Institute (AWI).

1.03 SUBMITTALS

A. Submit following:
   1. Shop Drawings: Include materials and wood species, component profiles, fastening, jointing details, finishes, and accessories to large scale.
   2. Product data.
   3. Samples: Submit samples of each:
   4. Wood species to receive transparent finish.
   5. Factory applied finish.
   6. Type and color of plastic laminate.
   7. Manufacturer's Installation Instructions.
   8. Warranty.

1.04 QUALITY ASSURANCE

A. Provide architectural woodwork in accordance with AWI Quality Standards.

B. Mock-up: Shop prepare typical counter unit required for Project, complete with hardware and applied finishes, which may be used as part of work when accepted by ENGINEER.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until Project site conditions are adequate to receive woodwork.
   1. Protect woodwork from weather while in transit.

B. Store indoors in ventilated areas with constant but minimum temperature of 60 degrees Fahrenheit and maximum relative humidity of 25 to 55 percent.

1.06 WARRANTY

A. Warranty to correct or replace architectural woodwork that exhibits defects in material and workmanship with minimum period of 2 years.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Plastic laminate: One of the following or equal:
   1. Formica Corp., Cincinnati, OH.
   2. Nevamar Corp., Odenton, MD.
   3. Wilson Art International, Temple TX.

B. Hardware: One of the following or equal:
   1. Hettich International, Grant Door Hardware, (Grant), Alpharetta, GA.
   2. Ives Ingersoll Rand (Ives), Indianapolis, IN.
   3. Knape and Vogt Mfg. Co. (KV), Grand Rapids, MI.
   4. Stanley Hardware Div., The Stanley Works (Stanley), New Britain, CT.

2.02 MATERIALS

A. Types: As specified in Section 06200, unless specified otherwise.

2.03 CASEWORK FOR TRANSPARENT FINISH

A. AWI quality grade: Premium.

B. Construction: Reveal overlay.

C. Veneer species for exposed surfaces: Cherry.

D. Lumber species, exposed portions: Cherry.

E. Edge treatment for shelves: Match veneer or lumber species in accordance with AWI Quality Grade.

F. Semi-exposed parts: As governed by AWI Quality Grade.

G. Casework doors: Minimum 3/4-inch thick.

H. Finish of exposed wood:
   1. AWI System:
      a. Alkyd-Urea Conversion Varnish.
   2. Grade: Premium.
   3. Sheen: Semi-gloss on 60-degree meter.
   4. Effect: Closed grain.

I. Hardware:
   1. Pulls: Stanley 4483-1/2 BHMA 626.
   2. Drawer guides: KV 1320.
   3. Pivot hinges: Stanley Nos. 331 or 335.
   4. Continuous hinge: Stanley SC311-l/4 BHMA 626, size as indicated on the Drawings.
   5. Drawer locks: KV 986.
   6. Door catches: Stanley 45 or 46; magnetic; 2 for each door over 42 inches high.
   7. Shelf brackets: KV No. 255.
   8. Shelf standards: KV No. 256.

2.04 CASEWORK FOR OPAQUE FINISH

A. AWI quality grade: Premium.

B. Construction: Reveal overlay.

C. Exposed solid wood parts: Black.

D. Exposed plywood parts: Black.

E. Casework doors: Minimum 3/4-inch thick.

F. Finish of exposed wood:
   1. AWI System:
      a. Alkyd-Urea Conversion Varnish.
   2. Grade: Premium.
   3. Sheen: Semi-gloss on 60-degree meter.
   4. Effect: Closed grain.
   5. Finish: Unfinished for field finishing as specified in Section 09910.

G. Hardware:
   1. Pulls: Stanley 4483-1/2 BHMA 626.
   2. Drawer guides: KV 1320.
   3. Pivot hinges: Stanley Nos. 331 or 335.
   4. Continuous hinge: Stanley SC311-l/4 BHMA 626, size as indicated on the Drawings.

H. Drawer locks: KV 986.
   1. Door catches: Stanley 45 or 46; magnetic; 2 for each door over 42 inches high.
   2. Shelf brackets: KV No. 255.
   3. Shelf standards: KV No. 256.

2.05 CASEWORK CLAD WITH HIGH PRESSURE LAMINATE

A. AWI quality grade: Premium.

B. Construction: Reveal overlay.

C. Casework doors: Minimum 3/4-inch thick.

D. Plastic laminate on exposed surfaces:
   1. Manufacturer: As selected or as indicated on the Drawings.
   2. Color: As selected or as indicated on the Drawings.

E. Plastic laminate, backing:
   1. Manufacturer: Same as for exposed surfaces.
   2. Color: As selected or as indicated on the Drawings.

F. Edge treatment for doors, drawer fronts, ends and exposed edges:
   1. Type: Vinyl barbed tee banding.
   2. Color: As selected or as indicated on the Drawings.

G. Hardware:
   1. Pulls: Stanley 4483-1/2 BHMA 626.
   2. Drawer guides: KV 1320.
   3. Pivot hinges: Stanley Nos. 331 or 335.
   4. Continuous hinge: Stanley SC311-1/4 BHMA 626, size as indicated on the Drawings.
   5. Drawer locks: KV 986.
   6. Door catches: Stanley 45 or 46; magnetic; 2 for each door over 42 inches high.
   7. Shelf brackets: KV No. 255.
   8. Shelf standards: KV No. 256.

2.06 HIGH PRESSURE LAMINATE COUNTERTOPS

A. AWI quality grade: Premium.
   1. Plastic laminate.
   2. Manufacturer: As selected or as indicated on the Drawings.
   3. Color: As selected or as indicated on the Drawings.

B. Exposed edge treatment: Self-edged.

2.07 PANELWORK

A. AWI quality grade: Premium.

B. Flush paneling, wood veneer:
   1. Manufacturer: As indicated on the Drawings or as selected.
   2. Type: Flush wood veneer.
   3. Thickness: As indicated on the Drawings.
   4. Core: Veneer.
   5. Face veneer: Species as selected.
   6. Veneer cut: Plain sliced.

7. Matching of adjacent pieces of veneer: Slip match.
8. Panel face assembly: Balance matched.
9. Matching of adjacent panels: Sequence matched sets.
10. Ratio of 3 to 1.

C. Finish of exposed wood:
1. AWI system:
a. Alkyd-Urea Conversion Varnish.
2. Grade: Premium.
3. Sheen: Semi-gloss on 60-degree meter.
4. Effect: Closed grain.

2.08 CLOSET AND STORAGE SHELVING, PAINTED

A. AWI quality grade: Custom.

B. Shelf material: Plywood, APA INT A-B, 3/4-inch thick, face veneers suitable for painting.

C. Edge treatment: Solid softwood, 3/8 by 3/4 inches.

D. Cleats: Solid 1 by 4 softwood.

E. Closet poles: Douglas Fir, clear with close, straight grain, and 13/8-inch diameter.

F. Closet pole supports: KV 735, 734, and 1195.

2.09 CLOSET AND STORAGE SHELVING CLAD WITH HIGH PRESSURE LAMINATE

A. AWI quality grade: Premium.

B. Plastic laminate on exposed surfaces:
1. Manufacturer: As selected or as indicated on the Drawings.
2. Color: As selected or as indicated on the Drawings.

C. Edge treatment: Self-edged.

D. Closet poles: Douglas Fir, clear with close, straight grain, 13/8-inch diameter.

E. Closet pole supports: KV 735, 734, and 1195.

2.10 EXTERIOR STANDING AND RUNNING TRIM

A. AWI quality grade: Premium.

B. Molding profile: As selected from standard WWPA shapes.

C. Wood species: As selected. Of grain type sufficient to receive opaque finish.

2.11 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. AWI quality grade: Premium.

B. Molding profile: As selected from standard WWPA shapes.

C. Wood species: As selected.

2.12 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. AWI quality grade: Premium.

B. Molding profile: As selected from standard WWPA shapes.

C. Wood species: Of grain type sufficient to receive opaque finish.

2.13 MISCELLANEOUS ORNAMENTAL ITEMS

A. AWI quality grade: Premium.

B. Solid wood: As selected.

C. Plywood: As selected.

2.14 FABRICATION

A. Size architectural woodwork components for easy handling and passage through building openings.

B. Fabricate woodwork with ample allowance for cutting when necessary to cut and fit on Project site. Provide trim for scribing and cutting.

C. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings.
   1. Verify locations of cutouts from construction measurements.
   2. Seal contact surfaces of cutouts.

D. Fit shelves, doors, and exposed edges with 3/8-inch thick matching hardwood edging.
   1. Use full-length pieces only.

E. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes, hairline corners and joints, and slightly beveled arises.
   1. Locate counter butt joints at 2 feet minimum from sink cutouts.

F. Cap exposed plastic laminate edges with material of same finish and pattern.
   1. Mechanically fasten back-splashes to countertops with steel brackets at 16 inches on center.

G. Apply plastic laminate backing sheets to reverse side of door panels having plastic laminate faces.

H. Use exposed fastening devices or nails only when permitted. Arrange orderly.

I. Sand woodwork smooth and set exposed nails and screws.
   1. Apply wood filler in exposed nail and screw indentations and leave ready to receive Project site applied finishes.

J. On woodwork to receive transparent finishes, use wood filler that matches surrounding surfaces and of types recommended for applied finishes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Back-paint wood surfaces to be concealed as specified in Section 09910.

B. Set and secure casework and finish carpentry items in place rigid, plumb, and square.

C. Use purpose designed fixture attachments for wall-mounted components.

D. Use threaded steel concealed joint fasteners to align and secure adjoining casework units and countertops.

E. Permanently fix casework and counter bases to floor using appropriate angles and anchorages.

F. Countersink semi-concealed anchorage devices used to wall mount components, and conceal with solid plugs of species to match surrounding wood.
   1. Place flush with surrounding surfaces.

G. Carefully scribe casework that is against other building materials, leaving gaps of 1/32-inch maximum.
   1. Do not use additional overlay trim for this purpose.

H. Install and adjust casework hardware to ensure smooth and correct operation.

END OF SECTION

SECTION 06608

FIBERGLASS REINFORCED PLASTIC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: General fabrication and design requirements for fiberglass reinforced plastic fabrications.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. RTP-1 - Reinforced Thermoset Plastic Corrosion Resistant Equipment.

B. ASTM International (ASTM):
   1. C 582 - Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
   2. D 883 - Standard Terminology Relating to Plastics.
   3. D 2563 - Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
   4. D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
   5. D 2584 - Standard Test Method for Ignition Loss of Cured Reinforced Resins.
   6. D 3299 - Standard Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Corrosion-Resistant Tanks.
   7. D 4097 - Standard Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks.

1.03 DEFINITIONS

A. The terminology of this specification is in accordance with ASTM D 883. Fabricators using this specification are responsible for correct interpretation.

B. Fiberglass reinforced plastic: Fiberglass Reinforced Plastic or glass fiber and resin fabrication consisting of approximately 35 to 55 percent glass fiber reinforcement by weight for hand lay-up structural laminates and 55 to 70 percent glass for filament wound structural laminates, unless otherwise specified.

C. Equipment: The fiberglass reinforced plastic equipment, including ancillary equipment, work, and materials as described in this specification.

D. Fabrication drawings: Those drawings produced by the Fabricator or CONTRACTOR, with the intention of providing the necessary information to construct or install the equipment.

E. Mat: Fibrous material consisting of randomly oriented chopped or swirled filaments loosely held together with a binder.

F. Chopped glass: Fibrous material consisting of randomly oriented chopped filaments applied directly to a mold surface or laminated under construction by a chopper gun.

G. Fiber prominence (jackstraw): The distinct visibility of individual glass strands causing a loss of translucency of the laminate.

1.04 DESIGN REQUIREMENTS

A. Design fiberglass reinforced plastic tanks, scrubbers, and other vessels following the procedures and methods, utilizing the equations and formulas, and incorporating safety factors and allowable design stresses and strains set forth in ASME RTP-1. Base the design of duct and other fiberglass reinforced plastic equipment not covered by ASME RTP-1 on the engineering rationale, applicable formulas, and safety factors set forth in ASME RTP-1.

B. Perform calculations necessary to ensure long-term, low risk service of the fiberglass reinforced plastic equipment with minimum reasonable maintenance requirements.
   1. Long-term, low risk service is defined as a service life of 20 years without major structural failure or leakage.
   2. The design shall ensure proper functioning of the equipment at the stated operating conditions.
   3. The design shall include as a minimum, engineering calculations, materials selection and documented physical and mechanical properties, and detailed drawings required for fabrication and assembly of the equipment.

C. Design in accordance with applicable national, regional, and local design and building codes.
   1. Wind and seismic forces shall be determined in accordance with the building code as specified in Section 01410.

D. Resistance to overturning shall not include the weight of the liquid contained in the equipment.

E. Consider the interaction of the installed system including but not limited to thermal expansion of duct, tanks, and vessels and the effects of external loading from piping, fans, pumps, platforms, and other attached items.

F. Allow for the most severe combination of conditions which may include, but not be limited to, the following:
   1. Internal or external pressure.
   2. Static head of contents (working and test conditions).
   3. Mass of structure and contents.

4. Design temperature including upset conditions.
5. Superimposed loads, such as seismic and wind forces.
6. Bending moments due to eccentric loads.
7. Localized loads acting at supports, lugs, and other attachments.
8. Shock loads.
9. Loads due to heating or cooling and thermal gradients.
10. Loads applied during transport or erection.
11. Loads imposed by personnel during erection and operations.
12. Fatigue.

G. Use safety factors and allowable strains specified in ASME RTP-1 unless otherwise specified. Do not use safety factors and allowable strains less than the following:
   1. Allowable hoop and axial strain shall be 0.001 inch per inch for filament wound tanks.
   2. A safety factor of 10 for hand lay-up components in tension, flexure, or other loading conditions where elastic stability is not in question.
   3. A safety factor of 5 for external loading (vacuum) or local buckling due to seismic or wind loading.

H. Safety factors for upset conditions or infrequent loading situations may be less than the above values for the specific condition if acceptable to the ENGINEER.

I. There will typically be other aspects that should be considered. Identify and consider their effects, identify design limitations, and submit this information.

J. Provide test reports or other documentation for laminate properties used in the design. Laminates shall be similar in construction, layer sequence, resin type, and cure to those used to determine tested properties. Properties shall be adjusted to reflect reductions at operating temperatures. Test reports shall be provided for:
   1. Grating: Indicate grating strength and deflection.
   2. Physical properties of test cover panels.
   3. Tanks showing conformance with specified strength requirements.

K. The corrosion liner shall be a minimum of 100 mils in thickness, unless otherwise specified, and documentation shall be provided verifying veil type, liner thickness, and resin cure.
   1. Consider 50 mils of the corrosion liner as sacrificial and do not include it in determining structural wall thickness.
   2. Use structural wall thickness not less than 0.375 inches for tanks and vessels and 0.1875 inches for ductwork.
   3. Submit minimum structural thicknesses of other types of fiberglass reinforced plastic fabrications.

L. Laminate types may include hand lay up, helical winding, and hoop/chop construction methods.
   1. In laminates with helix angles greater than 80 degrees and in hoop/chop laminates, orientate approximately 10 percent of the structural wall thickness at 0 degrees (longitudinal direction).
   2. Apply this reinforcement in at least 2 layers of weft unidirectional fabric and equally spaced within the structural wall.

M. For tanks and scrubbers; nozzles, determine manways and shell reinforcements according to the tables and formulas in ASME RTP-1.

N. Anchor tanks and vessels using lugs and a continuous filament wound band or an integral filament wound load ledge with external stainless steel anchor clips.
   1. The anchor clips shall be bolted to the concrete foundation; use non-shrink grout to level anchor clips.
   2. The design shall resolve the sum of the moments and the sum of the force equal to 0.

O. Design internal beams and support attachments using a maximum of 200 pounds per square inch shear stress for secondary bonds. Also apply this to design of external lugs required for ladders, platforms, and other attached items.

1.05 SUBMITTALS

A. Shop drawings and calculations:
   1. Submit general arrangement and fabrication drawings, calculations, and elements of the design.
   2. Include submittal information that describes specifically how the equipment is to be built and details necessary to ascertain that products meet specified requirements. Provide in the form of drawings, standards, specifications, or other shop instructions, but may also be partially contained in quality control records. The submittal shall include, but not be limited to:
      a. Fabrication drawings.
      b. General arrangement drawings signed by an ENGINEER registered in the state where the project is located, showing complete structural, fasteners, and erection procedures for a complete assembly.
      c. Quality control programs.
      d. Verification that the manufacturer has been engaged in fabrication of similar fiberglass reinforced plastic equipment for a minimum of 5 years.
      e. Statement of compliance with contract design requirements, codes, and standards.
      f. Recommendation for each resin selection from resin manufacturer.
      g. Type and amounts of fillers.
      h. Nominal corrosion liner description.
      i. Reinforcement types and glass content range for hand lay-up laminates.
      j. For filament wound laminates:
         1) Helix angle.
         2) Glass content range.
         3) Strand yield.
         4) Strand per inch in the winding band.
         5) Ply thickness.
         6) Amount of chop or unidirectional roving interspersed with winding, if any, and location within laminate.
      k. For other components:
         1) Construction type.
         2) Laminate thicknesses.
         3) Ply sequences.
         4) Glass content range.
      l. For secondary overlays (both interior and exterior):
         1) Laminate thicknesses.
         2) Ply sequences and widths.

m. Construction details: Construction details for assembly and other special configurations, including:
   1) Tank bottom/top attachments with knuckle configuration and overlays and thicknesses.
   2) Tank support and anchor lugs, including attachment details.
   3) Tank nozzles and installation, including cutout reinforcement, gusseting, and similar items.
   4) Tank lateral or other support fabrication details, including platform attachment clips and/or shoulders.
   5) Scrubber configuration and fabrication details of internal support system and other specialty items.
   6) Cover panel joints, anchorage detail, and details of doors and inspection ports and their attachment or incorporation within the cover.
n. Miscellaneous equipment required.
o. Test reports and certification of compliance with physical property requirements.
p. Color samples.
q. Manufacturer's installation instructions.
r. ASME RTP-1 certification.

B. Operation and Maintenance Data.

C. Warranty.

1.06 QUALITY ASSURANCE

A. Manufacturer qualifications: Fiberglass reinforced plastic manufacturer with experienced personnel, physical facilities, and management capacity sufficient to produce custom-made glass fiber and resin products of quality and size specified for minimum 5 years with satisfactory performance record.

B. Quality assurance plan: Fabricator shall be responsible for implementation of a comprehensive quality assurance plan. The quality assurance plan describes procedures with the following minimum requirements:
   1. Fabricator shall designate personnel to inspect equipment while in process and after completion to assure compliance to every aspect of the section and fabrication drawings.
      a. Inspection shall include, as a minimum, checks for visual defects, laminate thickness and sequence, glass content, Barcol hardness, dimensional tolerances, adherence to construction details, surface preparation, and environmental conditions.
      b. Fabricator's inspector shall complete a report of the findings including method of measurement for each separate assembly.
   2. Prior to use of resins in fabrication, fabricator shall extract samples of resins and retain them for use by the ENGINEER. Sample size shall be 100 cubic centimeters minimum:
      a. Take 1 sample for each manufacturer's batch number if resin is received in the form it will be used.

b. If the fabricator alters the resin after receipt, such as through the addition of styrene, promoters, or other additives, take samples from each drum or portion thereof mixed with additives.
c. Fabricator shall provide documentation for each sample including resin type, manufacturer, batch and lot number, drum number, complete listing of additives with amounts added, and description and manufacturer of each additive.

3. Fabricator shall inspect glass reinforcement prior to use in fabrication.
   a. Do not use glass that does not meet the manufacturer's acceptance standards.
   b. Do not use glass material that is wet or has been wet.
   c. For each type of glass and lot number used, fabricator shall record the manufacturer, product description, binder type, product code, production date, and lot number.
   d. For mat, woven roving, unidirectional roving, and cloth, also include in records actual measured weight per square yard of material.
4. Fabricator shall retain nozzle cutouts and other excess laminate, clearly marking each piece to identify its original location. These laminate samples become the property of the OWNER.
5. For areas where valid laminate samples are not available, take sample plugs at the ENGINEER's request.
   a. Repair subsequent holes in a manner acceptable to the ENGINEER.
6. Fabricator shall verify glass content on available samples in accordance with ASTM D 2584. Complete this test and submit the results complete for each major component where samples are available.
7. Prior to final shipment of the equipment, fabricator shall submit to the ENGINEER a complete quality control report, consisting of copies of records maintained for compliance with this section.

PART 2 PRODUCTS

2.01 RESIN AND REINFORCEMENT MATERIALS

A. General physical properties: In accordance with applicable specifications PS15-69, ASTM C 582, ASTM D 3299, ASTM D 4097, and ASME RTP-1 with verification of properties. Physical properties may include tensile, flexural, and compression modulus of elasticity and ultimate strengths, limiting strains, Poisson ratios, coefficients of expansion, and other directional properties as required for the design of the equipment.

B. Resin:
   1. Fabricate equipment using the corrosion-resistant resin(s) specified in the fiberglass reinforced plastic equipment specifications. The fabricator is required to obtain independent endorsement of each resin selection from the resin manufacturer. Unless otherwise specified, use the resin throughout laminates.
   2. The type of catalyst recommended varies between resin manufacturers. Submit resin/catalyst before fabrication begins to verify compliance to the resin manufacturer's recommended procedures.

3. Employ no fillers, additives, or pigments in the resin.
    a. A thixotropic agent for viscosity control may be used in the proportion and type recommended by the resin manufacturer.
    b. Use no thixotropic agent in the corrosion liner or on surfaces to be in contact with the corrosive environment.
4. Make resin putty using the same resin as was used in the original fabrication and shall contain milled glass fibers.
    a. The use of silica flour, grinding dust, or other fillers is not allowed.
5. When specified, add antimony trioxide or antimony pentoxide to the resin in the amount necessary to achieve the required fire retardancy rating in the structural wall only. Follow resin manufacturer's recommendations.
    a. Unless otherwise specified, the corrosion liner shall not contain this additive.

C. Reinforcement:
1. Show the type and sequence of reinforcements to be used on the fabrication drawings.
2. Use as commercial grade corrosion-resistant borosilicate glass fiber reinforcement, unless otherwise specified.
3. Use glass fiber reinforcing having a surface finish and binder that is specifically recommended by the glass manufacturer for the particular resin system to be used.
4. Use Type C (chemical grade) glass, 10 mils (0.01 inches) thickness, or polyester surfacing veil, such as Nexus surfacing veils.
5. Use Type E (electrical grade) glass, 1-1/2 ounces or 3/4-ounce per square foot, with nominal fiber length of 1.25, within 0.75 inches mat.
6. Continuous glass roving used in chopper guns for spray up shall be Type E chopper roving.
7. Woven roving shall be 24 ounces per square yard Type E glass and have a 5-by-4 plain weave.
8. Continuous roving used in filament wound structures shall be Type E glass winder roving with a yield of 200 yards or more per pound.
9. Use Type E glass unidirectional fabric. Weft unidirectional fabric shall be 15.7 ounces per square yard.
10. When specified, use Type ECR glass reinforcements supplied in similar fabric styles to those specified above.

2.02 FABRICATION

A. Molds:
1. Construct molds of a suitable material to produce a smooth and glossy corrosion liner surface on the fiberglass reinforced plastic equipment.
2. Covering of mandrels with cardboard must be accepted by the ENGINEER prior to start of fabrication.

B. Laminates:
1. Determine specified glass content in accordance with ASTM D 2584.
2. Consider laminate thicknesses shown on the fabrication drawings as construction minimums. Verify that minimum thicknesses are obtained using the laminate sequences specified. When only total laminate thicknesses are specified or indicated on the Drawings, the minimum allowable structural

laminate thickness shall be the total laminate thickness less the specified corrosion liner thickness.

3. Interruptions in laminating sequence shall follow the application of a ply of mat and be succeeded by a ply of mat.
4. The interruption shall not exceed 24 hours, and the in-process surface must retain acetone sensitivity until laminating is resumed. Lack of compliance with these aspects or indication that contamination of the surface has occurred shall require that surface preparation be accomplished before resuming.
5. Chopped strand glass applied by chopper gun is allowed in lieu of mat layers in the structural laminates only.
   a. Chopper gun application of the corrosion liner is not allowed.
6. Coat non-mold surfaces with resin containing wax additive in the amount necessary to allow full cure of the surface. In the case of exterior surfaces, this wax coat shall also contain an ultraviolet stabilizer in the type and amount recommended by the resin manufacturer.
7. The exterior surface of equipment shall be resin-rich and reinforced with 1 layer C glass surfacing veil, unless otherwise specified.
8. When specified, the exterior coat shall be an opaque pigmented surface coat, applied only after ENGINEER's inspection. Color shall be selected by the ENGINEER.

C. Corrosion liner laminates:
   1. The inner surface of laminates shall be resin-rich and reinforced with surfacing veil of the type and number of layers as shown on the fabrication drawings.
   2. The interior layer of the corrosion liner shall consist of 1-1/2 ounces per square foot mat in the number of layers specified on the fabrication drawings. An exotherm interruption is specifically prohibited within the corrosion liner.
   3. Chopped glass applied by chopper gun is not allowed in the corrosion liner.
   4. Plies of the inner surface and interior layer are to gel completely before proceeding with the structural laminates.
   5. Completed corrosion liner as described above shall contain not less than 20 percent nor more than 30 percent glass by weight.
      a. Use no thixotropic material in the resin for the liner, nor in the fabrication of fiberglass reinforced plastic components intended for internal service.
      b. The completed liner shall be the minimum thickness specified or indicated on the Drawings.
   6. Do not use a separately cured unreinforced gel coat.

D. Hand lay-up structural laminates:
   1. The corrosion liner laminate shall be followed by hand lay-up structural laminates of varying reinforcement sequences as indicated on the fabrication drawings.
   2. For hand lay-up structural laminates, reinforcement shall consist of mat and woven roving in the sequence specified on the fabrication drawings.
   3. Woven roving shall have a ply of mat on each side. Two adjacent plies of woven roving are not permitted.
   4. Laminates containing primarily 1-1/2 ounces per square foot mat layers in conjunction with woven roving shall contain not less than 35 percent or more than 45 percent glass (by weight).
   5. Laminates containing primarily 3/4-ounce per square foot mat layers in conjunction with woven roving are considered to be high strength laminates

and shall contain not less than 45 percent or more than 55 percent glass by weight.

E. Filament wound structural laminates:
   1. The corrosion liner laminate shall be followed by filament wound structural laminates as indicated on the fabrication drawings.
   2. For filament wound structural laminates, reinforcement shall consist of continuous strand fiberglass roving applied with a minimum of interruptions until the specified minimum thickness is attained.
      a. This laminate shall contain 55 to 70 percent glass by weight as indicated on the fabrication drawings.
   3. Each complete cycle of filament winding shall form a closed pattern of winding bands, which completely covers the surface with 2 bi-directional layers.
      a. Each layer shall be a maximum of 1 roving in thickness.
      b. Uniformly space the filaments across the winding band without bunching or gaping.
   4. Specify the helix angle of winding on the approved fabrication drawings, as measured from the centerline of revolution of the equipment shell.
   5. Tolerance on helix angle is plus or minus 2 degrees, unless otherwise specified.
   6. The fabrication drawings may require that layers of unidirectional roving be interspersed within the continuous filament winding.
   7. Apply the unidirectional roving with the glass strand aligned in the axial direction, to within plus or minus 5 degrees.
   8. If layers of mat or chopped glass are needed to ensure proper bonding of unidirectional roving, or within the filament winding to accommodate the Fabricator's manufacturing methods, consider the layers' extra material that will result in a thickness greater than specified. The amount of filament winding and unidirectional roving specified must still be applied.

F. Joining laminates:
   1. Fiberglass reinforced plastic joining laminates are subject to applicable requirements specified in other sections for laminates.
   2. Reinforce fiberglass reinforced plastic joints with an overlay of glass reinforcement and resin which extends equally within plus or minus 1/2 inch on each side of the joint. Use minimum thickness, ply sequence, and ply widths of fiberglass reinforced plastic joints as indicated on fabrication drawings.
   3. Restrain parts to be joined to prevent movement until completion and cure of the joint overlay.
   4. Fit-up parts and verify that tolerances and assembly requirements are satisfied. Completely fill the void between component parts with resin putty, taking care not to extrude an excessive amount of putty into the interior.

G. Environment:
   1. The fabrication process and materials at the point of fabrication are to be maintained within a range of 60 to 95 degrees Fahrenheit. This temperature must also be at least 5 degrees greater than wet bulb temperature, as measured with a sling psychrometer.
   2. Store materials in a dry area and within the temperature and humidity limits recommended by the manufacturers.

H. Flanges:
   1. Make flanges by hand lay-up construction with nozzle neck and flange made integrally in 1 piece and fabricated in accordance with the dimensions indicated on the fabrication drawings. Extend layers of reinforcement in the nozzle neck and hub uninterrupted into the flange.
   2. Build up additional hub thickness using alternating layers of 1-1/2 ounces per square foot mat and 24 ounces per square yard woven roving.
   3. Build up additional thickness in the flange using "ring" cutouts of mat, evenly distributed throughout the flange thickness.
   4. Press molded or filament wound flanges are not allowed.
   5. Overall machine facing of the back of flanges is not permitted.
      a. To obtain proper seating, spotface bolt holes for SAE size washers.
      b. Resin coat bolt holes and other cut surfaces so that no fibers are exposed.
      c. Spotfacing shall not produce a flange thickness less than indicated in the fabrication drawings.
   6. Bolt holes in flanges shall straddle principal centerlines of the Equipment. Tolerance in bolt hole locations and in diameter of bolt circle shall be plus 1/16 inch.
   7. Depressions or projections in flange face shall be no greater than 1/32 inch.

I. Allowable visual defects:
   1. Visual defects in areas of the equipment shall not exceed the maximum allowable levels of visual defects set forth in Table A, unless acceptable to ENGINEER.
   2. Visual defects in accordance with ASTM D 2563.
   3. Presence of visual defects in excess of the allowable levels of Table A shall be grounds for rejection of the equipment. Listed quantities apply to small, localized areas and shall not be averaged over larger areas.
   4. For the purpose of Table A, use of the following definitions apply:
      a. INNER surface - Interior process surface, thickness of surfacing veil(s), and interface between veils and mat layers. Includes surfacing veils on internal joints.
      b. Interior mat layers - Layers of mat following the inner surface, and interface between liner and structural wall. Includes mat layers on internal joints.
      c. Structural wall - Layers of filament winding or alternating layers of mat and woven roving following the corrosion liner, and layers of mat and woven roving in internal overlays.
      d. Exterior surface - The exterior surface of the laminate and the thickness of the surfacing veil.
      e. Dimensions listed in Table A refer to the largest dimension measured for defects.

TABLE A
MAXIMUM ALLOWABLE LEVELS OF VISUAL DEFECTS

Condition/ Defect	Inner Surface	Interior Mat Layers	Structural Wall	Exterior Surface
Chip	None	None	None	
Crack	None	None	None	

TABLE A MAXIMUM ALLOWABLE LEVELS OF VISUAL DEFECTS				
Condition/ Defect	**Inner Surface**	**Interior Mat Layers**	**Structural Wall**	**Exterior Surface**
Crazing	None	None	None	
Delamination	None	None	See Air Bubble	
Dry Spot	None	See Air Bubble	See Air Bubble	
Foreign Inclusion	None	Maximum Diameter 1/32"	See Air Bubble	
Fracture	None	None	None	None
Air Bubble/ Void	Less than 1/64" Ø unlimited. 1/64" to 1/16" Ø 2 / sq. in. Maximum Diameter 1/16"	Less than 1/32" Ø unlimited. 1/32" to 1/8" Ø 5 / sq. in. Maximum Diameter 1/8"	Less than 3/16" Ø unlimited. 3/16" to 1/4" Ø 2 / sq. in. Maximum Diameter 1/4"	
Blister	See Air Bubble	See Air Bubble	See Air Bubble	
Burned	None	None	None	
Pit (Pinhole)	Less than 1/32" Ø 50/square feet 1/32" to 1/16" Ø 10/square feet Maximum Diameter 1/16" Maximum Depth 1/32"	N/A	N/A	
Resin Pocket	None	Maximum 1 square inch per occurrence.	Maximum 1 square inch per occurrence.	
Wrinkle	Allowable if laminate is glass reinforced. No sharp edges allowed.	Allowable if laminate is glass reinforced and full mat layer thickness and total thickness are maintained.	Allowable if laminate is glass reinforced and full mat layer thickness and total thickness are maintained.	
Scratch	None	N/A	N/A	
Fiber Prominence	None	Maximum 10 fibers visible per square inch	Maximum 20 fibers visible per square inch	

2.03 SOURCE QUALITY CONTROL

A. Inspection:

1. OWNER's inspection: Permit the ENGINEER access to the equipment during fabrication and upon completion for the purpose of verifying compliance to the Contract Documents. The inspection is not intended to replace the Fabricator's own quality control procedures.

2. In no respect does inspection of equipment by ENGINEER relieve the Fabricator of compliance with the Contract Documents.
    a. A final inspection will be performed by the ENGINEER.
3. The Fabricator shall notify the ENGINEER at the completion of particular milestones during fabrication. The milestones are as follows:
    a. View tooling prior to fabrication.
    b. Beginning application of corrosion liner for each part, extraction of each part prior to beginning assembly.
    c. Upon completion of each separate assembly, ENGINEER reserves the right to include additional milestones.
4. Allow ENGINEER to photograph the equipment while in process and/or upon completion.
5. ENGINEER may use magnification or other special viewing or measurement devices during inspection.
6. Evidence of poor workmanship or lack of compliance with aspects of the Contract Documents will be grounds for rejection of the equipment.
7. Subsequent repair of rejected equipment may, at the ENGINEER's option, be undertaken in an attempt to bring the equipment to an acceptable state.
    a. Repair procedures must be accepted by the ENGINEER prior to implementation.

2.04 TESTING

A. The ENGINEER may employ destructive testing, such as ultimate tensile or flexure strength tests or glass content ignition tests, on available samples or use other non-destructive test methods, such as acoustic emission or ultrasonic polygauge thickness measurement, on the completed equipment for verification of compliance to the contract documents.

B. Testing performed by the ENGINEER will be accomplished through use of applicable ASTM test methods when appropriate.

C. Hardness tests will be made for acceptance by the ENGINEER on the liner surface using the Barcol impressor, Model GYZJ 934 1, calibrated at 2 points in accordance with ASTM D 2583.
    1. Ten readings will be taken in a localized area, deleting the 2 highest and 2 lowest, and averaging the remaining 6.
    2. Minimum acceptable Barcol hardness will be a reading of 30 unless otherwise specified.

D. An acetone sensitivity test will also be performed by the ENGINEER as an acceptance criteria. Evidence of a sticky or tacky surface following rubbing with an acetone-saturated cloth will be grounds for rejection of the equipment.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 06611

FIBERGLASS REINFORCED PLASTIC FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Fiberglass reinforced plastic fabrications including:
   1. Weirs.
   2. Baffles.
   3. Grating.
   4. Stair treads.
   5. Covers.
   6. Troughs.
   7. Pre-fabricated pedestal platforms.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01600 - Product Requirements.
      b. Section 01612 - Seismic Design Criteria.
      c. Section 01614 - Wind Design Criteria.
      d. Section 05120 - Structural Steel.

1.02 REFERENCES

A. NSF International (NSF):
   1. 61 - Drinking Water System Components-Health Effects.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary bracing for fabrications to ensure maintenance of dimensions during shipment. Maintain bracing in place for installation.

PART 2 PRODUCTS

2.01 WEIRS AND BAFFLES

A. Manufacturers: One of the following or equal:
   1. F. B. Leopold Company.
   2. Warminster Fiberglass Company.

3. Chemical Proof Corporation, Arlington, WA.
4. LaValley Construction, Biloxi, MS.
5. Norcore Plastics, Inc., Tacoma, WA.
6. Fibrex Corporation, Burlington, WA.
7. Specialty Plastics, Inc., Baton Rouge, LA.
8. Xerxes Corporation, Anaheim, CA.
9. Paramount Plastics, Rancho Cucamonga, CA.
10. Ershigs, Inc., Bellingham, WA.
11. Corrosion Controllers, Inc., Washougal, WA.
12. Fibercast, Sand Springs, OK.

B. Materials:
1. Hand lay-up construction.
2. Minimum corrosion liner:
   a. One "C" or Nexus veil as specified for the service environment.
   b. Remainder 1-1/2 ounce per square foot mat to total minimum thickness of 0.096 inches on surface exposed to the service environment.
3. Ultraviolet stabilizer: Added to the exterior surface coat of fabrications intended for outside service, in the type and amount recommended by the resin manufacturer.
4. Resin: Premium grade vinyl ester:
   a. Manufacturers: One of the following or equal: As recommended by the resin manufacturer for the specific operating environment:
      1) Dow Chemical Company, Derakane 411.
      2) Ashland Chemical Company, Hetron 922.
      3) Reichhold Inc., Reichhold Dion VER 9100.
      4) Interplastic Corporation, Interplastic VE 8300.
5. Color: Natural, unless otherwise specified.

C. Fabrication:
1. Baffles: Hand lay-up components to specified shape and dimensions.
2. Weirs:
   a. Match die molded.
   b. Weir plates:
      1) Of shape and dimensions specified.
      2) Provide 2-3/8 inch diameter holes for adjustment.
      3) Resin coat cut edges, and drilled and countersunk holes in fiberglass reinforced plastic fabrications.
   c. Furnish fiberglass reinforced plastic butt plates for joints.
   d. Washers:
      1) Of same material as weirs, with surfaces smooth, free of voids, and without dry spots and crazes.

D. Design criteria and chemical exposure: As specified for the application.

2.02 GRATING AND STAIR TREADS

A. Manufacturers: One of the following or equal:
1. AFC, Inc., Division of Strongwell, Chatfield, MN, Duradek.
2. Chemical Proof Corporation, Arlington, WA, Chemgrate.

B. Materials:
   1. Core: Unidirectionally aligned glass fibers.
   2. Mat: Submit standard corrosion liner.
   3. Veil: Submit standard corrosion liner.
   4. Ultraviolet stabilizer: Added to the exterior surfaces in the type and amount recommended by the resin manufacturer.
   5. Resin: Fire retardant premium vinyl ester, antimony trioxide or pentoxide added to meet Class I flame spread rating of ASTM E 84 and self-extinguishing requirements of ASTM D 635.
   6. Manufacturer: One of the following or equal as recommended by the resin manufacturer for the specific operating environment:
      a. Dow Derakane 530.
      b. Ashland Hetron 992.
      c. Interplastic VE 8400.
      d. Reichhold Dion VER 9300FR.
   7. Color: Grey.
   8. Anti-slip coating: Permanently bonded grit of selected color.

C. Design criteria and chemical exposure:
   1. Deflection and concentrated load: Maximum 0.15 inches at span of 48 inches under concentrated load of 250 pounds.
   2. Deflection and uniform distributed load: Capable of carrying uniform distributed load of 150 pounds per square foot on simple span of 64 inches without deflecting more than 0.25 inches.
   3. Weight: Maximum 3.3 pounds per square foot for 2-inch high grating with open area of minimum 50 percent.
   4. Suitability: Use stairs and grating suitable for use in environments containing chlorine and sulfuric acid solutions at the temperatures and concentrations specified for the application.

D. Components:
   1. Bearing bars: I-bars, 2-inch depth or as indicated on the Drawings, I-bars spaced at 1-3/16 inches on center.
   2. Cross bars: 3/8-inch diameter spaced at 12 inches on center.
   3. Hold downs, connectors, and accessories: Style as recommended by grating manufacturer.

E. Fabrication:
   1. Produce grating bearing and cross bars by pultrusion process. Do not use hand lay-up construction methods.
   2. Coat ends of grating with resin.
   3. Fabricate single sections for each span. Do not clamp 2 or more grating sections together within spans.
   4. Type 316 stainless steel plates and angles at openings:
      a. Install 5/8-inch thick plate or angle where required to fill openings at changes in elevation and at openings between equipment and grating.
      b. Install angle stops at ends of grating to prevent grating from sliding.
   5. Maximum 1/8-inch clearance allowed between ends of grating and inside face of vertical leg of support angles.

F. Cutouts:
   1. Provide where required for equipment access or penetrations, including valve operators, stems, and gate frames.
   2. Seal cut edges with resin.

2.03 COVERS

A. Manufacturers: One of the following or equal:
   1. Owens-Corning.
   2. Syntechnics.
   3. Chemical Proof Corporation.
   4. LaValley Construction.
   5. Norcore Plastics, Inc.
   6. Fibrex Corporation.
   7. Specialty Plastics, Inc.
   8. Xerxes Corporation.
   9. Paramount Plastics.
   10. Ershigs, Inc.
   11. Corrosion Controllers, Inc.
   12. Fibercast.

B. Materials:
   1. Hand lay-up construction: As specified in Paragraph 2.04 N.
   2. Minimum corrosion liner: As specified in Paragraph 2.04 N.
   3. Ultraviolet stabilizer: Add to the exterior surface gel coat in the type and amount recommended by the resin manufacturer.
   4. Resin: Fire retardant premium vinyl ester, antimony trioxide or pentoxide added to meet Class I flame spread rating of ASTM E 84 and self-extinguishing requirements of ASTM D 635 to structural laminate only, as
   5. Manufacturers: One of the following or equal: As recommended by the resin manufacturer for the specific operating environment:
      a. Dow Derakane 530.
      b. Ashland Hetron 992.
      c. Interplastic VE 8400.
      d. Reichhold Dion VER 9300FR.
   6. Color: Tan or light green as specified.

C. Chemical environment:
   1. Chemically resistant to environment of untreated wastewater and hydrogen sulfide gas.
   2. Suitable for service between temperature range of minus 30 degrees Fahrenheit to plus 120 degrees Fahrenheit.

D. Design criteria: As detailed, covers shall safely sustain following loads without permanent deformation or evidence of failure:
   1. Twenty pounds per square foot live load plus dead load.
   2. Dead load plus 20 pounds per square foot wind load up or down.
   3. Maximum deflection not to exceed the ratio of span to 200 for live load of 20 pounds per square foot plus dead load.
   4. Design panels to support a 500-pound load on an area 1 foot by 2 feet anywhere on the cover.

E. Fabricate covers as indicated on the Drawings.

F. Fabricate covers with minimum thickness of 1/4 inch.

G. Fabricate special details, joints, and other portions not specifically indicated on the Drawings in accordance with Fabricator's standard details for similar construction.

H. Use nameplates, manufacturer's name, and other identifications that do not exceed 6 inches by 6 inches in size.

I. Fabricate each cover with freestanding arch sections with 2 end panels.

J. Each cover shall consist of removable sections complete with lifting handles.

K. Fabricate cover sections with radial tongue and groove type joints.

L. Construction and clearances between adjacent fiberglass reinforced plastic panels of covers shall permit air infiltration into assembly.

M. Assembled fiberglass reinforced plastic panels shall provide continuous coverage with no gaps between panels exceeding 1/4 inch.

N. Panel fabrication:
   1. Form molds to insure constant and accurate dimensions of finished covers.
   2. Locate molded surfaces on exterior of finished part.
   3. Design molds so that each cover section is fabricated in 1 piece without joining of panels.
   4. Coat mold surface with 15 milligrams minimum thickness gel coat containing ultraviolet stabilizer in the type and amount recommended by the resin manufacturer, before glass is applied.
   5. Lay 1 layer of approximately 1-1/2 ounce per square foot of chopped strand mat or spray-up continuous roving adjacent to gel coat and roll out thoroughly to provide adequate exterior coat.
   6. Lay alternate layers of nominal 24 ounce per square foot woven roving and approximately 1-1/2 ounce per square foot of mat into mold to provide minimum total design thickness of 1/4 inch. Laminate to end with a mat layer.
   7. Following preceding layers of glass and resin reinforce entire interior surface of covers with Type C (chemical grade) surfacing or Nexus veil as specified for the service environment, and 15 milligrams minimum thickness resin-rich coat after main laminate has cured.
   8. Fabricate cover sections so that they can be lifted at 4 corners by 2 workers.
   9. Apply neoprene gasketing in factory and/or field where cover comes in contact with concrete.

O. Support or edge flanges:
   1. Finish and coat: As specified hereinbefore.
   2. Bottom surfaces of support flanges: In true plane, and when tested with 8 foot straight edge, deviation shall not exceed 1/4 inch.
   3. Reinforce flat surfaces such as doors, with solid fiberglass reinforced plastic structural members to prevent bowing, warping, and other distortions.

P. Accessories:
   1. Anchor bolts:
      a. Type 316 stainless steel, and as specified in Section 05120.
      b. Furnish anchor bolts and fasteners necessary for proper installation of covers.
   2. Inspection ports:
      a. Provided in each cover where indicated on the Drawings.
      b. Fabricate doors and frames of fiberglass reinforced plastic laminate as specified for cover, of sizes indicated on the Drawings.

Q. Hinges and latches: Type 316 stainless steel.

R. Test panels and testing:
   1. Make test panels of fiberglass reinforced plastic fabrications, using same materials and methods used for fabricating covers.
   2. Number test panels to correspond to production fiberglass reinforced plastic covers.
   3. Make test panels at same time as covers are fabricated.
   4. Provide minimum 24 inch by 24 test panels.
   5. Make 1 test panel with each cover for each tank.
   6. Submit test panels, as selected by ENGINEER, to independent testing laboratory for testing to confirm physical properties of glass fiber and resin fabrications.
   7. When test reveals that physical properties are less than submitted values or that deflections exceed specified maximums, reject or modify corresponding covers to comply with the Specifications.

2.04 TROUGHS

A. Manufacturers: One of the following or equal:
   1. Warminster Fiberglass Company.
   2. F.B. Leopold.

B. Materials:
   1. Fabricate trough of premium grade fiberglass reinforced polyester resin, with fiberglass constituting a nominal 30 percent by weight.
   2. Glass reinforcement shall be random chopped-strand type with a minimum strand length of 1 inch, and adequate contact molding pressure to provide complete wet-out of the glass fibers.
   3. Minimum physical properties:
      a. Tensile strength: 14,000 pounds per square inch.
      b. Flexural strength: 25,000 pounds per square inch.
      c. Flexural modulus: 1.0 times 10^6 pounds per square inch.
      d. Trough resin and all accessories shall be suitable for the specific operating environment.
   4. All trough supports and hardware shall be Type 316 stainless steel including bolts, nuts washers, straps, etc.
   5. All materials used in the construction of the troughs and accessories shall be approved for use in potable water.

C. Design:

1. Troughs shall be certified for use in potable water in accordance with NSF Standard 61.
2. Trough shall be laminated of fiberglass reinforced polyester resin to a minimum thickness of 1/4 inch.
3. Inside surface of each trough shall have a smooth gel coat finish, color as selected by the ENGINEER. The outside surface of each trough shall be resin sealed with no exposed glass fiber.
4. Color shall be molded in and an ultraviolet inhibitor shall be used.
5. Troughs shall have flat bottoms and vertical sides, unless otherwise indicated on the Drawings.
6. Top edges of trough shall be straight with no more than 1/8 inch deviation from a true plane.
7. Longitudinal stiffening ribs shall be integrally molded on the outside of the troughs to ensure rigidity.
8. Spacer rods:
   a. Sufficient plastic spacer rods shall be included to maintain a uniform width over the length of each trough.
   b. Spacer rods shall be spaced to prevent buckling and to provide maximum resistance to water loading on the sidewall of the trough.
9. Support system shall allow 1 inch minimum adjustment of the trough, horizontally and vertically, and shall allow no greater than the unsupported span divided by 1,000 (L/1,000) upward deflection while the trough is empty and water outside the trough is to the weir edge. Maximum vertical deflection shall not exceed the unsupported span divided by 1,000 (L/1,000) downward while the trough is full and water outside the trough is below the trough bottom.
10. Thickness of laminate at all supports such as saddles shall be a least 150 percent of the nominal thickness of the trough.
11. Fiberglass adjustable weir plates shall be factory assembled to the troughs as indicated on the Drawings.
12. Fiber stress limitations: Supplemental to the deflection criteria, the troughs shall also be designed such that the maximum wall stress under the most severe loading conditions is less than or equal to 1,500 pounds per square inch. This stress criterion is equivalent to 7:1 safety factor (approximate) as applied to the tensile and flexural properties of contact-molded troughs and launders.
13. Thermal expansion and contraction: The troughs shall be designed to accommodate a thermally induced expansion and contraction of 1/8 inch per 20 feet length of trough over temperature range of 10 degrees Fahrenheit to 100 degrees Fahrenheit, without exceeding the deflection or strain limitations set forth in the proceeding paragraphs.
14. Provide calculations sealed and signed by a registered professional structural engineer registered in the state of California for seismic sloshing loads and design of trough support system. All other calculations shall be sealed and signed by a registered professional engineer.
15. Trough manufacturer shall be responsible to design the troughs and all supporting members and accessories required for a complete installation.
16. Seismic design criteria for troughs, supports, and anchors shall be in accordance with Section 01612. Design for wind loads in accordance with Section 01614.

2.05 PRE-FABRICATED PEDESTAL PLATFORMS

A. Manufacturers: One of the following or equal:
   1. McNichols Fabrication Services, Dallas, TX.
   2. Grating Pacific, Phoenix, AZ.
   3. Fibergrate Composite Structures, Dallas, TX.

B. Materials:
   1. Vinyl Ester CVF or SV.
   2. Structural Shapes: Manufacturer's standard beams, adjustable pedestals, plates, anchor bolts, angles, 2-inch deep square mesh molded grating.
   3. Anchor Bolts, Connection Bolts, and Hardware: Stainless steel.

C. Design:
   1. Designed for applied dead loads plus live load of 150 psf, or concentrated load of 500 pounds.
   2. Seismic loads per Section 01612.
   3. In accordance with California Building Code (CBC 2010).
   4. Dimensions as shown on Drawings.
   5. Maximum size of removable grating panel equal 50 square feet.
   6. Maximum deflection under live load equal .375 inch.
   7. For grating, refer to Article 2.02.

D. Submittals:
   1. Shop drawings.
   2. Design calculations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for installation of products as specified in Section 01600.

3.02 ERECTION AND INSTALLATION, GENERAL

A. Install products where indicated on the Drawings in accordance with manufacturer's printed instructions.

3.03 WEIR PLATES

A. Fasten to concrete with stainless steel anchor bolts or concrete anchors.

B. Seal edge between concrete and weir with synthetic rubber.

C. Use stainless steel washers under nuts.

3.04 COVERS

A. Install fiberglass reinforced plastic covers where shown on the Drawings.

B. Set covers in place and bolt down.

C. Install covers so that it is straight, plumb, and rigid.

3.05 TROUGHS

A. Fasten to concrete with Type 316 stainless steel anchor bolts or concrete anchors.

B. Seal edges between concrete and trough with synthetic rubber.

C. Use Type 316 stainless steel nuts, bolts, and washers.

D. Aligned and leveled to within 1/32-inch maximum variation between any two points on the weir edges.

END OF SECTION

SECTION 06616

FIBERGLASS REINFORCED PLASTIC HANDRAIL AND GUARDRAIL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Fiberglass reinforced plastic handrail and guardrail.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. F 1092 - Standard Specification for Fiberglass (GRP) Pultruded Open-Weather Storm and Guard, Square Railing Systems

B. Occupational Safety and Health Administration (OSHA).

1.03 PERFORMANCE REQUIREMENTS

A. Structural performance:
   1. Design and fabricate assemblies to conform to current local, State, and OSHA standards requirements.
   2. Capable of withstanding concentrated vertical or horizontal load of 200 pounds at any point within 6-foot span.
   3. Maximum 5/8-inch deflection when subjected to 200-pound concentrated vertical load at mid-point of 5.0-foot span.

1.04 SUBMITTALS

A. Product data: Include available colors.

B. Shop drawings: Plans and elevations showing heights, sizes, shapes, and locations of installations, and details of connections and anchorage.

1.05 QUALITY ASSURANCE

A. Fiberglass handrail and guardrail shall comply with OSHA requirements.

B. Fabricate railing assemblies to conform to Typical Details indicated on the Drawings and to current local and state standards and requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass reinforced plastic handrail and guardrail: One of the following or equal:
   1. Fibergrate Corporation, Dallas, TX.
   2. Strongwell, Bristol, VA.

2.02 MATERIALS

A. Fiberglass reinforced plastic: Pultruded premium flame retardant vinyl ester resins containing ultraviolet absorbers, resistant to corrosion by hydrochloric acid, ferric chloride, sodium hydroxide, sodium hypochlorite, and chlorinated water at temperatures up to 120 degrees Fahrenheit; safety yellow, unless directed otherwise by the ENGINEER.

B. Touch-up resin: Compatible with handrail resin matrix.

C. Anchor bolts and brackets: Type 316 stainless steel.

2.03 FABRICATION

A. Fabricate handrail and guardrail in accordance with ASTM F 1092.

B. Seal machined edges and holes with touch-up resin.

C. Components:
   1. Posts: Minimum 2-inch square by 1/4-inch wall tubes.
   2. Rails: Minimum 1-3/4-inch square by 1/8-inch wall tubes.
   3. Kick or toe plates: Corrugated 1/8-inch by 4-inch or 1/4-inch by 4-inch with stiffening ridges.

D. Guardrail: 3 rail, nominal 42 inches high with middle rail nominal 29-1/2 inches above grade, and bottom rail 17 inches above grade.

E. Inclined handrail height: 34 inches from top of top rail to work line.

F. Post spacing: Maximum 6-foot center to center provided Article 1.03 requirements are met.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install handrail and guardrail in accordance with manufacturer's instructions.

B. Connect railings to appurtenant structures or tanks with anchor bolts and brackets.

C. Coordinate connections of railing to appurtenant structures and tanks with provisions for anchor bolts, and other clips and bracing.

END OF SECTION

SECTION 07110

DAMPPROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Dampproofing.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

B. California Air Resources Board (ARB):
   1. Architectural Coatings Suggested Control Measure.

1.03 SUBMITTALS

A. Product data.

B. Shop drawings.

C. Manufacturer's Installation Instructions.

D. Warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Conform to volatile organic compound limits specified in Table 1 of the California ARB Architectural Coatings Suggested Control Measure.

1.06 PROJECT/SITE CONDITIONS

A. Environmental requirements: Do not apply bituminous dampproofing when temperatures are 40 degrees Fahrenheit or lower or when rain is forecast for the 24 hours following application.

PART 2 PRODUCTS

2.01 MATERIALS

A. Dampproofing: ASTM D 1227, Asbestos Free, Emulsified Asphalt Coatings.
   1. Manufacturers: One of the following or equal:
      a. Karnak Corp., Karnak 220 AF.
      b. W.R. Meadows, Inc., Sealmastic Type 2 Asphalt Emulsion Dampproofing.

B. Sealing mastic: Type compatible with dampproofing and free of toxic solvents with thick mastic consistency and smooth and uniform in composition product as recommended by dampproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for application of products in accordance with manufacturer's recommendations.

B. Verify that surfaces to receive dampproofing are clean, dry, reasonably smooth, free of dust, dirt, voids, cracks, or sharp projections.

3.02 APPLICATION

A. Completely cover surfaces to receive dampproofing with 2 coats.
   1. Applied by brush or spray.
   2. Apply dampproofing at manufacturer's recommended rate of application or minimum 2 gallons per square per coat, whichever is greater.

B. Extend dampproofing to 6 inches above finish grade.

C. Apply each coat evenly so surfaces have uniform black appearance.

D. Apply second coat at right angles to first, allowing not less than 24 hours between coats.

E. Seal around items and services projecting through dampproofing surfaces in accordance with manufacturer's recommendations.

F. Ensure sealed areas are moisture tight.

G. Backfill completely against dampproofing application within time recommended by manufacturer.

END OF SECTION

SECTION 07190

WATER REPELLENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Water repellent for concrete masonry.

1.02 DEFINITIONS

A. Water repellent: Resistance to penetration of water from rainfall.

1.03 REFERENCES

A. International Union of Testing and Research Laboratories for Materials and Structures (RILEM):
   1. RILEM Test Method No. 11.4, Measurement Of Water Absorption Under Low Pressure

B. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 – Adhesive and Sealant Applications.

1.04 SYSTEM DESCRIPTION

A. Performance requirements: Surfaces with water repellent shall be uniform in color with unaltered texture.

1.05 SUBMITTALS

A. Product Data.

B. Samples: Water repellent applied on 8-inch-by-8-inch substrates to receive water repellent, marked with application date and application rate.

C. Manufacturer's Application Instructions.

1.06 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of water repellents for minimum 5 years with satisfactory performance record.

B. Applicator qualifications: Trained, approved, and accepted by water repellent manufacturer.

C. Spray personnel qualifications: Minimum 2 years of experience spraying exotic coatings.

D. Regulatory requirements: Comply with volatile organic compound regulations.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original containers with seals unbroken and labeled with manufacturer's batch number.

B. Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Sealants in compliance with SCAQMD Rule 1168.

B. Apply water repellent under temperature and relative humidity conditions before, during, and after application in accordance with manufacturer's instructions.

C. Allow surfaces to dry for minimum of 5 days after rains that occur beyond the masonry 28-day cure period..

1.09 PROJECT CONDITIONS

A. Make proper material allowance based upon substrate material and surface configuration when determining quantities of material.

1.10 WARRANTY

A. Warrant to furnish and apply water repellent on walls that experience water penetration because of failure of water repellent for a minimum of 5 years.

B. At end of application, manufacturer’s representative shall perform Rilem Tube Test and issue letter of warranty.

1.11 MAINTENANCE

A. None.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Water repellent sealer:
   1. Manufacturers: One of the following or equal:
      a. Rainguard Products, Inglewood, CA.
      b. PROSOCO, Inc., Lawrence, Kansas

2.02 MATERIALS

A. Water repellent sealer for concrete and concrete masonry: Silane/Siloxane; Volatile Organic Compound compliant; free of silicone oils, paraffin wax, or urethanes.
   1. Manufacturers: One of the following or equal:
      a. Rainguard, BLOK-LOK.
      b. PROSOCO Weatherseal Siloxane WB

2.03 EQUIPMENT

A. Spray equipment: High-volume, low-pressure, airless, with maximum 60 psi pressure:
   1. Pump: Adjust pressure so as not to atomize the repellent and to enable flow of repellent on walls at minimum 1 to 1-1/2 gallons per minute.
   2. Orifice size for concrete, slump block, exposed concrete aggregate, and cement plaster: 0.060 to 0.110 inches.
   3. Orifice size for brick, clay brick tile, brick veneer, stone, and wood: 0.060 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prepare 50 square feet test panel (mock-up).

B. Request manufacturer’s representative and Engineer to carefully inspect installed construction, and verify that mock-up is ready for repellent application.

Apply repellent to mock-up in presence of Manufacturer’s representative and Engineer.PREPARATION

C. Allow concrete or masonry walls to cure at least 28 days before applying water repellent.

D. Clean wall surfaces of soil, mud, efflorescence, or other detrimental materials.

E. Tuck-point or caulk cracks, other than hairline cracks.

F. Route out defective mortar joints, point with mortar and tool.

G. Moisture content: Apply water repellent sealer when moisture content of substrate is 15 percent or less.

3.02 APPLICATION ON CONCRETE MASONRY

A. Apply water repellent in accordance with manufacturer's printed instructions.

B. Apply flood coat using low-pressure spray equipment.

C. Start at bottom of wall and work up using overlapping horizontal passes.

D. Hold spray head 8 to 10 inches from surface so saturation coat runs freely down wall 4 to 8 inches below point of application on most substrates.

E. Spray by traveling horizontally to ensure uniform coverage.

F. Overlap each following pass by centering spray head on bottom line of the previous pass.

G. Trigger gun off at end of each pass to avoid applying excessive amount of material. Do not over apply.

H. Avoid application in hot or windy weather as premature drying can cause whitish residue on walls.

3.03 FIELD QUALITY CONTROL

A. Twenty days after application, test water repellent on CMU surfaces using RILEM Test Method No. 11.4.
   1. CONTRACTOR shall perform a 20-minute RILEM baseline test on dry untreated CMU units of each type to receive water repellent. Test results (water loss in milliliter) shall be compared to CMU units in walls after water repellent application.
   2. On water repellant coated CMU, a RILEM 50 mph driven rain tube test resulting in 5 milliliter or less after 20 minutes is necessary to qualify for 5-year warranty.

B. Notify the ENGINEER and manufacturer at least 72 hours in advance of test.

C. Where tested wall areas fail to pass RILEM tube test, apply additional coat of water repellent on entire wall from corner to corner.

D. Test all locations where directed by the ENGINEER.

3.04 CLEANING

A. Concrete, concrete masonry, exposed concrete aggregate, and cement plaster: Clean drips, runs, and overspray residue while still wet, using detergent and water. Clean application and spray equipment with detergent and water immediately following use.

B. Brick, clay brick tile, brick veneer, stone, and wood: Clean drips, runs, and overspray residue with petroleum type thinner following application.

C. Clean application and spray equipment according to the manufacturer's recommendations.

D. Remove excess materials, equipment, and debris incidental to water repellent application upon completion.

3.05 PROTECTION

A. During application, protect water repellent treated and adjacent surfaces from damage.

B. Protect glass, aluminum, and other surfaces from overspray.

C. Protect concrete sidewalks from runoff. Soak with water immediately prior to application on adjacent walls.

D. Repair damaged areas promptly.

END OF SECTION

SECTION 07214

BATT INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Batt or blanket type insulation.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

1.03 SYSTEM DESCRIPTION

A. Thermal resistance of ceiling and soffit insulation: Minimum R-30 unless otherwise indicated on the Drawings for 9-1/4-inch minimum thickness space.

B. Thermal resistance of wall insulation: Minimum R-3 for 1-3/4-inch spaces, R-11 for 3-1/2-inch spaces, R-19 for 5-1/2-inch spaces, and R-30 for 9-1/4-inch spaces, unless otherwise indicated on the Drawings.

1.04 SUBMITTALS

A. Product data.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation to project site in unopened containers labeled with the manufacturer's name, brand designation, and R-valve rating.

B. Store insulation in a dry, well ventilated, and watertight enclosure providing protection from damage.

1.06 PROJECT/SITE CONDITIONS

A. Do not install insulation until the building has been made substantially water and weathertight.

PART 2 PRODUCTS

2.01 BATT INSULATION

A. Manufacturers: One of the following or equal:
   1. Owens-Corning Fiberglas.
   2. John Manville, Inc.
   3. U. S. Gypsum.

B. Unfaced insulation: ASTM C 665, Type I; fiberglass batts.
   1. Thickness as indicated on the Drawings.
   2. Flame spread: 25 or less.

C. Foil-faced insulation: ASTM C 665, Type III; fiberglass batts.
   1. Thickness: As indicated on the Drawings, aluminum foil vapor barrier faces and nailing flanges.
   2. Flame spread: 25 or less.

2.02 ACCESSORIES

A. Welded impaling pins:
   1. Manufacturers: The following or equal:
      a. Owens-Corning Fiberglas, Pinwelding System.

B. Adhesive applied impaling pin system:
   1. Manufacturers: The following or equal:
      a. Stic-Klips Manufacturing Co., Type B Stic-Klips with locking plates, holding plates, and Type S adhesive.

C. Wiring or netting: As recommended by insulation manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for installation of products.

B. Verify that construction required to be in place before application of insulation has been completed, that available space has sufficient depth for required insulation thickness, and that substrate is clean and dry.

3.02 PREPARATION

A. Remove cover projections in construction framing that may damage or prevent proper installation of insulation.

B. Weld impaling pins to steel in accordance with manufacturer's instructions.

C. Apply adhesive-applied impaling pins to concrete.
   1. Apply thin coat of adhesive to impaling pin bases with putty knife.
   2. Press pin bases on clean surface until adhesive fills holes.
   3. Remove excess adhesive.
   4. Allow adhesive to cure overnight before proceeding.

3.03 APPLICATION

A. Install unfaced insulation wherever insulation will be in direct contact with covering material.

B. Install foil-faced insulation wherever insulation will not be in direct contact with covering material.

3.04 INSTALLATION

A. Install insulation when construction has progressed to point that inclement weather will not damage or wet insulation material.

B. Install Insulation in accordance with manufacturer's recommendations.

C. Install insulation to attain minimum R-values.

D. Exercise care to maintain vapor barrier integrity.
   1. Patch and seal punctures, tears, and voids.

E. Install foil-faced insulation with vapor barrier toward warm-in-winter side of assembly.

F. Maintain integrity of insulation over entire insulated area, including contiguous breaks, corners, pockets, voids, and offsets.

G. Place insulation between exterior wall and pipes and conduit.

H. Carefully cut and fit insulation around pipes, conduit, and other obstructions, compressing insulation where necessary.

I. Do not block or restrict air ventilation devices.

J. Provide 3-inch clearance between insulation and lighting fixtures, fans, and operating equipment.

K. Impale insulation over clips.
   1. Install washer and bend prongs over in opposite direction where indicated on the Drawings.
   2. Friction fit insulation between studs.
   3. Fill space between studs with as thick as possible insulation.
   4. Provide supplementary support where insulation is over 8 feet high to hold insulation in place until interior finish is applied.

L. Staple facing flanges of faced insulation to sides of wood framing at 8 inches on center or closer as necessary to hold flanges tightly to framing members.

M. Support ceiling and soffit insulation with wire at maximum 24 inches on center or netting attached to structure.

3.05 CLEANING

A. Remove insulation damaged by construction and replace with new undamaged insulation.

END OF SECTION

SECTION 07220

ROOF AND DECK INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Roof and deck insulation and associated accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01312 - Project Meetings.
      b. Section 07415 - Standing Seam Sheet Metal Roofing.
      c. Section 05310 - Metal Decking.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. D 41- Standard Specification for Asphalt Primer Used in Roofing, Damp-proofing, and Waterproofing.
   3. D 312 - Standard Specification for Asphalt Used in Roofing.

B. FM Global (FM).

C. National Roofing Contractors Association (NRCA).

D. Underwriters Laboratories, Inc. UL.

1.03 SYSTEM DESCRIPTION

A. Roof insulation system: As follows with UL Class A and FM Class 1A fire classification and meeting FM 1-90 wind up-lift requirements.
   1. Where 3.5-inch rigid foam roof insulation is indicated on the Drawings, insulation shall be as follows:
      a. First layer: 1.5-inch thick foam insulation having an R-Value of 9.0.
      b. Vapor retarder.
      c. Second layer: 2-inch thick foam insulation having an R-Value of 12.1.
      d. Total system thickness shall be 3.5 inches and have a minimum R-Value of 21.0.
      e. Top surface of composite board shall be perlite.

1.04 SUBMITTALS

A. Product Data.

B. Samples. Include 6-inch square samples of each type and thickness of insulation required.

C. State thickness and R-value of insulation to be provided at each building.

D. Manufacturer's Installation Instructions: Include the following:
   1. Indicate special environmental conditions required for installation.
   2. Indicate adhesive recommendations.
   3. Indicate fastener recommendations and attachment pattern to meet specified FM 1-90 requirements.
   4. Indicate installation techniques.

E. Certificates:
   1. Certify that products meet or exceed specified requirements.
   2. Certify that insulation is approved by manufacturer for use with specified roofing materials.

F. Manufacturer's Field Reports.

G. Warranty.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

B. Installer qualifications:
   1. Manufacturer-approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.
   2. Committed to complying with manufacturer's specifications and NRCA recommendations.
   3. Committed to assuming undivided responsibility for roof insulation, roofing membrane and sheet metal flashing, and trim associated with roofing.

C. Product compatibility: Provide roofing manufacturer approved roof insulation.

D. Pre-installation conference: Conduct as specified in Section 01312.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's instructions.

B. Label asphalt containers with certification of full compliance with requirements of ASTM D 312, Table 1, and indicating equiviscous temperature, finished flowing temperature, and flash point.

C. Store roof system materials on pallets or dunnage at least 4 inches above ground and suitably covered to protect from weather.

1.07 SEQUENCING AND SCHEDULING

A. Apply no more insulation than can be completely covered with roofing membrane on the same day.

B. When installation of insulation and roof membrane cannot be completed within same day, install temporary water cutoffs at end of day's work and remove cutoffs prior to resumption of work.

1.08 WARRANTY

A. Furnished by roof membrane manufacturer, as specified in Section 07415.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rigid foam roof insulation:
   1. Closed cell polyisocyanurate foam core bonded to universal fiberglass reinforced facers.
   2. Utilizing environmentally compliant blowing agent.
   3. Manufacturers: One of the following or equal:
      a. Johns Manville, Inc., Denver, CO, ENRGY 3.

B. Atlas Roofing Corporation, Atlanta, GA, ACFoam II.

2.02 ACCESSORIES

A. Screw fastener system for steel decks:
   1. Self-drilling and self-tapping, zinc plated or stainless steel screws, sized for 1/2- to 3/4-inch exposure on exposed to view underside of deck, with minimum 3-inch square or diameter ribbed steel stress plates, hot-dip galvanized with minimum G-60 coating in accordance with ASTM A 123.
   2. Manufacturers: One of the following or equal:
      a. Tru Fast, Bryan, OH.
      b. TW Buildex, Itasca, IL.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck is properly graded to outlets.

B. Verify that deck surfaces are clean, dry, and where required, coated with primer.

3.02 INSTALLATION OVER STEEL DECK

A. Install roof insulation in accordance with manufacturer's specifications.

B. Secure wood nailers to roof deck adjoining eaves, at roof curbs for attachment of flashing and counter-flashing, and at other locations indicated on the Drawings.
   1. Nailers shall be built up of pressure treated wood to match the thickness of the insulation.

C. Apply first layer of roof insulation with long joints continuous, either parallel or at right angles to ribs of deck.

D. Form joints parallel to ribs over solid bearing.

E. Stagger end joints.

F. Secure with approved mechanical fasteners in FM I-90 pattern:
   1. Space fasteners as recommended by insulation manufacturer.
   2. Drive fasteners through tin caps or plastic fastener/cap assemblies, unless they are provided with integral flat cap not less than 1 inch across.
   3. Install screw fastener system in top rib of steel deck in accordance with manufacturer's instructions. Where underside of metal deck is exposed to view, size fasteners to penetrate deck from 1/2- to 3/4-inch, unless otherwise recommended by fastener manufacturer.

G. Vapor retarder:
   1. Apply one 18 inch wide layer of vapor retarder, then continue with full 36 inch widths, lapping each course 2 inches over preceding one.
   2. Install each felt so felt is firmly and uniformly set, without voids, into hot asphalt applied just before felt at nominal uniform 23 pounds per square over entire surface.
   3. Turn up edges of felts on, but not connected to, vertical surfaces and extend beyond roof edges for coverage sufficient to permit minimum 4-inch return over top surface of insulation.

H. Apply second layer of roof insulation with both long and short joints offset from joints of first layer. Firmly set in full width mopping of hot asphalt applied at approximately 33 pounds per square.

I. Install cant strips at curbs, parapets, and intersections of roofs and vertical walls, when recommended by membrane manufacturer. Place on top of insulation and set in solid mopping of asphalt.

J. Roof crickets:
   1. Install as required to achieve drainage pattern indicated on the Drawings, and as otherwise required to obtain roof warranty. Set in full mopping of hot asphalt. Feathered edges of crickets and tapered insulation shall be formed of perlite or fiber board.
   2. Mop 12-inch wide felt strip into solid asphalt at valley formed by installation of roof crickets to provide additional membrane reinforcement.

K. Before application of roofing, turn over and solidly mop projecting felt to insulation at vertical surfaces and edges.

L. Do not leave insulation exposed to weather.

3.03 FIELD QUALITY CONTROL

A. Roof insulation that becomes wet or damaged shall be removed and replaced with solid, dry insulation, unless installer provides written acceptance of the damaged insulation from the roofing manufacturer, whose warranty shall cover the system.

B. Inspections: Roof membrane manufacturer, whose warranty shall cover complete roof assembly, shall provide supervision and inspection necessary to secure warranty.

END OF SECTION

SECTION 07414

METAL SIDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for providing preformed metal siding.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. ASTM A1063 Standard Specification for Steel Sheet, Twin-Roll Cast, Zinc-Coated (Galvanized) by the Hot-Dip Process.

1.03 DESIGN REQUIREMENTS

A. Design and size components to withstand dead and live loads as calculated in accordance with the Building Code as specified in Section 01410.

B. Maximum allowable deflection:
   1. Wall panel: 1/180.
   2. Roof panel: 1/240.

C. System to accommodate, without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; deflection of structural support framing.

D. Accommodate positive drainage for moisture entering or condensation occurring within panel system, to exterior.

1.04 SUBMITTALS

A. Product data.

B. Shop drawings: Complete erection drawings showing siding section, adaptations around openings, other special conditions, method of securing sections to supporting structure, procedure for attaching end closure plates, end butt joint cover plates, and miscellaneous flashing.

C. Samples:
   1. Submit samples for selection of panel and trim color and finish from manufacturer's standard line.
   2. Submit samples of finish, 6 by 6 inches in size illustrating selected finish color, sheen, and texture.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications: Company specializing in manufacturing the products specified in this Section with minimum 3 years experience.

B. Installer qualifications: Company specializing in performing the Work of this Section approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's recommendations.

B. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

C. Stack pre-finished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

D. Prevent contact with materials which may cause discoloration or staining.

E. Submit warranty for approval prior to purchase of materials.

F. Storage and protection: Stack siding stored at the site on platforms or pallets, and cover with tarpaulins or other suitable weathertight covering.

1.07 PROJECT CONDITIONS

A. Field measurements: Verify that field measurements are as indicated on shop drawings.

1.08 WARRANTY

A. Provide 5-year warranty under provisions of the Contract Documents.

B. Warranty: Include coverage for degradation of panel finish including color fading caused by exposure to weather.

PART 2 PRODUCTS

2.01 PRECOATED STEEL SIDING

A. Section and minimum gauge are indicated on the Drawings.

B. Section modulus and moment of inertia shall be not less than for type of section indicated on the Drawings.

C. Manufacturer: One of the following or equal:
   1. H. H. Robertson.

D. Coating system: Manufacturer: One of the following or equal:
   1. H. H. Robertson "Versacor AF."

E. Material: ASTM A 1063 steel sheet with minimum G 90 galvanized coating on both sides.

F. Furnish siding in lengths to minimize number of end laps.

G. Fasteners: Number 14 by 1-inch recessed hex head Type B, Type 305 stainless steel, self-tapping screws with composite aluminum neoprene washers.

H. Furnish siding complete, including cutting, shaping, fitting, drilling, welding, reinforcing plates for openings, trim, flashing, and miscellaneous pieces necessary for proper installation and weathertight construction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Examine Work in place to verify that it is satisfactory to receive the Work of this Section.
   2. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 PREPARATION

A. Protection: Do not use siding for storage or working platform.

3.03 INSTALLATION

A. Do not damage or overload preformed metal siding.

B. Install siding as indicated on the Drawings, in conformance with manufacturer's drawings, specifications, and erection instructions.

C. Install siding in straight and continuous rows, with ribs at right angles to supporting members, unless otherwise indicated on the Drawings.

D. Accurately place sections end-to-end, and adjust for proper alignment and spacing between sections before being permanently secured to structural supports.

E. Cut openings at locations indicated on the Drawings, and as necessary for installation of piping and equipment.

F. Reinforce openings with structural steel members unless otherwise indicated on the Drawings.

G. Make end laps occur over supports, lapping minimum 6 inches; and apply mastic strip between panels at end laps.

H. Fasten panels at ends and intermediate supports through rib-valley to supporting structural members at 8-inch maximum spacing.

I. Lap sides one rib, laid shingle fashion, and apply non-hardening mastic strip along laps.

J. Unless otherwise indicated on the Drawings, fasten side laps of aluminum siding at 12-inch maximum spacing with 3/16-inch aluminum pop-rivets.

K. Install corrugated rubber closures with corrugations to match panel configuration at the eave and base connection of corrugated panels to supporting structural members, and at other points indicated on the Drawings.

L. Install flashings at corners and penetrations, using 3/16-inch aluminum pop-rivets at 12-inch maximum spacing for aluminum siding.

M. Fasten siding to structure with specified fasteners.

N. Repair damage to galvanized surfaces, including edges that have been cut and holes, with zinc-rich primer specified elsewhere in these Specifications.

O. Repair damage to baked-on color coating as recommended by coating system manufacturer.

END OF SECTION

SECTION 07415

STANDING SEAM SHEET METAL ROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preformed metal roofing, fascia, and associated accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.
      b. Section 01410 - Regulatory Requirements.
      c. Section 01614 - Wind Design Criteria.
      d. Section 07900 - Joint Sealants.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. B 32 - Standard Specification for Solder Metal.

B. NSF International (NSF).

1.03 SYSTEM DESCRIPTION

A. Design and manufacture roof decking in accordance with the Building Code as specified in Section 01410:
   1. Live load design: 20 pounds per square foot.
   2. Uplift for a wind: As specified in Section 01614.

1.04 SUBMITTALS

A. Submit as specified in Section 01330.

B. Shop drawings: Include thicknesses and dimensions of parts, fastening and anchoring methods, details and locations of seams, joints, and other provisions for thermal movement. Show plans and elevations at minimum scale of 1/4 inch to 1 foot, and details at minimum scale of 3 inches to 1 foot.

C. Product data: Include standard color and finish options.

D. Samples: Include 8-inch square samples of color and finish on specified substrate.

E. Manufacturer's installation instructions.

F. Certificates: Manufacturer's approval of installer and shop drawings.

G. Maintenance data.

H. Warranty.

1.05 QUALITY ASSURANCE

A. Installer qualifications: Manufacturer-approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

B. Exposed sheet metal material used for roofing including roofing panels, flashings, closures, and other trim shall be product of 1 manufacturer.

C. Other materials shall be products approved or recommended by roofing system manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's recommendations.

1.07 WARRANTY

A. Roofing: Warrant to maintain roof, including flashings, in watertight condition and to maintain finish free from change in color or physical deterioration for minimum 5 years limited to ordinary wear and tear by elements or defects due to faulty materials and workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Preformed metal roofing: One of the following or equal:
   1. IMSA Building Products, West Sacramento, CA.
   2. Metal Sales Manufacturing Corp., Woodland, CA.
   3. Berridge Manufacturing Co., Houston, TX.

2.02 PREFORMED METAL ROOFING

A. System: Batten type, sheet steel roofing system including fascia, flashing, and sealants.

B. Batten spacing: 16 inches on center.

2.03 EXPOSED COMPONENTS

A. Sheet steel: ASTM A 653, G90 minimum coating designation, minimum 22 gauge.

B. Finish:
   1. Top: Precoated, factory-finished aliphatic polyurethane over epoxy-based primer, minimum total dry film thickness 1.5 mil within 0.20 mil.
   2. Bottom: NSF approved 2-coat epoxy coating, minimum total dry film thickness 8.0 mil within 0.2 mil.

C. Surfaces must be prepared in accordance with coating manufacturer's recommendations.

D. Color: As selected by OWNER from manufacturer's standard colors.

2.04 ACCESSORIES

A. Hold-down clips: Stainless steel of type that will allow thermal movement of roof panels.

B. Closures: System manufacturer's standard neoprene blocks shaped to fit roof metal profile.

C. Solder: ASTM B 32 alloy composition SN 50.

D. Fasteners:
   1. Nails, screws, rivets, and other fasteners: Stainless steel or alloy appropriate to roofing metal.
   2. Nails: Ringed or twisted shank type, of lengths required.
   3. Screws: Stainless steel pan head wood or sheet metal screws for use with hold-down clips.

E. Sealant: As specified in Section 07900, unless recommended otherwise by panel manufacturer.

2.05 FABRICATION

A. Panels:
   1. Fabricate with upturned edges to form standing seam joints with minimum 1-1/2-inch high edges.

B. Fabricate to extend from eaves to ridge in a single length, with no end laps.

C. Ridge, hips, eaves, rakes, fascia, coping, and other exposed flashings: Form of sheet steel matching roofing to provide weathertight roofing system.

D. Form sheets, battens, strips, cleats, valleys, ridges, edge treatments, integral flashings, gutters, downspouts, and other components to profiles indicated on the Drawings and required for permanent leakproof construction.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify governing dimensions at building.

B. Verify that substrate is firm, dry, and free of foreign materials.

3.02 PREPARATION

A. Clean and repair adjoining surfaces when necessary for proper installation of preformed metal roofing panels.

3.03 UNDERLAYMENT

A. Apply single-ply of underlayment, lapped shingle fashion, with Kraft paper side up, 3-inch head laps and 6-inch side laps, and cover with slip sheet similarly lapped.

B. Hold underlayment in place with minimum number of fasteners.

C. Install no more underlayment than can be covered by metal roofing in a single day.

3.04 ROOFING

A. Install roofing in accordance with manufacturer's recommendations.

B. Lay out pattern to place batten seams equidistant from corners and aligned with seams on other side of hip or ridge.

C. Start installation from eaves.

D. Secure roofing panels in place with concealed clips and fasteners.
   1. Exposed fasteners through roof panels, batten covers, and flashings shall not be used.

E. Locate clips in joints within 6 inches of panel ends.

F. At eaves, cut upturned edges and bend panel down to form fascia.

G. At intersections of roof slope with ridge and hips, turn up edges of roof panels 1 inch.

H. Form cross seams with 3/4-inch fold-under on lower end and 2-inch fold-over on upper end.

I. Slit folds in cross seams at each corner 1 inch in from batten to form tab.

J. Hook hold-down cleats, fold on lower end of panel into fold on upper end of underlaying panel.

K. Exposed batten ends to have neoprene closures or watertight cap.

L. Form valleys of sheets not exceeding 10 feet in length.

M. Lap joints 6 inches in direction of drainage.

N. Extend valley sheet minimum of 6 inches under roofing sheets.

O. At valley, double fold valley and roofing sheets and secure with cleats spaced 18 inches on center.

P. Install ridge and hip covers securely in place using Z closer clips and fasteners.

Q. Seal joints where necessary for watertightness.

R. Completed roof shall be watertight.

S. Exposed surfaces shall be free of dents, scratches, abrasions, stains, and other visible defects.

END OF SECTION

SECTION 07600

FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: flashing, sheet metal, and associated accessories.

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 06100 - Rough Carpentry.
   b. Section 07415 - Standing Seam Sheet Metal Roofing.
   c. Section 07900 - Joint Sealants.

1.02 REFERENCES

A. Aluminum Association (AA).

B. ASTM International (ASTM):
1. A 240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip For Pressure Vessels and General Applications.
2. A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. B 32 - Standard Specification for Solder Metal.
4. B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
5. B 221 - Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. B 224 - Standard Classification of Coppers.
7. B 370 - Standard Specification for Copper Sheet and Strip for Building Construction.
8. B 749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
9. D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
10. D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

1.03 SUBMITTALS

A. Product data.

B. Shop drawings: Show fabrication details, material profiles, connections, jointing pattern, jointing details, fastening methods, isolation methods, and installation details.

C. Manufacturer's Installation Instructions.

1.04 SEQUENCING AND SCHEDULING

A. Coordinate sheet metal installation with installation of materials specified in Sections 07220, 07414, and 07415.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation.

B. During storage, prevent contact with materials that may cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Galvanized steel sheet, pre-coated: ASTM A 653, G-90; 24-gauge core steel, pre-coated with coating of selected standard color to match roofing.

2.02 ACCESSORIES

A. Fasteners and metal washers: Types best suited for purpose, of same material as sheet metal being fastened or of composition that will not support electrolysis, such as Type 18-8 stainless steel for fastening aluminum.

B. Sealer washers: Rubber type, minimum 0.040 inch thick.

C. Underlayment: ASTM D 226; Number 30 asphalt saturated roofing felt. Polyethylene, 6-mil thick**.**

D. Metal primer.

E. Protective backing paint: Bituminous.

F. Slip sheet: Rosin sized building paper.

G. Bedding compound: Rubber-asphalt type.

H. Roof cement: ASTM D 4586, plastic asphaltic cement.

I. Solder: ASTM B 32.

2.03 FABRICATION

A. Form sheet metal true to shape, accurate in size, square, and free from distortion or defects.

B. Form rises and angles into flashing true and straight, with exposed surfaces free from waves and buckles.

C. Fabricate cleats and starter strips of same material as sheet, minimum 3 inches wide, interlockable with sheet.

D. Form pieces in longest practical lengths. Size and space joints to provide adequate movement for thermal expansion and contraction.

E. Hem exposed edges on underside 1/2 inch; miter and seam corners.

F. Form material with standing flat lock cover plate seams.

2.04 FINISH

A. Prepare and prime exposed ferrous metal surfaces.

B. Back-paint concealed metal surfaces with protective backing paint to minimum dry film thickness of 15 mil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets are in place, and nailing strips are located.

B. Verify membrane termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

A. Install flashing and sheet metal in accordance with AA and SMACNA references, and when in connection with roofing, roofing manufacturer's specifications.

B. Install sheet metal to even smooth, sound, thoroughly clean and dry surfaces, free from defects that could affect installation.

C. Install flashings where necessary to provide leakproof conditions.

D. Isolate dissimilar metals from direct contact with protective backing paint.

E. Install starter, edge strips, and cleats before starting installation.

F. Perform cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate work of other sections.

G. Install sealer washers under metal washers or fastener heads where weathertightness is required.

H. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

I. Insert counterflashings into reglets to form tight fit.

J. Secure in place with lead or plastic wedges at maximum inches on center. Pack remaining spaces with lead wool. Seal flashings into reglets with sealant.

K. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations acceptable to the ENGINEER.

L. Lap, lock, cleat, sam, and seal joints. Make connections watertight and weathertight.

M. Apply roof cement compound between metal flashings and felt flashings.
   1. Fit flashings tight in place.
   2. Make corners square, surfaces true and straight in planes, and line accurate to profiles.

N. Seal metal joints watertight.

O. Flash roof drains, vents, and pipes with sheet lead flashing.

P. Flash and counterflash pipes, stacks, ducts, vents, conduit, and other penetrations through roofs.

Q. Extend flashings not less than 6 inches up pipes and counterflash with standard cast-iron or malleable iron recessed roof couplings.

R. Carry flashing for vents up to top of vent and turn down into pipe.

S. Extend flashing flange not less than 4 inches from vent or pipe in every directions, set in roofing cement, and prime before stripping in accordance with related roofing Section.

END OF SECTION

SECTION 07840

FIRESTOPPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: The requirements for providing firestopping.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. E 814 - Standard Test Methods for Fire Tests of Penetration Firestops Systems.

B. International Conference of Building Officials (ICBO).

C. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Product data: Submit manufacturer's data and installation instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Firestopping:
   1. Intumescent material capable of expanding up to 8 to 10 times when exposed to temperatures over 250 degrees Fahrenheit.
   2. Product shall be UL classified and have ICBO approved fire resistance rating up to 3 hours in accordance with ASTM E 814.

PART 3 EXECUTION

3.01 INSTALLATION

A. Fill and seal holes or voids in fire rated floors and walls including pipes penetrating between buildings with acceptable firestopping material in accordance with manufacturer's instructions:
   1. Penetrations shall be free of dirt and debris.
   2. Dam penetrations, if required, with an acceptable material.

B. Apply firestopping material to the penetration using a caulking gun, putty knife, or other normal trade tools:
   1. Provide minimum 1/2-inch caulk or putty for 2-hour fire rating with metal pipe.
   2. Provide minimum 1-inch caulk or putty for 3-hour rating with metal or insulated metal pipe.

C. Normal curing time is 7 days; however, seal shall be immediately functional, providing cold smoke, water, and fire seal.

D. Remove damming materials if necessary after cure.

3.02 CLEANING

A. Clean surrounding areas after installation in compliance with manufacturer's instructions.

END OF SECTION

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Acrylic-Latex sealant.
   2. Precast concrete joint sealant.
   3. Silicone sealant.
   4. Synthetic rubber sealing compound.
   5. Synthetic sponge rubber filler.
   6. Related materials.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. M 198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

B. ASTM International (ASTM):
   1. C 920 - Standard Specification for Elastomeric Joint Sealants.
   2. C 990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
   3. D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
   4. D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

1.03 SUBMITTALS

A. Product data.

B. Samples, include color selections.

C. Manufacturer's Installation Instructions.

D. Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.05 PROJECT/SITE CONDITIONS

A. Environmental requirements: Do not apply sealant on wet or frosty surfaces or when surface temperature is higher than 100 degrees Fahrenheit or lower than recommended by the manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's recommendations.

B. Code date packages. Do not use material older than manufacturer’s published shelf life. Store materials at temperatures lower than 80 degrees Fahrenheit. Condition materials in accordance with manufacturer’s instructions prior to installation.

1.07 SEQUENCING AND SCHEDULING

A. Caulk joints prior to painting.

1.08 WARRANTY

A. Warrant to correct defective products for minimum 5 years in accordance with manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 ACRYLIC-LATEX SEALANT

A. Permanently flexible, nonstaining, and nonbleeding latex modified acrylic sealant compound, colors as selected by Engineer from manufacturer's standard options. Manufacturers: One of the following or equal:
   1. Tremco, Tremflex 834.
   2. Pecora Corp., Number AC-20.
   3. Sonneborn, Sonolac.

2.02 PRECAST CONCRETE JOINT SEALANT

A. Preformed, cold-applied, ready-to-use, flexible joint sealant in accordance with ASTM C 990 and AASHTO M 198. Manufacturers: One of the following or equal.
   1. Henry Corporation, Ram-Nek.
   2. Concrete Sealants Division, ConSeal.

2.03 SILICONE SEALANT

A. ASTM C 920, Type S, Grade NS, Class 25, single component silicone sealant. Manufacturers: One of the following or equal:
   1. Tremco, Proglaze.
   2. Pecora Corp., Number 864.
   3. Dow Corning, Number 795.
   4. General Electric, Number 1200 Series.

2.04 SYNTHETIC RUBBER SEALING COMPOUND

A. Manufacturer: One of the following or equal:
   1. Sika Corporation, Lyndhurst, NJ, Sikaflex 2c NS or SL
   2. Polymeric Systems, Inc., PSI 275.
   3. Pacific Polymers, Garden Grove, CA, Elastothane 227R.

B. Material: In accordance with ASTM C 920 Type M, Grade P (pourable), Class 25 and Type M, Grade NS (non-sag), Class 25; multi-part polyurethane; able to cure at room temperature to firm, highly resilient polymer; able to perform satisfactory when continuously submerged in water or sewage and exposed to direct sunlight in dry condition; with the following properties determined at 75 degrees Fahrenheit and 50 percent relative humidity:
   1. Base: Polyurethane rubber.
   2. Solids: Minimum 97 percent.
   3. Application time: Minimum 2 hours.
   4. Cure time: Maximum 3 days.
   5. Tack free time: 24 hours.
   6. Ultimate hardness: Non-sag 25, Pourable/SL 40, within 5 Shore A.
   7. Tensile strength: Non-sag 120 pounds per square inch minimum and self-leveling minimum 170 pounds per square inch when tested in accordance with ASTM D 412.
   8. Ultimate elongation: Minimum 490 percent when tested in accordance with ASTM D 412.
   9. Tear resistance: Non-sag 45 pounds per inch minimum and self-leveling minimum 85 pounds per inch when tested in accordance with ASTM D 624, Die C.
   10. Service temperature range: Minus 25 degrees to 158 degrees Fahrenheit.

C. Color: Gray to match concrete, unless indicated on the Drawings.

2.05 SYNTHETIC SPONGE RUBBER FILLER

A. Closed-cell expanded sponge rubber manufactured from synthetic polymer neoprene base, or resilient polyethylene foam backer rod. Manufacturers: One of the following or equal:
   1. Presstite, Number 750.3 Ropax Rod Stock.
   2. Rubatex Corp., Rubatex-Cord.

B. Characteristics:
   1. Suitable for application intended.
   2. Strength: As necessary for supporting sealing compound during application.
   3. Resiliency: Sufficient resiliency to prevent significant load transfer across joint.
   4. Resistance to environmental conditions of installation.
   5. Bonding: No bonding to the sealing compound.
   6. Structure: Cellular, prevents wicking or absorption of water.
   7. Compatibility with other materials in joint and acceptance by manufacturer of sealing compound.
   8. Size: Minimum 25 percent greater than nominal joint width.

2.06 RELATED MATERIALS

A. Primer: Nonstaining type, recommended by sealant manufacturer to suit application.

B. Joint cleaner: Noncorrosive, nonstaining, compatible with joint forming materials and as recommended by sealant manufacturer.

C. Bond breaker tape: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify acceptability of joint dimensions, physical, and environmental conditions.

B. Verify that surfaces are dry, clean, and free of dirt, grease, curing compound, and other residue which might interfere with adhesion of sealants.

3.02 PREPARATION

A. Allow concrete to cure thoroughly before caulking.

B. Synthetic sponge rubber filler:
   1. Prepare surfaces designated to receive filler in accordance with manufacturer's installation instructions.
   2. Do not stretch filler beyond its normal length during installation.

C. Caulking:
   1. Verify that surfaces are dry, clean, and free of dirt, grease, curing compounds, and other residue that might interfere with adhesion of sealant.
   2. Concrete, masonry, wood, and steel surfaces: Clean and prime in accordance with manufacturer's instructions prior to caulking.

D. Synthetic rubber sealing compound:
   1. Ensure surfaces to which synthetic rubber must bond are dry and free of dust, dirt, and other foreign residue.
   2. Heavy sandblasted caulking groove to sound surface, and prime with manufacturer's recommended primer for particular surface.

E. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but neither more than 5/8 inches deep nor less then 3/8 inches deep.

F. For normal moving building joints sealed with elastomeric sealants not subject to traffic, fill joints to depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.

G. For joints sealed with acrylic-latex sealants, fill joints to depth in range of 75 percent to 125 percent of joint width.

H. Use joint filler to achieve required joint depths, to allow sealants to perform properly.

I. Prepare surfaces and install synthetic sponge rubber filler in accordance with manufacturer's recommendations.

J. Do not stretch filler beyond normal length during installation.

K. Apply bond breaker when recommended by joint sealer manufacturer.

3.03 INSTALLATION

A. Synthetic sponge rubber filler: Install filler in accordance with manufacturer's installation instructions.

B. Caulking, joints, and sealing:
   1. Construct expansion, contraction, and construction joints as indicated on the Drawings.
   2. Install pipe and conduit in structures as indicated on the Drawings.
   3. Caulk doors, windows, louvers, and other items installed in or over concrete openings inside and out.
   4. Use synthetic rubber sealing compound for caulking where indicated on the Drawings or as specified, except for masonry construction and where specified otherwise.
   5. Complete caulking prior to painting.
   6. Verify that concrete is thoroughly cured prior to caulking.
   7. When filler compressible material is used, use untreated type.
   8. Apply caulking with pneumatic caulking gun.
   9. Use nozzles of proper shape and size for application intended.
   10. Maintain continuous bond between caulking and sides of joint to eliminate gaps, bubbles, or voids and fill joint in continuous operation without layering of compound.
   11. Employ experienced applicators to caulk joints and seams in neat workmanlike manner.
   12. To hasten curing of compound when used on wide joints subject to movement, apply heat with infrared lamps or other convenient means.
   13. Apply synthetic rubber sealing compound with pneumatic caulking tool or other acceptable method.

3.04 CLEANING

A. Clean surfaces adjacent to sealant as work progresses.

B. Remove excess uncured sealant by soaking and scrubbing with sealant cleaning solvent.

C. Remove excess cured sealant by sanding with Number 80 grit sandpaper.

D. Leave finished work in neat, clean condition.

3.05 SCHEDULE

A. Acrylic latex:
   1. Use where indicated on the Drawings.
   2. Interior joints with movement less than 7.5 percent and not subject to wet conditions.

B. Silicone:
   1. Use where indicated on the Drawings.

2. Joints and recesses formed where window, door, louver and vent frames, and sill adjoin masonry, concrete, stucco, or metal surfaces.
3. Door threshold bedding.
4. Moist or wet locations, including joints around plumbing fixtures.
5. Stainless steel doors and frames, including joints between applied stops and frames, and around anchor bolts.
6. Plenum joints.

C. Synthetic rubber sealing compound, non-sag Type II:
1. Use where indicated on the Drawings.
2. Water-bearing and earth-bearing concrete structures.
3. Joints in masonry, concrete vertical surfaces, and metal-faced panels in vertical surfaces.
4. Joints between sheet metal flashing and trim.
5. Joints between sheet metal flashing and trim, and vertical wall surfaces.
6. Small voids between materials requiring filling for weathertight performance in vertical surfaces.
7. Perimeters of frames of doors, windows, louvers, and other openings where bonding is critical to airtight performance.
8. Expansion and control joints in masonry vertical surfaces.

D. Synthetic rubber sealing compound, self-leveling Type I:
1. Use where indicated on the Drawings.
2. Expansion and control joints in masonry, concrete horizontal surfaces, and metal panels in horizontal surfaces.
3. Small voids between materials requiring filling for weathertight performance in horizontal surfaces.
4. Pavement joints.
5. Perimeters of frames of doors, windows, louvers, and other openings in horizontal surfaces where bonding is critical to airtight performance.

END OF SECTION

SECTION 08110

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Steel Fire Resistive Rated and Non-Fire Resistive Rated:
   1. Doors.
   2. Door frames.
   3. Window frames. Glazed frames.
   4. Combination door frames and window frames with mullions, muntins, and transom bars.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.
      b. Section 04220 - Concrete Unit Masonry.
      c. Section 08710 - Door Hardware.
      d. Section 08800 - Glazing.
      e. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. A250.6 - Hardware on Steel Doors (Reinforcement Application).
   2. A250.8 - Recommended Specification for Standard Steel Doors and Frames.

B. ASTM International (ASTM):
   1. A 653/A653M - Standard Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. A 924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic- Coated by the Hot-Dip Process.
   3. A 1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
   4. A 1011 – Standard Specification for Steel, Sheet and Strip, Hot Rolled, Carbon, Structural, High Strength Low Alloy, High Strength Low Alloy with Improved Formability, and Ultra High Strength.

5. E 152 - Standard Methods of Fire Tests of Door Assemblies.
6. E 413 - Classification for Rating Sound Insulation.
7. E 1408 - Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems.
8. E 2074 - Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.

C. National Association of Architectural Metal Manufacturers (NAAMM)/Hollow Metal Manufacturers Association (HMMA):
1. HMMA 861 - Guide Specifications For Commercial Hollow Metal Doors and Frames.

D. National Fire Protection Association (NFPA):
1. 80 - Standard for Fire Doors and Other Opening Protectives.

E. Steel Door Institute (SDI):
1. SDI-111 - A Steel Doors and Frame Details.
2. SDI-117 - Manufacturing Tolerances Standard Steel Doors and Frames.

F. Underwriters' Laboratories, Inc., (UL):
1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

1.03 SUBMITTALS

A. Product data.

B. Shop drawings: Show the following with references to the Engineer's door marks and hardware groups:
1. Location of door and frame types.
2. Details of fabrication, including core construction, glass lights, louvers, weatherstripping, and factory finish for each door.
3. Cutouts and reinforcements for hardware.
4. Methods of installation and anchorage to adjacent construction.

C. Certificates documenting:
1. Fire-rated units have been successfully tested in accordance with Article 2.06.

D. Manufacturer's instructions: Submit manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Testing agency qualifications: Approved by ultimate enforcing authority for the Project; regularly engaged in inspection of materials and workmanship at factory.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Before delivery, identify type and size of each door and frame in such a way that markings will not damage finish.

B. Preassemble doorframes in shop and deliver to Project site with spreader bar at sill or tie them in pairs to form box.

C. Protect doors and frames with resilient packaging sealed with heat shrunk plastic. Break seal on-site to permit ventilation.

D. Protect doors and frames during shipment and storage to prevent warping, bending, and corrosion.

1.06 SEQUENCING AND SCHEDULING

A. Ensure timely delivery of reviewed hardware schedule and hardware templates such that no delay occurs in the work of the Contract.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sheet steel: ASTM A 1008, commercial quality, level, cold rolled steel, or ASTM A 1011, hot rolled, pickled and oil rolled steel. Galvanize by hot-dip process with zinc-coating conforming to ASTM A 653/A 653M and A 924/A 924M A 60, with a coating weight of not less than 0.60 ounces per square foot (0.30 ounces per square foot per side). Clips, bolts, screws, and rivets: sized as recommended by manufacturer.

B. Primer: Rust- inhibitive metal primer capable of being baked and compatible with finish painting system specified in Section 09960.

C. Touch-up materials: Primer as recommended by manufacturer.

D. Door hardware: As specified in Section 08710.

E. Grout: As specified in Section 04220.

F. Glass and glazing materials: As specified in Section 08800.

2.02 DOOR AND FRAME TYPES

A. Interior doors: ANSI 250.8, Grade III, Model 3 or NAAMM HMMA 810 Type A and NAAMM HMMA 861, flush steel rib-stiffened, minimum 18 gauge face sheets.

B. Exterior doors: ANSI 250.8, Grade III, Model 3, or NAAMM HMMA 810 Type A and NAAMM HMMA 861, flush steel rib-stiffened, minimum 16 gauge face sheets.

C. Interior frames: ANSI 250.8 or NAAMM HMMA 861, fully welded frames, minimum 16 gauge, sizes and shapes as indicated on the Drawings.

D. Exterior frames: ANSI 250.8 or NAAMM HMMA 861, fully welded frames HMMA 861, except minimum 14 gauge sizes and shapes as indicated on the Drawings.

E. Sound-rated (acoustical) assemblies: Provide door and frame assemblies fabricated as sound-reducing type, tested in accordance with ASTM E 90, and classified in accordance with ASTM E 413:
   1. Unless otherwise indicated, where sound-rated doors are scheduled, provide acoustical assemblies with sound ratings of Sound Transmission Class (from ASTM E 413) (STC) 33 or better.

2.03 COMPONENTS

A. Door cores:
   1. Stiffeners: Vertical steel ribs formed from minimum 22-gauge plain sheet steel, spaced at maximum 6 inches apart and securely attached to face sheets by spot welds at maximum 5 inches on center.
   2. Core fillers: Insulation, minimum 0.60 pound density noncombustible type, installed in spaces between stiffeners for full height of door; labeled door core material shall conform to requirements of labeling authority.

B. Glazing stops: Minimum 18 gauge sheet steel, mitered, square, or rectangular:
   1. Outside of exterior doors: Fixed, integral to doors and frames.
   2. Secure side of interior doors: Removable.

C. Removable stop fasteners: Flat head, countersunk, tamperproof, self-tapping sheet metal screws.

D. Louvers:
   1. Type: Flush with face, inverted Y blades, with UL approved fusible link type louvers at fire rated doors.
   2. Material: Steel sheet, same type sheet as door material.
   3. Blade gauge: Minimum 24.
   4. Frame gauge: Minimum 20.
   5. Construction: Provide louvers that are welded to frame (except at fusible link type).
   6. Moldings: Secure and detachable type. Locate detachable moldings on room or non-security side of doors.

E. Louver screens:
   1. Use: At exterior door louvers.
   2. Location: Locate screens on interior face of louver and secured to louvers in rigid manner that permits easy removal.
   3. Screens: Stainless steel insect screen mesh.
   4. Frames: Stainless steel manufacturer's standard type and gauge.

2.04 FABRICATION OF FRAMES

A. Galvanize all frames installed in exterior openings.

B. Frames: Sheet steel, integral type, welded continuous to full depth of frames with minimum 5/8-inch deep stops, unless otherwise indicated on the Drawings.

C. Hardware reinforcement: Minimum 7 gauge at hinges; 12 gauge at strikes, bolts, closers, and other applied hardware.

D. Jamb Anchors: As required for adjacent wall construction, minimum 3 per jamb, unless otherwise indicated on the Drawings.

E. Floor anchors: Fixed type, except where adjustable anchors are indicated on the Drawings, 1 per jamb, with minimum 2 holes for anchorage. Where floor fill occurs, terminate bottom of frames at indicated finished floor level and support by adjustable extension clips resting on and anchored to structural slabs.

F. Anchors at masonry: Adjustable strap and stirrup, minimum 16 gauge corrugated or perforated steel at maximum of 30 inches on center and extending minimum 8 inches into masonry.

G. Anchors at previously placed concrete: Countersink machine screws through the frame into expansion devices spaced at maximum 30 inches on center.

H. Anchors at structural steel framing: Welded or otherwise securely fastened with stainless steel screws.

I. Anchors for fire resistive frames: Conform to requirements of labeling authority having jurisdiction.

J. Masonry angle stiffeners: Factory welded into heads of frames for installation in openings more than 48 inches wide.

K. Mullions, muntins, and transom bars: Minimum 18 gauge, tubular sheet steel matching, and butt-welded to head and jamb members.

L. Removable stops: Fasten at approximately 12 to 16 inches on center.

2.05 FABRICATION OF DOORS

A. Galvanize all doors installed in exterior openings.

B. Reinforce face sheets with steel rib stiffeners, spaced at maximum 6 inches apart, and securely attached to face sheets by spot welds at maximum 5 inches on center.

C. Fill voids between face sheets and stiffeners with fiberglass insulation having a minimum density of 0.8 pounds per cubic foot.

D. Edges: Full weld without visible joints. Bevel striking edge 1/8 inch in 2 inches.

E. Tops and bottoms of doors: Close with continuous recess steel channel of minimum 16 gauge, extending full width of door and spot welded to both faces.

F. Tops and bottoms of exterior doors: Flush closing channels welded to make tops and bottoms waterproof with weep holes for escape of moisture.

G. Hinge reinforcement: 7 gauge.

H. Lock, closer, and flush bolt reinforcement: 12 gauge.

I. Astragals:
   1. Install on active leaf of double doors in accordance with UL listing requirements for fire resistive ratings as indicated on the Drawings, and for exterior pairs of doors.
   2. Do not install on doors swinging in pairs with rating of 90 minutes or less in means of egress where both leaves are required to provide building code required exiting widths.
   3. Do not provide astragal cutouts for hardware operations.

J. Astragal clearances for fire resistive rated doors:
   1. Door bottoms at doors designated to receive non-combustible threshold: Not to exceed 3/8 inch between threshold and door bottom.
   2. Door bottoms where there is no threshold: Maximum clearance between door and floor not to exceed 1/2 inch.
   3. Door bottoms at doors designated to receive combustible floor coverings: Not to exceed 1/2 inch between floor covering and door bottom.
   4. Clearance between door and frame and between meeting edges of pairs of doors: Not to exceed 1/8 inch.

K. Astragal clearances for non-fire resistive rated doors: Same as fire resistive rated doors, unless otherwise indicated on the Drawings.

L. Glazing: In accordance with fire labeling.

2.06 FABRICATION OF FIRE RATED DOORS AND FRAMES

A. Fabricate to meet requirements of the building code as specified in Section 01410, UL 10C, and ASTM E 2074, except hose stream test shall not be required for opposite swing double egress exit doors and for doors of fire endurance rating of less than 45 minutes with or without approved glass lites.

B. Temperature rise requirements of doors at exit enclosures and exit passageways: Maximum transmitted temperature end point of less than 450 degrees Fahrenheit above ambient at end of 30 minutes when tested in accordance with the building code as specified in Section 01410.

C. Apply approved testing agency labels on fire rated doors and frames.

D. Fabricate oversized fire rated doors in accordance with requirements for ratings indicated on the Drawings.

2.07 HARDWARE PREPARATION

A. Cutout, drill, and reinforce frames and doors for hardware in accordance with hardware templates.

B. Install plaster guards or mortar boxes in back of hardware cutouts in and welded to frames.

C. Prepare fire resistive rated doors for hardware in accordance with requirements of labeling authority.

D. Do not weld hinges to doorframes.

E. Silencers:
   1. Drill single leaf doorframe jamb stops for minimum 3 silencers.
   2. Drill double-leaf doorframe head stops for minimum 2 silencers.
   3. Do not drill doorframes for silencers when weatherstripping is to be installed.

2.08 FINISHING

A. Thoroughly clean surfaces of oil, grease, and other impurities; touch-up abraded galvanizing; and chemically etch.

B. Fill irregularities and sand smooth finish surface. Apply 1 coat of manufacturer's standard rust inhibitive baked-on primer.

C. Finish painting: As specified in Section 09960.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine reviewed hardware schedules and verify proper coordination of hardware and doors and frames.

B. Examine opening locations and verify the following:
   1. Correctness of dimensions, backing, or support conditions.
   2. Absence of defects that would adversely affect frame or door installation.

3.02 INSTALLATION

A. Install doors and frames in accordance with approved shop drawings and manufacturer's instructions.

B. Frames:
   1. Set accurately in position, plumb, align, and attach securely to structure.
   2. Set in place before construction of adjacent masonry or framed walls.
   3. Anchor frames to previously placed concrete.
   4. Set frames before removing spreader bars.
   5. Fully grout frames in masonry as the Work progresses.
   6. Grout frames at concrete through keyways provided at head and jambs.

C. Doors: Install at correct openings, ensure smooth swing and proper closure with frame.

D. Fire resistive frames and doors: Install to conform to NFPA 80 for fire resistive rated class as indicated on the Drawings.

E. Door hardware: Install in accordance with Section 08710.

F. Separate or isolate dissimilar metals with neoprene gaskets, sleeves, and washers, or with coatings acceptable to the Engineer.

3.03 TOLERANCES

A. Manufacturing and installation tolerances: As indicated on the Drawings or in conformance to SDI 117 as minimum.

3.04 ADJUSTING AND CLEANING

A. Prime coat touch-up: Immediately after installation, sand smooth and touch-up rust areas, and other areas where primer has been damaged, with prime touch-up paint.

B. Make adjustments as required for correct, proper, and free function and smooth operation without binding of hardware or doors and frames.

C. Protect doors and frames from damage to surface or profile.

END OF SECTION

SECTION 08212

FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Flush wood solid core doors with wood veneer, and medium-density overlay faces; glazing; louvers; astragals; flashing for exterior wood doors; factory prefitting, factory machining for hardware, and installation of finish hardware.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01600 - Product Requirements.
      b. Section 08110 - Hollow Metal Doors and Frames.
      c. Section 08710 - Door Hardware.
      d. Section 08800 - Glazing.
      e. Section 09960 - High-Performance Coating.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. A 208.1 - Mat Formed Particleboard.

B. National Fire Protection Association (NFPA):
   1. 80 - Standard for Fire Doors and Other Opening Protectives.

C. Underwriters' Laboratories, Inc. (UL):
   1. BMA - Building Materials Directory.
   2. 10B - Fire Tests of Door Assemblies.

D. Window and Door Manufacturers Association (WDMA):
   1. I.S. 1A - Architectural Wood Flush Doors.
   2. I.S. 4 - Industry Standard for Preservative Treatment of Millwork.

1.03 SUBMITTALS

A. Product data: Complete description of products.

B. Shop drawings: Include door types, details of construction including internal blocking for hardware attachment; astragals, and door locations referenced to Engineer's door mark and hardware group.

C. Samples:
   1. Minimum 6-inch square samples of typical corner to show construction and finish.
   2. Minimum 6-inch square samples of specified hardwood veneers, illustrating wood grain, stain, or opaque paint color and sheen. Furnish additional samples upon request for trial application of finishes.

D. Quality control submittals:
   1. Certificates of compliance: Submit certificates certifying compliance with designated standards, governing codes, and applicable labeling agencies.
   2. Manufacturer's instructions: Submit manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Regulatory requirements:
   1. Provide fire-resistive rated doors in accordance with UL 10B except 20-minute doors do not have to comply with hose stream test.
   2. Provide doors in fire-resistive rated openings bearing label, which corresponds to or exceeds fire-resistive rating noted.
      a. Provide UL label or label issued by testing agency approved by agency having jurisdiction.
   3. Oversized doors: Provide doors constructed in accordance with requirements for fire-resistive ratings indicated.

B. Certifications: Submit certificates stating that oversized fire-resistive doors comply with labeling requirements of labeling agency.

C. Provide doors in accordance with WDMA I.S. 1A.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to and at project site in accordance with manufacturer's instructions.

B. Identify type and size of each door before delivery in order to permit installation at correct location.

C. Deliver wood doors to project site only after facilities are available for handling, sorting, and protecting them, and receiving areas are broom-cleaned; exterior openings are closed up and wet work completed.

D. Packing, shipping, storage, and protection:
   1. Provide temporary protective covers for items during delivery, installation, and until final acceptance.
   2. Protect doors during shipment and storage to prevent warping and bowing.

E. Handling:
   1. Always handle doors with clean hands or gloves.
   2. Do not drag doors across one another.
   3. Maintain factory packaging or other means of protection on doors, until final acceptance.

1.06 PROJECT CONDITIONS

A. Environmental requirements:
   1. Provide proper heat and humidity in area of installation and storage to maintain equilibrium moisture content in wood until job is completed.
   2. Relative humidity shall range from 50 to 65 percent at 70 degrees Fahrenheit.

1.07 WARRANTY

A. Submit warranties.

B. Submit manufacturer's standard warranties with riders to include cost of hanging, setting of hardware, glazing, finishing, and related work when replacing or repairing defective products for following durations:
   1. Interior doors: Minimum 2 years.
   2. Non-fire-resistive exterior doors: Minimum 5 years.

PART 2 PRODUCTS

2.01 PRODUCTS

A. Non-fire-resistive 5-ply doors: Manufacturers: One of the following or equal:
   1. Architectural Door Division of Weyerhaeuser Co., Marshafield Series Particleboard Core Door, Model DPC-1.
   2. Algoma Hardwoods, Model Algoma Novodor Core Door.
   3. Eggers Industries, Architectural Wood Flush Door, Model.

B. Non-fire-resistive 7-ply doors: Manufacturer: One of the following or equal:
   1. Cal Wood Door Inc., Model Architectural Particleboard Solid Core.
   2. Haley Brothers Inc., Solid Core Model PBS.

C. Non-fire-resistive doors with plastic laminate faces: Manufacturers: One of the following or equal:
   1. Architectural Door Division of Weyerhaeuser Co., Marshfield Series Particleboard Core Door, Model DPC-1.
   2. Algoma Hardwoods, Model Algoma Novodor Core Door.
   3. Eggers Industries, Architectural Wood Flush Door, Model.

D. Fire-resistive 5-ply doors with 20-minute fire rating: Manufacturers: One of the following or equal:
   1. Architectural Door Division of Weyerhaeuser Co., Model DEP-20, Marshfield Series Fire Doors, Particleboard Core.
   2. Algoma Novodor.

E. Fire-resistive 7-ply doors with 20-minute fire rating: Manufacturers: One of the following or equal:
   1. Cal-Wood Door Inc., Model PC, Architectural Particleboard Core Solid Core, with medium-density facing as part of 3-ply doorskin.

F. Fire-resistive 5-ply doors with 45-, 60-, or 90-minute rating: Manufacturers: One of the following or equal:
   1. Architectural Door Division of Weyerhaeuser Co., Model DFM Series, rating as scheduled, Marshfield Series Fire Door Mineral Core.
   2. Algoma Hardwoods, Composite Fire Doors.
   3. Eggers Industries, Model Fire Guard, Architectural Composite Core Fire Doors.

G. Fire-resistive 5-ply doors with 45-, 60-, or 90-minute rating: Manufacturers: One of the following or equal:
   1. Cal Wood Door, Inc., M-Series, Mineral Core Models.
   2. Haley Brothers, Inc., FD-Series, Fire Door Mineral Core Models.

H. Glazing stops for non-fire-resistive and 20-minute fire-resistive 5-ply doors: Manufacturers: One of the following or equal:
   1. Architectural Door Division of Weyerhaeuser Co., Model W-3 at interior locations and W-2 with metal bead at exterior locations, Marshfield Series Standard Door Molding.
   2. Algoma Hardwoods, Model W-4, Bead.
   3. Eggers Industries, Model 101 at interior locations and Model 107 at exterior locations, Beads.

I. Glazing stops for non-fire-resistive and 20-minute fire-resistive 7-ply doors: Manufacturers: The following or equal:
   1. Cal-Wood Doors Inc., Model S-1, Lip-Stop.

J. Metal glazing stops for fire-resistive rated doors: Manufacturers: One of the following or equal:
   1. Weyerhaeuser Co., Model 115, Fire Door Slim Line Frame.
   2. Algoma Hardwoods, Model 115, Vision Panel Frame.
   3. Eggers Industries, Model 115, Standard Metal Vision Panel Frame.

K. Wood veneer clad metal glazing stops for fire-resistive rated doors: Manufacturers: One of the following or equal:
   1. Architectural Door Division of Weyerhaeuser Co., Wood Veneer Vision Frame System.
   2. Anemostat Products Division of Dynamics Corp. of America, Wood Veneer Vision Panel Frames.

L. Louvers: Manufacturers: The following or equal:
   1. Dynamics Corp. of America's Anemostat Products Division, Model FLDL.

2.02 COMPONENTS

A. Cores:
   1. For non-fire-resistive doors: Particleboard, in accordance with ANSI A 208.1.
   2. For 20-minute fire-resistive doors: Solid core mat-formed particleboard in accordance with ANSI A 208.1, Grade 1-L-1.
   3. For 45-, 60-, and 90-minute fire-resistive doors: Mineral core, manufacturer's standard.

B. Stiles and rails: Manufacturer's standard.

C. Edge bands for doors with wood faces: Wood species to match face veneers.

D. Crossbands for 5-ply doors: Hardwood, manufacturer's standard.

E. Species: Cherry.

F. Faces:
   1. Cut: Plain Sliced.
   2. Matching of pairs of doors: Book Matched.
   3. Grade: WDMA I.S. 1A, Grade I.
   4. Faces where scheduled for opaque finish: Birch, WDMA I.S. 1A.
   5. Plastic laminate faces and edges: High-pressure, minimum 0.50 inch thick, in accordance with NEMA LD-3, general purpose grade, having non-directional textured finish, solid colors as selected.

G. Adhesive:
   1. For plastic laminate: As recommended by plastic laminate manufacturer for specified substrate.
   2. For wood crossbands and faces: WDMA I.S. 1A, Type II for interior doors, Type I for exterior doors.

H. Glazing stops:
   1. For non-fire-resistive and 20-minute fire-resistive doors: Solid stock; profiles lip type; prepared for countersunk style tamper proof screws.
   2. For fire-resistive doors, metal: Listed in UL Directory, slim-line 1 piece metal frame of type tested in door assembly bearing fire-rated label; corners neatly mitered; lapped corners not acceptable.

I. Louvers for non-fire-resistive doors: Sight-proof, chevron type; metal as standard with manufacturer with recessed bead.

J. Louvers for fire-resistive doors: Metal, listed in UL BMA for installation in fire rated doors up to 1-1/2 hours in flush wood veneered doors, with 135 degree fusible link mechanism; sizes as indicated.

K. Astragals: Manufacturer's standard labeled metal type.

L. Edges for 20-minute doors: Treated wood edges matching faces, manufacturer's standard.

M. Flashing for exterior doors: Manufacturer's standard aluminum flashing, size, and shapes as required at top edge of door, covering core and facing top surface of glazed and louver openings, and bottom edge of door.
   1. Edges for 20-minute doors: treated wood edges matching faces, manufacturer's standard.

N. Preservative treatment for exterior doors: In accordance with WDMA I.S. 4.

O. Primer and Sealer: Manufacturer's standard compatible with finish painting system as specified in Section 09960.

P. Metal door frames: As specified in Section 08110.

Q. Glass: Clear Tempered as specified in Section 08800.

R. Primer and sealer: As specified in Section 09960.

2.03 FABRICATION

A. Fabricate non-fire-resistive doors in accordance with WDMA I.S 1A requirements.

B. Fabricate fire-resistive rated doors in accordance with WDMA I.S. 1A and respective labeling requirements.

C. Door thickness: 1-3/4 inch, unless indicated otherwise.

D. Prefitting: Prefit doors in accordance with WDMA I.S. 1A and following:
   1. Door edges: Bevel latch side single doors and meet edges of pairs of doors minimum 1/8 inch in 2 inches.

E. Undercutting and trimming fire-resistive doors:
   1. Door bottoms at doors designated to receive non-combustible threshold: Not to exceed 3/8 inch between threshold and door bottom.
   2. Door bottoms where there is no threshold: Maximum clearance between door and floor not to exceed 3/4 inch.
   3. Door bottoms at doors designated to receive combustible floor coverings: Not to exceed 1/2 inch between floor covering and door bottom.
   4. Clearance between door and frame and between meeting edges of pairs of doors: Maximum 1/8 inch.
   5. Undercutting and trimming non-fire-resistive doors: Same as for fire-resistive doors, unless indicated otherwise.

F. Factory machining:
   1. Hardware: Pre-machine doors for door hardware by pre-drilling for screw and bolt holes, machining, and coring in accordance with hardware templates as specified in Section 08710.

G. Hardware blocking: Provide for hardware as specified in Section 08710, unless specified otherwise.
   1. Kick plate blocking: Provide for be minimum 10-inch high kick plates.

H. Cutouts: Provide for glazed vision panels and louvers.

I. Edges: Provide for parallel swinging, fire-resistive rated door pairs in accordance with respective labeling requirements.

J. Flashings for exterior doors: Provide doors with flashings as follows:
   1. Edges of doors: Top and bottom edges of doors, except doors designated to receive door bottoms or combination door bottoms and rain-drips as specified in Section 08710, covering core and facing, for full width of door.
   2. Sills of glazed and louver openings.

2.04 FINISHES

A. Preservative treat exterior doors with manufacturer's standard system prior to priming or sealing when required by manufacturer's guarantee requirements.

B. Apply minimum 2 coats of sealer on door surfaces to receive transparent finish.

C. Apply minimum 2 coats of primer on door surfaces to receive opaque finish.

D. Transparent or opaque finishes as indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for installation of products as specified in Section 01600.

3.02 INSTALLATION

A. Install doors in accordance with reviewed manufacturer's shop drawings and manufacturer's instructions.

B. Install hardware as specified in Section 08710.

C. Install glass and glazing as specified in Section 08800.

D. Install louvers plumb and level.

E. Coordinate installation of doors with installation of frames specified in Section 08110.

F. Tolerances: Installed doors shall comply with following alignment tolerances when measured with straight edge over 36- by 84-inch door face:
   1. Maximum diagonal distortion (warp): 1/4 inch, measured corner to corner.
   2. Maximum vertical distortion (bow): 1/4 inch, measured top to bottom.
   3. Maximum width distortion (cup): 1/4 inch, measured edge to edge.

3.03 ADJUSTING

A. Adjust doors and hardware for smooth, balanced door movement, with no binding in hardware, or between doors and frames.

END OF SECTION

SECTION 08332

OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Fire rated and non-fire rated, non-insulated and insulated overhead coiling doors.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01612 - Seismic Design Criteria.
      b. Section 01614 - Wind Design Criteria.
      c. Section 08710 - Door Hardware.
      d. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
   2. Type 4X enclosure in accordance with NEMA 250.
   3. Type 12 enclosure in accordance with NEMA 250.
   4. MG 1 – Motors and Generators.

B. ASTM International:
   1. ASTM A 123 – Standard specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
   3. ASTM A 666 – Standard specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   4. ASTM A 924 – Standard Specification for General Requirements of Steel Sheet, Metallic-Coated by the Hot-Dip Process (Referenced by ASTM A 653).

1.03 DEFINITIONS

A. NEMA:
   1. Type 4X enclosure in accordance with NEMA 250.
   2. Type 12 enclosure in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Compatibility with space and service requirements:
      a. Doors and equipment items provided shall be compatible with space limitations specified and indicated on the Drawings.
      b. Make modifications to doors and equipment items necessary to conform with space limitations or with utility services specified for rough-in.
      c. Provide items complete including all necessary ancillary equipment as may be required for complete and trouble-free operation.
   2. Maintenance requirements: For ease of maintenance, provide overhead coiling doors complying with following requirements:
      a. Provide each door assembly as complete unit produced or supplied by a single manufacturer, including frames, sections, brackets, operating mechanisms, hardware, except hardware items specified in Section 08710, and all necessary accessories for installation of complete in openings indicated.
      b. Unless otherwise specified, all doors of particular type throughout the entire project shall be as manufactured or supplied by a single manufacturer.

1.05 SUBMITTALS

A. Product data:
   1. General: Submit data completely describing products, including rough-in diagrams.
   2. Electrical operators: Submit complete manufacturer's data for all components for electric door operators. Show motor size and characteristics. Show manufacturer's verification that motor has been adequately sized for each size and type of door required. Submit electrical schematic diagrams.

B. Shop drawings:
   1. Drawings showing complete installation details, required clearances, relation to building structure, complete electrical rough-in requirements required for installation of motor operators for doors and for connection of such doors to fire alarm system, referenced to the door mark number.
   2. Show location and size of access doors required to perform maintenance on doors and auxiliary equipment.
   3. Information substantiating compliance with fire-rating of intended space.

C. Samples: Submit samples of finishes for finish selection.

D. Quality control submittals:
   1. Manufacturer's instructions:
      a. Installation instructions for each type and size of door, including manufacturer's data, operating instructions, and maintenance data.
      b. Furnish installer copy of diagrams and installation instructions.

E. Contract closeout submittals:
   1. Project record documents:
      a. Operation and maintenance data: Provide manufacturer's operation and maintenance data for each different type of door specified, complete with manufacturer's list of recommended spare parts and their prices, electrical

schematic diagrams, and name and address of nearest maintenance organization approved by door manufacturer.

b. Warranty: Provide manufacturer's standard warranty.

1.06 QUALITY ASSURANCE

A. Regulatory requirements:
   1. Wind loading as specified in Section 01614.
   2. Seismic requirements for door anchorage and support systems as specified in Section 01612.
   3. Provide electrical materials in NEMA Type enclosures as specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packing, shipping, and storage: Protect doors during shipment and storage to prevent warping, bending, and corrosion.

B. Deliver materials only after proper facilities are available. Provide clean dry surfaces or platform as required and protect from deterioration and foreign matter.

1.08 PROJECT CONDITIONS

A. Field measurements: Field verify all opening dimensions and clearances prior to fabricating doors. Fitting doors to openings is the responsibility of the CONTRACTOR.

1.09 SEQUENCING AND SCHEDULING

A. Inserts and anchorages: Furnish inserts and anchoring devices that must be set into concrete or built into masonry. Provide setting drawings, templates, and directions for installation of anchorage devices. Coordinate delivery with other work to avoid delay to the Contract.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Acceptable Manufacturer: One of the following or equal:
   1. Overhead Door Corp., Lewisville, TX 75067.
   2. Wayne-Dalton Corp., Mt. Hope, Ohio 44660.
   3. The Cookson Company, Inc., Phoenix, Arizona 85043.

B. Aluminum overhead coiling door:
   1. Mounting: Face of wall. Location as indicated on the Drawings.
   2. Operation: As indicated on the Drawings.
   3. Curtain:
      a. Exterior Slats: Minimum 18-gauge B & S or heavier aluminum alloy manufacturer's standard, interlocking flat-faced slats with ends of alternate slats fitted with metal end locks to hold curtain in alignment.
      b. Bottom bar: Fitted with 2 equal-sized aluminum angles minimum 1/8-inch thick, with lift handle and slide bolt at either end.

4. Weatherstripping:
    a. Bottom bar: Manufacturer's standard, provided with a flexible PVC bulb type astragal to ensure a consistent seal along the floor. Extrusion designed to interlock with door curtain.
    b. Door jambs: Manufacturer's standard, wool or nylon pile, vinyl extrusion seals.
    c. Hood: Manufacturer's standard neoprene baffle.
5. Guides: steel galvanized In accordance with ASTM A 123, formed of roll formed steel channels and angles or structural angles of sufficient depth to provide a groove of adequate depth on each jamb to hold curtain firmly in guides under design wind pressure.
6. Brackets: steel galvanized In accordance with ASTM A 123, steel plate with permanently sealed ball bearings designed to enclose ends of coil and provide support for counterbalance pipe at each end.
7. Barrel and counterbalance mechanism: Steel pipe of sufficient size to carry door load with maximum deflection of 0.03 inch per foot of opening width and counterbalanced by helical springs, oil tempered torsion type designed with minimum safety factor of 1.25, and having cast iron barrel plugs that anchor springs to tension shaft and pipe.
8. Hood: Fabricated minimum 0.050-inch thick aluminum, designed to enclose curtain coil and counterbalance mechanism.

C. Galvanized:
1. Interior slats: material to match exterior slats as specified in previous article, interlocking flat-faced slats, manufacturer's standard size with ends of alternate slats fitted with metal end locks to hold curtain in alignment.
2. Insulation: CFC-free Polyethylene foam yielding a minimum R-value of 6.20.

D. Door operators:
1. Push-up operator: Unless otherwise indicated on the Drawings, use at doors less than 56 square feet in area. Provide lift handles at the bottom bar.
2. Chain operator: Unless otherwise indicated on the Drawings, use at doors 56 square feet or larger in area. Provide a continuous hand chain and gearing on coil side of door.
3. Motor operator: Unless otherwise indicated on the Drawings, provide a heavy-duty type motor operator.
    a. High starting torque type motor having sufficient power to operate the load at an average speed of 1 foot per second.
    b. Totally enclosed, fan cooled, continuous-duty motor, sized to suit door size (1 horsepower minimum), with Class B insulation.
    c. 480 volt, 3-phase operation.
    d. Controlled by momentary contact 3-button station marked OPEN, CLOSE, and STOP. As indicated on the Drawings.
    e. Provide automatic screw-type limit switch to break circuit at termination of travel.
    f. Provide gear reducer consisting of high efficiency worm gearing running in an oil bath and a spring set, solenoid-operated brake designed to hold the load when power is off.
    g. Provide emergency hand chain operator that does not affect the time of the limit switch, to operate the load in case of power failure.

h. Operator to have reversing NEMA Size 1 starter having mechanical and electrical interlocks, properly sized 24-volt control transformer, and other controls necessary for proper operation, completely assembled and wired to a terminal strip to facilitate field wiring of the power source, pushbutton stations, and/or other remote devices.
i. Unless otherwise indicated on the Drawings, all electrical material supplied shall be in NEMA Type 12 enclosures for interior locations and in NEMA Type 4X enclosure or NEMA Type 4 enclosures for exterior or wet locations.
j. Provide electronic safety edge to reverse direction of door if obstruction is encountered.
k. Where no safety edge is specified, 2-button constant pressure type pushbutton stations marked OPEN and CLOSE shall be provided in lieu of 3-button station previously indicated.

2.02 ACCESSORIES

A. Fasteners: Sizes and types as recommend by reviewed door manufacturer.

2.03 FINISHES

A. Slats, Hood and Bottom Bar:
   1. Galvanized steel: Manufacturer’s standard rust inhibitive prime coat and with powder coat finish as selected by OWNER from manufacturer’s standard colors.

B. Guides and Bracket Plates:
   1. Galvanized steel: manufacturer's standard rust inhibitive prime coat in a flat black finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine openings to receive overhead coiling doors and verify:
   1. Dimensions and correctness of backing or support conditions.
   2. Absence of defects that would adversely affect installation.

B. Do not start the work until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Verify dimensions and design for each opening.

B. Coordinate details with other work supporting or adjoining coiling doors.

C. Furnish fastening devices as required to mount doors properly.

3.03 INSTALLATION

A. Install doors in strict accordance with manufacturer's installation instructions, unless specifically otherwise indicated on the Drawings.

B. Install assemblies plumb, square, and level at their proper elevations and in their proper planes.

C. Securely anchor assemblies to interior face of openings, in manner that provides full opening clearance, perfectly aligned and adjusted for smooth operation.

D. Interface with other products: Separate or isolate dissimilar metals with neoprene gaskets, sleeves, or washers, or with an acceptable coating.

3.04 ADJUSTING

A. Verify that door assemblies are securely anchored to structure, guides are perfectly aligned, and doors are adjusted for smooth operation.

B. Upon completion of installation, ensure doors are free from warp, twist, or distortion and are lubricated and properly adjusted to operate freely.

3.05 CLEANING

A. Thoroughly clean surfaces of grease, oil, and other impurities.

B. Replace any damaged or otherwise disfigured doors with new prior to final acceptance.

3.06 DEMONSTRATION

A. Provide OWNER's maintenance employees with minimum of 8 hours of maintenance instruction.

3.07 PROTECTION

A. Protect installed doors from damage until final acceptance.

END OF SECTION

SECTION 08412

ALUMINUM ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Aluminum entrance and storefront framing systems, including entrance door hardware and accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01612 - Seismic Design Criteria.
      b. Section 01614 - Wind Design Criteria.
      c. Section 07900 - Joint Sealants.
      d. Section 08710 - Door Hardware.
      e. Section 08800 - Glazing.

1.02 REFERENCES

A. Aluminum Association (AA):
   1. 45 - Designation System for Aluminum Finishes.

B. ASTM International (ASTM):
   1. A 36 - Standard Specification for Carbon Structural Steel.
   2. B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
   3. B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   4. E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   5. E 330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.
   6. E 331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.

1.03 PERFORMANCE REQUIREMENTS

A. Air infiltration of single acting offset pivot or butt hung entrance doors: As follows per linear foot of perimeter crack of 3- by 7-foot doors when tested in accordance with ASTM E 283:
   1. Single: Maximum 0.50 cubic feet per minute.
   2. Pair: Maximum 1.00 cubic feet per minute.

B. Air infiltration of storefront: Maximum 0.06 cubic feet per minute at 6.24 pounds per square foot when tested in accordance with ASTM E 283.

C. Water infiltration of storefront: No water penetration when tested in accordance with ASTM E 331 at 8 pounds per square foot.

D. Deflection of storefront: Maximum 1/175 of span when subjected to wind loading specified in Section 01614 and tested in accordance with ASTM E 330.

E. Safety factor: Minimum 1.65 of allowable stress when tested in accordance with ASTM E 330.

F. Seismic requirements: Designed in accordance with criteria specified in Section 01612.

1.04 SUBMITTALS

A. Product data: Include cleaning instructions.

B. Shop drawings: Include the following:
   1. Entrance door types, construction including hardware reinforcement, installation details, and locations referenced to ENGINEER's door mark and hardware group.
   2. Storefront framing systems, glass and glazing, and details including components and attachments or junction with adjacent work.

C. Samples: Sufficient number of sections to show extremes of color range for each color selected.

D. Certificates of compliance: Include the following:
   1. Manufacturer's certificate, or certified test report from and accepted testing agency stating that entrance doors and storefront framing system meet or exceed performance requirements.
   2. Manufacturer's certificate stating that anodic finishes comply with requirements.

E. Manufacturer's Installation Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver entrances and storefront units and components marked with type and location of installation.

B. Protect aluminum from damage with protective sleeves, polyethylene sheets, removable coatings, or other suitable means.
   1. Protect prefinished aluminum surfaces with strippable coating.

C. Deliver products when proper facilities are available.

D. Ship and store products in manner that prevents damage such as warping, bending, stains, discolorations, scratches, abrasions, or soiling.

E. Remove protective devices only when required to perform work or in absence of damage-producing conditions prior to final acceptance.

PART 2 PRODUCTS

2.01 ENTRANCE DOORS

A. Manufacturers and type: One of the following or equal:
   1. Kawneer Co. Inc., Visalia, CA, Model 190, Narrow Stile Doors.
   2. Amarlite Architectural Products, Atlanta, GA, equivalent product.
   3. PPG Industries, Inc., Denver, CO, equivalent product.
   4. VistaWall Architectural Products, Terrell, TX, equivalent product.

B. Framing material: Extruded 6063-T5 alloy and temper in accordance with ASTM B 221 alloy G.S. 10A-T5, minimum 0.125 inches thick.

C. Stile and rail face dimensions:
   1. Vertical stiles: Maximum 2-1/8 inches.
   2. Top rail: Maximum 2-1/4 inches.
   3. Bottom rail: Minimum 10 inches.

D. Bottom rail of door: Manufacturer's standard channel section that closes bottom of door.

E. Glass:
   1. Tinted monolithic, tempered, 1/4-inch thick, as specified in Section 08800.

F. Glazing gaskets: EPDM elastomeric extrusions, manufacturer's standard sizes and shapes.

G. Glazing moldings: Minimum 0.050-inch thick, hook-in type.

H. Fasteners:
   1. Exposed fasteners: Aluminum, stainless steel or plated steel in accordance with ASTM B 633.
   2. Perimeter anchors: Aluminum or steel.

2.02 HARDWARE

A. Hinges: Entrance door manufacturer's standard, minimum 4-1/2-inch-by-4-inch, 5-knuckle, ball bearing, non-removable pin, number per door as specified in Section 08710, finish as selected by ENGINEER.

B. Cylinders: As specified in Section 08710.

C. Inactive door locking system:
   1. Manufacturers: The following or equal:
      a. Kawneer Co. Inc., Visalia, CA, Controller Locking System.

D. Closers:
   1. Overhead concealed type with hydraulic spring control with rack and pinion operation, adjustable controls for closing, latching speed, back check, and hold open; concealed arm and track mounted in door top rail.
   2. Manufacturers: The following or equal:
      a. LCN Closers Division, Schlage Lock Co., Princeton, IL, 2030.

E. Push bar and pull handle: US32D brushed stainless steel.
   1. Manufacturers: One of the following or equal:
      a. Kawneer Co. Inc., Visalia, CA, Style CPII and CO-9.
      b. Amarlite Architectural Products, Atlanta, GA, equivalent products.
      c. PPG Industries, Inc., Denver, CO, equivalent products.
      d. VistaWall Architectural Products, Terrell, TX, equivalent products.

F. Thresholds: Entrance door manufacturer's standard 1/2-inch by 4-inch aluminum, mill finish.

G. Weatherstripping: Entrance door manufacturer's standard as follows:
   1. For jambs and heads: Thermoplastic elastomer in tubular shape with semi-rigid polymeric backing.
   2. For bottom door rail: EPDM blade gasket sweep strip.
   3. For double acting door stiles: Pile cloth.

2.03 STOREFRONT

A. Manufacturers and type: One of the following or equal:
   1. Kawneer Co. Inc., Visalia, CA, Trifab VG 451.
   2. Amarlite Architectural Products, Atlanta, GA, equivalent product.
   3. PPG Industries, Inc., Denver, CO, equivalent product.
   4. VistaWall Architectural Products, Terrell, TX, equivalent product.

B. Framing material: Extruded 6063-T5 allow and temper in accordance with ASTM B 221 alloy G.S. 10A-T5, minimum 0.125 inches thick.

C. Dimensions: 2-inch face by 4-1/2 inch overall depth.

D. Glazing provisions: Center glazed in minimum 1-inch deep by 15/16 wide pockets, able to conceal insulating glass spacers, for flush glazing without projecting stops, capable of being outside glazed.

E. Glazing gaskets: EPDM elastomeric extrusions, manufacturer's standard sizes and shapes.

F. Glass: Insulating, as specified in Section 08800.

G. Adapters and mountings for trim moldings and face materials: Capable of installation without interfering with normal assembly and weathering of storefront.

H. Steel reinforcing: ASTM A 36.

I. Flashings: Minimum 0.32-inch thick aluminum sheet.

J. Closures: Minimum 0.125-inch thick aluminum sheet.

K. Fasteners:
   1. Exposed fasteners: Aluminum, stainless steel or plated steel in accordance with ASTM B 633.
   2. Perimeter anchors: Aluminum or steel.

L. Anchorage and alignment brackets: Capable of concealed support of storefront from building structure.

M. Coating to isolate dissimilar metals: Bituminous paint, minimum 2 coats having minimum total thickness of 5 mils.

N. Coating to isolate aluminum from concrete, wood or other absorptive material: Zinc chromate metal primer, minimum 2 coats having minimum thickness of 3 mils.

O. Sealants: As specified in Section 07900.

2.04 FABRICATION

A. Extrude sections true to details with clean, straight, sharply defined profiles, smooth surfaces of uniform texture, and free from defects impairing strength and durability.

B. Accurately mill and fit sections to provide flush hairline joints.

C. Execute cutting, fitting, forming, drilling, and grinding of metalwork prior to cleaning, finishing, treatment, and application of coatings.

D. Maintain continuity of line and accurate relations of planes and angles.

E. Securely attach and support mechanical joints with hairline fit of contacting members.

F. Install stiffeners to reinforce framing when necessary to meet performance requirements.

G. Separate dissimilar metals with bituminous paint or preformed separators that will prevent corrosion.

H. Separate metal surfaces at moving joints with nonmetallic separators to prevent freeze-up of joints.

I. Fabricate frame assemblies for exterior walls with flashing and weeps to drain penetrating moisture to exterior.

J. Allow for thermal expansion of exterior units.

K. Accurately make cutouts, recesses, mortising, or milling, and reinforce doors for hardware.

L. Weld door joints along concealed lines of contact to prevent pitting, halo, and other imperfections after finishing.
   1. Thoroughly penetrate material with welds to produce complete fusion of metal between stiles and rails.
   2. Door corner construction to have manufacturer’s limited lifetime warranty.

M. Mechanically join door sections with interlocking aluminum channel clips and flat head stainless steel screws.

N. Both mechanically clip fasten and weld door corners by manufacturer's standard methods.

O. Drill, tap, cut out, and reinforce frames and doors for mortise hardware and surface mounted hardware in accordance with templates supplied by hardware manufacturers.

P. Make total thickness of reinforcement equal to nominal diameter of hardware fasteners.

2.05 FINISHING

A. Exposed aluminum surfaces: Anodized in accordance with AA 45 Architectural Class 1, Anodic Coating AAM12C22A42/44; without gripper marks on exposed surfaces; with uniform color from exposed faces onto exposed edges, dark bronze color.

B. Concealed aluminum surfaces: Same as exposed aluminum surfaces or anodized in accordance with AA 45 Architectural Class 2, Anodic Coating AAM12C22A31, clear.

C. Exposed fasteners: Match adjacent material in color and appearance or 300 series stainless steel heat-tempered to match color of anodized surface.

D. Concealed steel fasteners:
   1. In contact with aluminum: Stainless steel, 300 Series.
   2. Not in contact with aluminum: Structural or mild steel hot-dip galvanized after fabrication and touched-up when welded.

E. Steel: Mill scale and rust cleaned or ground off, grease and dirt cleaned off, chemically etched and 1 prime coat applied.

2.06 MARKING UNITS AND COMPONENTS

A. Mark entrances and storefront units and components with type and location of installation.
   1. Mark without damaging surfaces.
   2. Use designations indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify wall openings and adjoining work are ready to receive work of this Section.

B. Examine receiving frames and reviewed hardware schedules to verify coordination with doors.

3.02 INSTALLATION OF ENTRANCE DOORS

A. Install aluminum entrance and storefront systems in accordance with manufacturer's instructions and ENGINEER-accepted shop drawings.

B. Install doors at correct openings.

C. Set plumb, square, level, and in exact alignment for operation.

D. Ensure proper smooth swing and proper closure with frame.

E. Seal joints between entrance framing and building structure in order to secure watertight installation.

F. Install finish hardware for doors and adjacent framing as specified in Section 08710.

3.03 INSTALLATION OF STOREFRONT

A. Install aluminum entrance and storefront systems in accordance with manufacturer's instructions and ENGINEER accepted shop drawings.

B. Separate or isolate dissimilar metals and materials with coatings prior to installation.

C. Set plumb, square, level, and in alignment with other work.

D. Use anchorage devices to securely attach framing assembly to structure.

E. Align assemblies plumb and level, free of warp or twist.
   1. Maintain assemblies' dimensional tolerances and align with adjacent work.

F. Install watertight flashings.
   1. Set sill members in double bead of sealant.

G. Lead collected moisture or water to outside as directly as possible.

H. Seal joints between framing and building structure as specified in Section 07900.

3.04 ADJUSTING

A. After completion of glazing and finish painting, adjust doors and door hardware as required for smooth operation and correct function.

B. Lubricate hardware and moving parts.

3.05 CLEANING

A. Remove protective material from prefinished aluminum surfaces just before inspection for final acceptance.

B. Clean in accordance with recommendations of AA and manufacturer's cleaning instructions using only materials approved by aluminum manufacturer.
   1. Where doubt exists, make spot tests.

C. Remove soil or other sources of discoloration.

END OF SECTION

SECTION 08550

WOOD WINDOWS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: aluminum-clad fixed and operable wood-framed windows.

B. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 08550 – Glazing.

1.02 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/I.S.2/NAFS:
   1. LC: Light Commercial.

B. Performance grade number according to AAMA/WDMA 101/I.S.2/NAFS:
   1. Design pressure number in pounds force per square foot used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide wood windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of test size indicated below:
   1. Size required by AAMA/WDMA 101/I.S.2/NAFS for both gateway performance and optional performance grade.

B. Structural Performance: Provide wood windows capable of withstanding the effects of the following loads based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:
   1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings:
      a. Basic Wind Speed: 90 mph.
   2. Deflection: Design glass-framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch, whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.

C. Windborne-Debris Resistance: Provide glazed windows capable of resisting impact from windborne debris, based on the pass/fail criteria as determined from testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.

1.04 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of wood window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:
   1. Mullion details, including reinforcement and stiffeners.
   2. Joinery details.
   3. Expansion provisions.
   4. Flashing and drainage details.
   5. Weather-stripping details.
   6. Thermal-break details.
   7. Glazing details.
   8. Window cleaning provisions.
   9. For installed products indicated to comply with design loads, include structural analysis data prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of wood windows and used to determine the following:
      a. Structural test pressures and design pressures from basic wind speeds indicated.
      b. Deflection limitations of glass framing systems.

C. Samples for Initial Selection: For units with factory-applied color finishes:
   1. Include similar Samples of hardware and accessories involving color selection.

D. Samples for Verification: For wood windows and components required, prepared on Samples of size indicated below:
   1. Main Framing Member: 12-inch-long, full-size sections of window frame with factory-applied color finish.

2. Window Corner Fabrication: 12- by-12-inch-long, full-size window corner including full-size sections of window frame with factory-applied color finish, weather stripping, and glazing.
3. Operable Window: Full-size unit with factory-applied finish.
4. Hardware: Full-size units with factory-applied finish.
5. Weather Stripping: 12-inch-long sections.

E. Product Schedule: For wood windows. Use same designations indicated on Drawings.

F. Qualification Data: For Installer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of wood window. Test results based on use of downsized test units will not be accepted.

H. Maintenance Data: For operable window sash, operating hardware, weather stripping and finishes to include in maintenance manuals.

I. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to wood window manufacturer for installation of units required for this Project:
1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of data for wood windows, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A manufacturer capable of fabricating wood windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

C. Source Limitations: Obtain wood windows through one source from a single manufacturer.

D. Forest Certification: Provide windows made with all wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

E. Product Options: Information on Drawings and in Specifications establishes requirements for wood windows' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

F. Product Options: Drawings indicate size, profiles, and dimensional requirements of wood windows and are based on the specific system indicated. Do not modify size and dimensional requirements:
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

G. Fenestration Standard: Comply with AAMA/WDMA 101/I.S.2/NAFS, "North American Fenestration Standard Voluntary Performance Specification for Windows, Skylights and Glass Doors," for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated:
   1. Provide AAMA, WDMA-certified wood windows with an attached label.

H. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

I. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
   1. Build mockup for type(s) of window(s) indicated, in location(s) shown on Drawings.

J. Pre-installation Conference: Conduct conference at Project site prior to installation. Review methods and procedures related to wood windows including, but not limited to, the following:
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review, discuss, and coordinate the interrelationship of wood windows with other exterior wall components. Include provisions for structural anchorage, glazing, flashing, weeping, sealants, and protection of finishes.
   3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
   4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify wood window openings by field measurements before fabrication and indicate measurements on Shop Drawings:
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating wood windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to meet performance requirements.

b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
c. Faulty operation of movable sash and hardware.
d. Deterioration of wood, metals, vinyl, other materials, and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:
   a. Window: 10 years from completion date of Testing Phase.
   b. Glazing: 20 years from completion date of Testing Phase.
   c. Metal Finish: 10 years from completion date of Testing Phase.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. Aluminum-Clad Wood Windows:
      a. Hurd Millwork Company, Inc.
      b. Kolbe & Kolbe Millwork Co., Inc.
      c. Marvin Windows and Doors.
      d. Peachtree Doors and Windows; TPC Acquisition, Inc.
      e. Sierra Pacific Windows.
      f. Weather Shield Mfg., Inc.
      g. Loewen Windows.

2.02 MATERIALS

A. Wood: Clear ponderosa pine or another suitable fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.

B. Aluminum Extrusions and Rolled Aluminum for Cladding: Manufacturer's standard formed sheet or extruded-aluminum cladding, mechanically bonded to exterior exposed wood members. Provide aluminum alloy and temper recommended by wood window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, and not less than 16,000-psi minimum yield strength:
   1. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   2. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   3. High-Performance Organic Finish for Extrusions and Sheet: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-

chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Fluoropolymer Two-Coat System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604:
   1) Color: Bronze.

C. Wood Trim and Glazing Stops: Material and finish to match frame members.

D. Clad Trim and Glazing Stops: Clad-wood material and finish to match clad frame members.

E. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with wood window members, cladding, trim, hardware, anchors, and other components:
   1. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

F. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

G. Reinforcing Members: Aluminum, or nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

H. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when wood window is closed:
   1. Weather-Stripping Material: Elastomeric cellular preformed gaskets complying with ASTM C 509.
   2. Weather-Stripping Material: Dense elastomeric gaskets complying with ASTM C 864.
   3. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/I.S.2/NAFS.

I. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.
   1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

J. Replaceable Weather Seals: Comply with AAMA 701/702.

2.03 WINDOW

A. Window Type: Casement and Fixed As indicated on Drawings

B. AAMA/WDMA Performance Requirements: Provide wood windows of performance indicated that comply with AAMA/WDMA 101/I.S.2/NAFS:
   1. Performance Class: LC.

C. Condensation-Resistance Factor (CRF): Provide wood windows tested for thermal performance according to AAMA 1503, showing a CRF of 45.

D. Thermal Transmittance: Provide wood windows with a whole-window, U-factor maximum indicated at 15-mph exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.
   1. U-Factor: 0.43 Btu/sq. ft. x h x deg F or less.

E. Solar Heat-Gain Coefficient (SHGC): Provide wood windows with a whole-window SHGC maximum of 0.50, determined according to NFRC 200 procedures.

F. Sound Transmission Class (STC): Provide glazed windows rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

G. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/I.S.2/NAFS, Air Infiltration Test:
   1. Maximum Rate: 0.3 cfm/sq. ft. of area at inward test pressure of 1.57 lbf/sq. ft.

H. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/I.S.2/NAFS, Water Resistance Test:
   1. Test Pressure: 20 percent of positive design pressure, but not more than 15 lbf/sq. ft.

I. Forced-Entry Resistance: Comply with Performance Grade 30 requirements when tested according to ASTM F 588.

J. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/I.S.2/NAFS.

K. Operating Force and Auxiliary (Durability) Tests: Comply with AAMA/WDMA 101/I.S.2/NAFS for operating window types indicated.

2.04 GLAZING

A. Glass and Glazing Materials: Refer to Section 08800 for glass units and glazing requirements applicable to glazed wood window units.

B. Glass: Clear, insulating-glass units, argon gas filled, with low-E coating pyrolytic on second surface complying with Section 08800.

C. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal and complies with requirements for windborne-debris resistance.

2.05 HARDWARE

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with wood and aluminum cladding; designed to smoothly operate, tightly close, and securely lock wood windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide nonmagnetic stainless steel.

B. Counterbalancing Mechanism: Comply with AAMA 902:
   1. Sash-Balance Type: Concealed, tape-spring, spiral-tube, spring-loaded, or block-and-tackle type, of size and capacity to hold sash stationary at any open position.

C. Sill Cap/Track: Extruded-aluminum track with natural anodized finish with manufacturer's standard integral color, of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.

D. Locks and Latches: Designed to allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.

E. Roller Assemblies: Low-friction design.

F. Push-Bar Operators: Provide telescoping-type, push-bar operator designed to open and close ventilators with fixed screens.

G. Gear-Type Rotary Operators: Comply with AAMA 901 when tested according to ASTM E 405, Method A.
   1. Operation Function: All ventilators move simultaneously and securely close at both jambs without using additional manually controlled locking devices.

H. Four- or Six-Bar Friction Hinges: Comply with AAMA 904.
   1. Locking mechanism and handles for manual operation.
   2. Friction Shoes: Provide friction shoes of nylon or other non-abrasive, non-staining, non-corrosive, durable material.

2.06 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside of window and provide for each operable exterior sash or ventilator.

B. Glass-Fiber Mesh Fabric: Mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration; in the following color. Comply with ASTM D 3656:
   1. Mesh Color: Silver gray.

2.07 FABRICATION

A. Fabricate wood windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Fabricate wood windows that are reglazable without dismantling sash or ventilator framing.

C. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator, unless otherwise indicated.

D. Factory machine windows for openings and for hardware that is not surface applied.

E. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads of window units.

F. Factory-Glazed Fabrication: Except for light sizes in excess of 100 united inches, glaze wood windows in the factory where practical and possible for applications indicated. Comply with requirements in Section 08800 and with AAMA/WDMA 101/I.S.2/NAFS.

G. Glazing Stops: Provide nailed or snap-on glazing stops coordinated with Section 08800 and glazing system indicated. Provide glazing stops to match sash and ventilator frames.

H. Factory-Primed Windows: Provide manufacturer's standard factory-prime coat complying with WDMA T.M. 11 on exposed exterior and interior wood surfaces.

I. Factory-Finished Windows: Provide manufacturer's standard factory finish complying with WDMA T.M. 12 Apply finish to exposed exterior and interior wood surfaces:
   1. Color: Bronze.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate, and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation:
   1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
   2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches of opening.

3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.03 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

E. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Door hardware.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 08110 - Hollow Metal Doors and Frames.
      b. Section 08212 - Flush Wood Doors.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   2. E 283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

B. Builders Hardware Manufacturers Association (BHMA):
   1. A156.7 - Template Hinge Dimensions.
   2. A156.18 - Materials and Finishes.

C. Underwriters Laboratories, Inc.

1.03 SUBMITTALS

A. Product Data.

B. Hardware schedule: Include references to ENGINEER's hardware group number, door type designations, locations, other pertinent data, and manufacturer names or suitable abbreviation opposite items scheduled.

C. Keying Schedule: Include list giving key code and numbers of doors that can be opened by each key.

D. Samples: Include for each different type and manufacturer for review of finish.

E. Construction key distribution list: Submit upon OWNER's request.

F. Templates:
   1. Furnish hardware templates to fabricators of doors, frames, and other work to be factory-prepared for hardware.
   2. Check shop drawings of other work to confirm that adequate hardware backing is available.

G. Project record documents: Include corrected hardware schedule.

1.04 REGULATORY REQUIREMENTS

A. Provide hardware for fire-resistive rated openings that complies with UL and listed by UL.

B. Provide State Fire Marshall approved fire-rated cross-corridor assemblies and panic devices.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver hardware where directed in unopened packages with items packed separately, complete and ready for installation with necessary fittings, trim, fasteners, and accessories.

B. Provide packages bearing the manufacturers' labels with each item or group of items identified according to the accepted hardware schedule.

1.06 MAINTENANCE

A. Require lockset manufacturers to deliver permanent removable cylinder cores and keys and minimum 2 extractor keys to OWNER directly.

1.07 SCHEDULING AND SEQUENCING

A. Upon receipt of accepted hardware schedule, coordinate accepted hardware schedule, templates, reinforcing units, and template instructions to door and frame sections.

B. Restrict distribution of construction keys to superintendents and foremen. Maintain record of persons who have received keys on construction distribution list.

PART 2 PRODUCTS

2.01 FASTENERS

A. Types:
   1. To concrete, marble, or masonry: Machine screws and flush shells.
   2. To wood: Wood screws.
   3. On gypsum board or plaster: Screws of sufficient length to provide solid connection to framing or backing behind gypsum board or plaster.
   4. To mineral and hollow core doors: Sex bolts.
   5. Of exit devices to doors: Thru-bolts, unless otherwise specified.

B. Screws, exposed: Phillips-head type, full-threaded screws, not combination type.

C. Sizes: Suitable for heavy use.

D. Finish: Stainless steel, unless otherwise required to match material and hardware finish.

2.02 HINGES

A. Manufacturers: One of the following or equal:
   1. Stanley.
   2. Hager.
   3. McKinney.
   4. Ives.

B. Material:
   1. Interior fire resistive rated doors: Steel.
   2. Interior doors in corrosive environments: Stainless steel.
   3. Interior office doors: Brass.
   4. Interior doors in operation areas: Brass.
   5. Exterior doors: Stainless steel.

C. Knuckles, number of: Minimum 5.

D. Ball bearings: Concealed with interior self-lubricating bushings.

E. Type for doors with closers: Ball bearing.

F. Material for fire-resistive rated doors: Steel.

G. Pins for interior doors: Non-rising.

H. Pins for exterior doors: Non-removable.

I. Template hinges: BHMA A156.7.

J. Tips: Flat button.

K. Height: As follows, unless otherwise specified:
   1. Doors 1-3/8-inch thick: 3-1/2 inches.
   2. Doors 1-3/4-inch thick and up to 41 inches wide: 4-1/2 inches.
   3. Doors 1-3/4-inch thick and from 41 to 48 inches wide: 4-1/2 inches, extra heavy.
   4. Doors 2 inches thick or over 48 inches wide: 5 inches, extra heavy.

L. Widths: Sufficient to clear trim projection when door swings 180 degrees, unless otherwise specified.

M. Number per door leaf: As follows, unless otherwise specified:
   1. 3 hinges on door to 7 feet, 6 inches in height.
   2. 1 additional hinge for each additional 2 feet, 6 inches of height or fraction thereof.

2.03 LOCKSETS

A. Manufacturers typical: One of the following or equal:
   1. Schlage ND Series Rhodes design with removable core cylinders.
   2. Sargent, Division of Essex Industries, Inc., Model 10-Line with removable core cylinders, and Model L levers and roses.

B. Manufacturer for corrosive environments: Suitable for marine use or other severe climate conditions, having only stainless steel or bronze parts. One of the following or equal:
   1. Schlage L Series with removable core cylinders, and 06A lever and rose.
   2. Sargent, Division of Essex Industries, Inc., Model 8200 with removable core cylinders, and Model L levers, and Model LN roses.

C. Cylinders:
   1. Number of pins: Minimum 6.
   2. Cases: Steel, cylindrical.
   3. Interior parts: Non-corrosive with non-plastic, non-die-cast, non-aluminum mechanisms.
   4. Accessibility to key-in-knob type cylinders: Not requiring removal of lockset from door.
   5. Plugs: Extruded brass bar material fully round without flattened areas.
   6. Cores: Removable.

D. Strikes:
   1. Material: Same as lock trim.
   2. Lock and latch boxes: Wrought.
   3. Lips: Extended, able to protect trim from marring by latch bolt.
   4. Cutouts at metal frames: In accordance with ANSI, unless otherwise specified.

E. Levers: Type that returns to within 1/2 inch of door.

F. Backset: 2-3/4 inches.

G. Trim materials: As follows, unless otherwise specified:
   1. Typical: Stainless steel.
   2. Corrosive environments: Stainless steel.

2.04 CONSTRUCTION KEYING

A. Type: Removable core system.

2.05 PERMANENT KEYING AND KEYS

A. Keying schedule:

Group	Name	Function
Group 1	General Entry	General Building Entry
Group 2	Secured Areas	Signal, Communications, and Electrical Rooms in Various Buildings

B. Number of keys:
   1. Grand master keys: 4.
   2. Keyed alike: 8 keys for each keyed alike group furnished.
   3. Keyed different: 2.

C. Identification:
   1. Emboss face of each cylinder plug and key with minimum 3-digit visual key control system.
   2. Emboss DO NOT DUPLICATE on keys.

2.06 PUSH/PULL PLATES

A. Manufacturers: One of the following or equal:
   1. Ives.
   2. Trimco.
   3. Rockwood.

B. Pulls:
   1. Material: As scheduled.
   2. Size: Minimum 8 inches center-to-center, minimum grip diameter of 3/4-inch, minimum projection of 2-1/4 inch.

C. Pull plates:
   1. Material: As scheduled.
   2. Plate size: Minimum 3 by 12 inches by 0.050-inch thick, with beveled edges on 4 sides with pull.
   3. Pull size: Minimum 8 inches center-to-center, minimum grip diameter of 3/4 inch, minimum projection of 2-1/4 inch.

D. Push plates:
   1. Material: As scheduled.
   2. Size: Minimum 3 by 12 inches by 0.050-inch thick, with beveled edges on 4 sides.

2.07 CLOSERS

A. Manufacturers:
   1. Features:
      a. Heavy-duty.
      b. Non-handed and non-sized.
      c. Adjustable spring power from size 1 through 4.
      d. Manufacturer's special rust-inhibitive epoxy primer on every part.
   2. One of the following or equal:
      a. Sargent, 351 Series.
      b. LCN, Super Smoothee Model 4041 Series.
      c. Norton Door Controls, Multi-Size Door Closers Model 7500BF Series.

B. Type: Full rack and pinion type with steel spring and non-gumming, non-freezing hydraulic fluid.

C. Controls: Separate set for regulating sweep speed, latch speed, backcheck and backcheck positioning, or where schedules, spring power.

D. Sizes: As recommended by accepted manufacturer.

E. Covers: Metal, capable of receiving finishes to match adjacent hardware finishes, unless otherwise specified.

F. Narrow frame provisions: Drop plates.

G. Effort to operate: As follows:
   1. Exterior: Maximum 8-1/2 pounds.
   2. Interior: Maximum 5 pounds.
   3. Fire-resistive rated doors: Maximum 15 pounds.

H. Adjust closers in accordance with manufacturer's directions for size of door.

2.08 EXIT DEVICES

A. Lever design:
   1. Manufacturers: The following or equal:
      a. Von Duprin, Lever Model 06.

B. Rim device, non-fire resistive rated:
   1. Manufacturers: One of the following or equal:
      a. Von Duprin Inc., Model Series 98.
      b. Sargent Essex Industries, Model Series 8800.

C. Rim device, fire-resistive rated:
   1. Manufacturers: One of the following or equal:
      a. Von Duprin Inc., Model Series 98-F.
      b. Sargent Essex Industries, Model Series 12-8800.

D. Mortise lock device, non-fire-resistive rated:
   1. Manufacturers: The following or equal:
      a. Von Duprin Inc., Model Series 9875L.

E. Mortise lock device, fire-resistive rated:
   1. Manufacturers: The following or equal:
      a. Von Duprin Inc., Model Series 9875L-F.

F. Material: As scheduled.

G. Corrosive environment provisions: Zinc dichromate coated internal parts.

2.09 MISCELLANEOUS DOOR HARDWARE

A. Wall stops: As scheduled.
   1. Manufacturers: One of the following or equal:
      a. Ives.
      b. Trimco.
      c. Rockwood.

B. Floor stops: As scheduled with strike of suitable height to compensate for clearance between door and floor.
   1. Manufacturers: One of the following or equal:
      a. Ives.
      b. Trimco.
      c. Rockwood.

C. Mechanical holders: Foot-operated plunger with instant release by touch of toe and integral spring to keep constant shoe pressure against floor; brass.
   1. Manufacturers: The following or equal:
      a. Glynn-Johnson.

D. Electromagnetic holders: Electromagnetic hold open device; able to be connected to smoke alarm system; UL BMA listed; consisting of completely flush wall-mounted electro-magnetic holder and door thru-bolted contact plate; depth as required; with minimum holding force of 25 and maximum of 40 pounds; voltage and mounting height as indicated on the Drawings; steel.
   1. Manufacturers: One of the following or equal:
      a. Rixson-Firemark Inc., Electromagnetic Door Release Model 990 Series.
      b. LCN Electromagnetic Door Release Model SEM 7800 Series.
      c. Dorma Door Controls Inc., Electromagnetic Door Holder Model Series EM.

E. Automatic flush bolts: Mortise, bar with stop-mounted coordinator and strikes; materials as scheduled.
   1. Manufacturers: One of the following or equal:
      a. Glynn-Johnson.
      b. Hager Hinge Co.

F. Kick plates: As scheduled, 0.050-inch thick, beveled edges, 10 inches high, 1-1/2 inches narrower than single doors, 1 inch narrower than leaf of door pairs.
   1. Manufacturers: One of the following or equal:
      a. Ives.
      b. Trimco.

G. Gasketing systems: As scheduled, self-adhesive silicone seal, continuous at head and jambs, rated for fire and smoke in accordance with ASTM E 283, sound rated in accordance with ASTM E 90.
   1. Manufacturers: One of the following or equal:
      a. Pemko Mfg. Co.
      b. National Guard Products Inc.
      c. Reese.

H. Weatherstripping for exterior doors and smoke, light, and sound seals for interior doors.

I. Thresholds: As scheduled, extruded aluminum, maximum 1/2-inch high, maximum slope of 1 foot in 2 feet.
   1. Manufacturers: One of the following or equal:
      a. National Guard Products Inc.
      b. Pemko Mfg. Co.

J. Dustproof strike: As scheduled.
   1. Manufacturers: One of the following or equal:
      a. Ives.
      b. Trimco.

K. Coordinator with filler bar: As scheduled, non-handed, series type length as required for door sizes indicated, complete with filer lengths as required, with mounting brackets and carry bars when required for proper operation; steel with manufacturer's standard prime finish capable of receiving painted finish.
   1. Manufacturers: One of the following or equal:
      a. Glynn-Johnson Coordinators, Model COR Series.
      b. Ives, Door Co-Ordinator, Model 900 Series.

L. Door bottoms: As scheduled, extruded aluminum with vinyl insert, surface mounted, length equal to door width minus 2 inches, automatic, recessed in bottom of door.
   1. Manufacturers: One of the following or equal:
      a. Pemko.
      b. Reese.

M. Astragals: As specified in Sections 08110 and 08212.

N. Silencers: As scheduled, pneumatic gray rubber.
   1. Manufacturers: One of the following or equal:
      a. Trimco.
      b. Ives.
      c. Rockwood.

2.10 FINISHES

A. Brass and bronze: BHMA A156.18 626 (US26D), satin chrome.

B. Steel: BHMA A156.18 652 (US26D), satin chrome.

C. Stainless steel: BHMA A156.18 630 (US32D), satin stainless steel.

D. Aluminum: BHMA A156.18 628 (US28).

E. Plastic closer covers: Spray paint to match typical door hardware finish.

F. Metal closer covers: Plate covers to match typical door hardware finish.

G. Electromagnetic hold open devices: Manufacturer's standard brushed zinc finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect doors and door frames for damage or defects and examine hardware for compatibility with receiving conditions and suitable to intended use.

B. Verify that required wall backing has been installed.

3.02 INSTALLATION

A. Install finish hardware in accordance with manufacturer's templates and instructions.

B. Accurately and properly fit hardware.

C. Securely fasten fixed parts for smooth, trouble-free, non-binding operation.

D. Fit faces of mortise parts snug and flush.

E. Ensure that operating parts move freely and smoothly without binding, sticking, or excessive clearance.

F. Protection:
   1. Protect door hardware from damage or marring of finish during construction, use strippable coatings, removable tapes, or other acceptable means.
   2. Ensure door hardware displays no evidence of finish paint after final building cleanup.

G. Latch guard and dead bolts: Install so that bolts automatically engage in keeper, whether activated by closer or by manual pressure.

H. Closers:
   1. Mount on opposite sides of corridors or vestibules, except at exterior doors.
   2. Mount for 180-degree swing wherever possible.
   3. Mount with drop plates at narrow top rail doors.
   4. Adjust to operate noiselessly and evenly.
   5. Have closer manufacturer regulate closers prior to final acceptance of project.

I. Kick plates: Screw on push side of doors, unless otherwise indicated on the Drawings.

J. Gasketing: Mount to provide complete contact between door and frame, finished floor, or both; and weathertight and/or soundproof enclosure per Door Schedule in the Drawings.

K. Thresholds:
   1. Install immediately before inspection for Substantial Completion or protect from heavy traffic damage during construction.
   2. Cope to fit door frame profile and drill to suit required flush bolts and panic bolts.
   3. Unless indicated on the Drawings to be set in grout, set in double bead of sealant, tightly fit at jambs, and make waterproof.
   4. Fasten to concrete slab with 5/16-inch stainless steel flat head countersunk machine screws and concrete anchors at 8-inch centers.

L. Silencers: Insert into predrilled holes in frames.

3.03 CONSTRUCTION KEYING

A. Insert construction inserts in cylinder cores of exterior doors, and doors requiring security and access for workman, unless otherwise directed by the ENGINEER.

3.04 ADJUSTING

A. Examine hardware in place for complete and proper installation. Lubricate bearing surfaces for proper function.

B. Replace, rework, or otherwise correct defective door hardware, including incorrect hand or function.

3.05 CLEANING

A. Remove protective materials and devices and thoroughly clean exposed surfaces of hardware.

B. Check for surface damage prior to final cleaning for acceptance of project.

3.06 PERMANENT KEYING

A. Remove construction key inserts with extractor key.

B. Inspect each lockset to ensure permanent cylinders with cores are operating satisfactorily.

C. Test keys for proper conformance with keying system.

3.07 HARDWARE SCHEDULE

A. Refer to the Door Schedule on the Drawings.

END OF SECTION

SECTION 08800

GLAZING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Glass and glazing.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01410 - Regulatory Requirements.
      b. Section 01614 - Wind Design Criteria.
      c. Section 07900 - Joint Sealants.
      d. Section 08412 - Aluminum Entrances and Storefronts.
      e. Section 08550 - Wood Windows.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. Z97.1 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.

B. ASTM International (ASTM):
   1. C 1036 - Standard Specification for Flat Glass.
   2. C 1048 - Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
   3. E 773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units.

C. Glass Association of North America (GANA):
   1. GANA Glazing Manual.

D. Insulating Glass Certification Council (IGCC):
   1. Certified Products Directory.

E. U.S. Consumer Product Safety Commission (CPSC):
   1. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.

1.03 DEFINITIONS

A. Full height windows: Windows meeting the following conditions:
   1. Lowest edge is less than 18 inches above floor.
   2. Area is greater than 9 square feet.
   3. Walking surface is on both sides either of which is within 36 inches of window.
   4. Window has no minimum 1-1/2-inch railing or mullion at from 24 to 36 inches above floor.

1.04 SUBMITTALS

A. Product data.

B. Shop drawings: Locations of glass types and typical glazing details.

C. Samples: As follows:
   1. Glazing sealants, 2-inch long beads, for color selection.
   2. Glass, 1 square foot of each type specified.

D. Certificates of compliance: Certification that tempered glass in accordance with ANSI Z97.1 and CPSC 16 CFR 1201.

E. Manufacturer's Installation Instructions.

1.05 REGULATORY REQUIREMENTS

A. As specified in Section 01410.

B. Wind loading: As specified in Section 01614.

C. Provide glass and glazing that conforms to CPSC 16 CFR, Part 1201, and exit requirements of the building code.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in manner to prevent damage.

B. Deliver and store packaged materials in original containers bearing manufacturer's name.

C. Deliver glass affixed with manufacturer's labels showing strength, grade, thickness, type and quality of glass, and for insulating glass, IGCC certification label.

D. Remove labels after installation, inspection, and final acceptance.

1.07 PROJECT CONDITIONS

A. Perform glazing when ambient air temperature is 40 degrees Fahrenheit or above.

1.08 WARRANTY

A. Warrant to replace insulating glass units that exhibit interpane dusting or misting within 10 years with new in accordance with manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 GLASS

A. Clear monolithic: ASTM C 1036, Type I, Class 1, Quality q3; minimum 1/4-inch thick.
   1. Manufacturers: One of the following or equal:
      a. PPG Industries, Inc., Cheswick, PA.
      b. Guardian Industries Corp., Auburn Hills, MI, Sunguard, Clear.

B. Tinted monolithic: ASTM C 1036, Type I, Class 2, Quality q3; tinted light bronze; minimum 1/4-inch thick.
   1. Manufacturers: The following or equal:
      a. PPG Industries, Inc., Cheswick, PA, Solarbronze.
      b. Guardian Industries Corp., Auburn Hills, MI, Sunguard, bronze.

C. Tempered: ASTM C 1048, Kind FT, Condition A, Type I, Class 1 or Class 2 as scheduled below, Quality q3; tempered without visible tong marks when installed; minimum 1/4-inch thick.
   1. Manufacturers: The following or equal:
      a. PPG Industries, Inc., Cheswick, PA, Herculite.
      b. Guardian Industries Corp., Auburn Hills, MI, equivalent product.

D. Insulating glass units: IGCC Rating Level CBA when tested in accordance with ASTM E 773 and E 774; hermetically sealed units consisting of minimum 1/4-inch thick, tinted exterior light, minimum 1/4-inch thick, clear interior light, and 1/2-inch wide air space, dehydrated with blended molecular sieve and silica gel desiccant, with metal spacer channel with bent corners and welded splice on one vertical side, and polyisobutylene primary and silicone secondary seals.
   1. Manufacturers: The following or equal:
      a. PPG Industries, Inc., Cheswick, PA, Twindow.
      b. Guardian Industries Corp., Auburn Hills, MI, equivalent product.

E. Wired monolithic: ASTM C 1036, Type II, Class 1, Form 1, Quality q8, Mesh m2, minimum 1/4-inch thick.

F. Spandrel monolithic: ASTM C 1048, Kind HS, Condition B, Class 2, Quality q3; tinted to match adjacent tinted glass; minimum 1/4-inch thick.
   1. Manufacturers: One of the following or equal:
      a. PPG Industries, Inc., Cheswick, PA, Spandrelite.
      b. Guardian Industries Corp., Auburn Hills, MI, equivalent product.

G. Mirror glass: ASTM C 1036, Type I, Class 1, Quality q1; silver coating finish of electrolytic copper plated silver coating protected by mineral oxide oil base paint; minimum 1/4 inch thick; pencil polished edges.

2.02 GLAZING MATERIALS

A. Setting blocks: Neoprene, 80 to 90 durometer.

B. Spacer blocks: 30 to 40 durometer, thickness equal or greater than insulated window thickness by minimum 6 inches long.

C. Pressure tape: Butyl rubber tape.
   1. Manufacturers: One of the following or equal:
      a. Tremco Mfg. Co., Tremco 440 Tape.
      b. 3-M Co., Weatherban 5422.

D. Sealant: Silicone.
   1. Manufacturers: One of the following or equal:
      a. General Electric Co., Silicone Construction Sealant Series SCS-1200.
      b. Dow Corning Corp., 999-A, Silicone Building and Glazing Sealant.

E. Glazing gaskets and other materials for exterior openings:
   1. Aluminum entrances and storefronts: As specified in Section 08412.
   2. Aluminum windows: As specified in Section 08550.

2.03 SOURCE QUALITY CONTROL

A. Allowable bow and warp tolerances: As measured with glass resting on edge upon two 1 inch wide supports:
   1. Typical: Maximum 1/8 inch in 48 inches.
   2. Tempered glass: Maximum allowed in accordance with ASTM C 1048.

B. Mirror setting blocks: Neoprene or other resilient blocks of 70 to 90 Shore A durometer hardness tested for compatibility with glazing sealant, properly sized for application.

C. Mirror mastic. Manufacturers: The following or equal:
   1. Palmer Co., Palmer Mastic.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine openings to receive glass for defects that would affect glass and glazing work.

B. Verify removal of rivets, screws, bolts, welding fillets, or other projections from clearances in glazing rabbets.

3.02 PREPARATION

A. Examine frames receiving glass and ensure surfaces are clean and dry.

B. Remove dust and oil from glass by wiping clean immediately before installation.

C. Verify that sealants are compatible with glazing materials.

3.03 INSTALLATION OF MONOLITHIC GLASS

A. In accordance with GANA Glazing Manual, manufacturer's instructions, and accepted shop drawings by the ENGINEER.

B. Glaze doors in closed position after hanging and adjustment.

C. Accurately size and cut glass clean for each glazing condition.
   1. Do not nip edges.

D. Cut and set glass to full fit and play consistent with expansion and contraction requirements and at exterior for absolute security under maximum high velocity wind and vacuum stresses.

E. Maintain edge clearance at least equal to glass thickness from perimeter of glass to inside of rabbet.

F. Maintain 1/8-inch clearance between faces of glass and adjacent stop or bead.

G. Maintain minimum bite of 3/8 inch.

H. Set glass as required to ensure against optical distortion.

3.04 INSTALLATION OF INSULATED GLASS UNITS

A. In accordance with GANA Glazing Manual, manufacturer's instructions, and accepted shop drawings by the ENGINEER.

B. Use wet and dry glazing method.

C. Cut glazing tape to length and set against permanent stops to project 1/16 inch above sight line.

D. Place setting blocks at quarter points and no closer than 6 inches from corners.

E. Rest glazing on setting blocks and push against tape for full contact at perimeter of unit.

F. Place glazing gasket.

G. Install removable stop with concealed leg notched to accommodate setting blocks.

H. Align top of gasket with stops.

3.05 INSTALLATION OF GASKETS

A. Gaskets: Install in accordance with manufacturer's instructions.

B. Glazing of interior metal frames: Use pressure or foamed tape and sealant as indicated as required to eliminate rattle and reduce sound transmission.

3.06 SEALANT APPLICATION

A. As specified in Section 07900, unless specifically noted otherwise.

B. Ensure protective coatings have been removed from aluminum surfaces.

C. Where setting blocks and spacer shims are required to be set in sealant, butter with sealant, place into position, and allow to set prior to installation of glass.

D. Neatly tool sealant or compound joints to compress material and improve adhesion. Repair or replace pockets exposed by tooling.

3.07 INSTALLATION OF MIRRORS

A. Comply with glass manufacturer's glazing recommendations.

B. Verify that wall surface is primed and sealed, smooth and firm, thoroughly dry. Support mirrors on setting blocks.

C. Set mirror in mastic spots or strips as recommended by mirror manufacturer. Apply mastic so it covers approximately 25 percent of mirror and so mastic does not impede ventilation.

D. Seal bottom edge and abutting materials joints.

3.08 CLEANING

A. After inspection by ENGINEER, remove labels and marks from glass in accordance with manufacturer's published recommendations.

B. Clean glass and surrounding surfaces from spatter and blemishes resulting from glazing operations.

C. Clean and polish glass inside and outside.

D. Clean glass with a soft, clean, grit-free cloth and mild soap, detergent, or slightly acidic cleaning solution.
   1. Immediately rinse with clean water and remove excess rinse water with a clean squeegee.
   2. Do not use an abrasive cleaner.

E. Remove grease and miscellaneous glazing materials with commercial solvent. Follow with normal wash and rinse.
   1. Be careful not to damage joint sealers.

3.09 GLASS AND LOCATION SCHEDULE

A. Exterior locations: Glass as follows, unless otherwise scheduled or indicated on the Drawings:
   1. Typical: Insulating, tinted.
   2. Non-fire-rated doors: Tinted and tempered.
   3. Fire-rated doors: Wired.
   4. Fire-rated windows: Wired.
   5. Entrance doors: Tempered and tinted.
   6. Windows within 48 inches of doors: Insulating, tinted, and tempered.
   7. Full height windows: Insulating, tinted, and tempered.
   8. Spandrels: Spandrel, tinted.

B. Interior locations: Glass as follows, unless otherwise scheduled or indicated on the Drawings:
   1. Typical: Clear, non-tempered.
   2. Non-fire-rated doors: Clear and tempered.
   3. Fire-rated doors: Wired.
   4. Fire-rated windows: Wired.
   5. Windows within 48 inches of doors: Clear and tempered.
   6. Full-height windows: Clear and tempered.

C. Public toilet mirrors: Mirrors, sizes as indicated on the Drawings.

END OF SECTION

SECTION 09250

GYPSUM BOARD

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Gypsum board and associated accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 09960 – High Performance Coatings.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 475 - Standard Specification for Joint compounds and Joint Tape for Finishing Gypsum Board.
   2. C 514 - Standard Specification for Nails for the Application of Gypsum Wallboard.
   3. C 557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard in Wood Framing.
   4. C 840 - Standard Specification for Application and Finishing of Gypsum Board.
   5. C 919 - Standard Practice for Use of Sealants in Acoustical Applications.
   6. C 1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Based to Wood Studs or Steel Studs.
   7. C 1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
   8. C 1396 - Standard Specification for Gypsum Board.
   9. E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   10. E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   11. E 413 - Classification for Rating Sound Insulation.

B. Gypsum Association:
   1. GA 216 - Application and Finishing of Gypsum Board.

C. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Product Data: Include manufacturer's instructions for sealing openings, penetrations, and cut edges of water-resistant gypsum board.

B. Samples: Include texture samples on minimum 6 inch square specified materials.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Provide gypsum board products from single manufacturer or from manufacturers recommended by manufacturer of gypsum board.

B. Regulatory requirements: When indicated, provide UL listed and labeled fire-rated components or by other recognized rating service.

C. Pre-installation conference: Convene with affected entities to review coordination and sequencing of construction to ensure that everything that will be concealed by gypsum board has been installed, and that chases, openings, supplementary framing and blocking have been completed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum board under cover, stacked flat, off floor.

B. Store adhesives in dry place, protected against freezing.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain uniform room temperature between 55 and 70 degrees Fahrenheit in cold weather during application of wallboard and joint treatment until joint treatment is completely dry or building is occupied.

B. Provide adequate ventilation.

PART 2 PRODUCTS

2.01 GYPSUM BOARD

A. Regular board:
   1. ASTM C 1396; 5/8 inches thick; tapered edge; Type X where required for fire rating.
   2. STC Rating: 40 or greater.

B. Moisture resistant board:
   1. ASTM C 1396; 5/8 inches thick; tapered edge; Type X where required for fire rating.

C. Insulating gypsum board: Gypsum board as specified with aluminum foil on back surface; ends square cut; tapered edges.

D. Exterior ceiling board:
   1. ASTM C 1396; 5/8 inch thick; weather and sag resistant type with water-repellent face paper; eased tapered edge.
   2. Flame spread: Maximum 20 flame spread.
   3. Smoke developed: Maximum 0 smoke developed.

2.02 ACCESSORIES

A. Square corner bead reinforcement: One of the following or equal:
   1. Dur-A-Bead as manufactured by USG or equal.
   2. Wallboard corner bead with 1-1/4 inch flanges by manufactured Gold Bond National Gypsum Company.

B. Metal casing bead: One of the following or equal:
   1. No. 200A Metal Trim manufactured by USG or equal.
   2. No. 100 wall board casing manufactured by Gold Bond National Gypsum Company.

C. Control joints: One of the following or equal:
   1. No. 093; as manufactured by USG or equal.
   2. 0.093 zinc control joint, manufactured by Gold Bond National Gypsum Company.

2.03 FASTENERS

A. Screws for metal studs: ASTM C 1002, Type S; self-drilling, self-tapping, bugle head, for use with power driven tool, minimum 1-1/4 inches long or length to suit application.

B. Screws for wood framing: ASTM C 1002, Type W, minimum 1-1/4 inches.

C. Nails: ASTM C 514; minimum 1-1/4 inch long, 12-1/2 gauge, 1/4 inch diameter head.

D. Staples: Type G; 1/2 inch; manufactured by Bostitch or equal.

2.04 LAMINATING ADHESIVES

A. Gypsum board to metal framing: One of the following or equal:
   1. Durabond 200 or 300; manufactured by USG.
   2. Sta-Smooth setting type compound by Gold Bond National Gypsum Company.

B. Gypsum board to wood framing: ASTM C 557.

C. Gypsum board to gypsum board: One of the following or equal:
   1. Durabond 600; manufactured by USG.
   2. Gypsum board laminating adhesive, manufactured by Gold Bond National Gypsum Company.

D. Gypsum board to concrete or masonry: Durabond 500; manufactured by USG or equal.

2.05 ACOUSTICAL SEALANT

A. Type: ASTM C 919; Architecture Sealant, manufactured by USG or equal.

2.06 FINISHING MATERIALS

A. Moisture or water resistant sealant:
   1. Manufacturers: One of the following or equal:
      a. USG, Sheetrock W/R Sealant.
      b. Gold Bond National Gypsum Company.

B. Joint compound and tape: ASTM C 475:
   1. Manufacturers: One of the following or equal:
      a. USG, Sheetrock joint system consisting of Sheetrock Reinforcement Tape and Sheetrock All Purpose Ready Mixed Compound for embedding, fill, and finishing.
      b. Sta-Smooth HS tape and Sta-Smooth joint compound by Gold Bond National Gypsum Company.

C. Texturing compound for walls:
   1. Manufacturers: One of the following or equal:
      a. USG, Spray Texture Finish.
      b. Perfect Spray EM, orange peel finish, by Gold Bond National Gypsum Company.

D. Texturing compound for exterior ceilings:
   1. Manufacturers: One of the following or equal.
      a. USG, Duracal Exterior Spray Texture Finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install gypsum board systems in accordance with ASTM C 840 and GA 216.

3.02 GYPSUM BOARD INSTALLATION ON WALLS

A. Cut gypsum wallboard by scoring and breaking or by sawing, working from face side.

B. Use boards of maximum practical length to minimize end joints.

C. Apply board with long dimension at right angles to framing or furring members with ends on studs. Attach upper boards first.

D. Bring boards into contact with each other but do not force into place.

E. Do not place butt ends against tapered edges.

F. Stagger end joints. Locate joint on opposite sides of partition on different studs.

G. Do not align joints with edges of openings, except for control joints. Cut board neatly to fit around openings. Locate joints at least 8 inches from openings. Center vertical end joints above openings.

H. Extend board to within 1/4 inch of floor.

I. Install fasteners proceeding from center portion of gypsum board toward edges and ends.

J. On non-fire rated walls, screw board to framing at maximum 12 inches on center in field of board at bearings and along abutting edges. Nail board to framing at maximum 8 inches on center in field at bearings and along edges.

K. On fire rated walls, nail or screw board to framing at maximum 8 inches on center in field of board at bearings and along edges, unless indicated otherwise by UL assembly requirements.

L. Drive fasteners home with maximum 1/32 inch dimple in wall surface. Avoid breaking face paper of wallboard. Remove improperly driven nails.

M. Thoroughly seal openings, penetrations and cut edges of water-resistant wallboard in accordance with manufacturer's recommendations.

N. Double stud partitions:
   1. Install strips of gypsum board 12 inches wide and of length to span partition depth by screwing to webs of opposing studs.
   2. Space strips approximately 42 inches on center.

O. Double layer partitions:
   1. Install first layer vertically then second layer horizontally.
   2. Stagger joints between layers and on opposite sides as far as is practical.

P. Sound control partitions:
   1. Apply full running beads of acoustical sealant at perimeter of sound control partitions.
   2. Apply acoustical sealant with air operated equipment.
   3. Inspect joints to receive sealant to be sure they are clean, dry and free of dust, dirt and other foreign matter.
   4. Seal around light boxes, outlets, and switches, with continuous bead of sealant.
   5. Remove excess of sealant or smears as construction progresses.

Q. Perimeter relief where non-load bearing gypsum board partitions abut structural decks or ceilings or vertical structural elements:
   1. Allow not less than 1/4 inch, nor more than 1/2 inch gap between gypsum board and structure.
   2. Finish edges of board face layer with metal casing bead and caulk space between casing bead and structure with continuous sealant bead.
   3. Attach board to studs not less than 1/2 inch below bottom edge of ceiling track flanges and to first stud adjacent to vertical tracks. Do not attach boards directly to tracks.

3.03 ADHERING GYPSUM BOARD TO MASONRY

A. Apply 1-1/2 inch diameter by 1 inch high daubs of adhesive at 6 inch on center along edges and at 12 inch on center each way on field of gypsum board.

B. Position boards vertically and 1/4 inch above floor.

C. Press boards on masonry walls within 10 minutes after applying adhesive. Apply firm hand pressure over entire board to flatten daubs of adhesive to level board.

D. Drive masonry nails through wood blocks at top and bottom of each panel to temporarily secure gypsum board. Remove nails and wood blocks when adhesive has set.

3.04 GYPSUM BOARD INSTALLATION ON SUSPENDED CEILINGS

A. Attach board to suspension system in accordance with manufacturer's instructions with:
   1. Screws at 8 inches on center to furring runners, furring ties, cross ties and wall track.
   2. Long dimension paralleling furring runners.
   3. Joints staggered.

B. Loading of suspension component may not cause deflection of more than 1/360 of span.

3.05 GYPSUM BOARD INSTALLATION ON FRAMED OR FURRED CEILINGS

A. Apply board with long dimension at right angles to framing or furring members with abutting ends and edges occurring over flanges.

B. Use board to maximum practical length to minimize end joints.

C. Cut gypsum board neatly to fit around openings.

D. Neatly fit a stagger end joints.

E. Nail field of boards at bearing, and along abutting edges at maximum 7 inches on center. Drive nails up to form slight dimple in board.

F. Screw field of boards, at bearings, and along abutting edges at maximum of 8-inches on center.

3.06 EXTERIOR SOFFIT

A. Install exterior board at right angles to supports, with end joint staggered over supports.

B. Install exterior board with 1/4 inch open space where boards abut other construction.

C. Install exterior board with 1/16 to 1/8 inch space between butt ends of boards.

D. Fasten to supports screws at 12 inches on center or nails at 8 inches on center.

3.07 INSTALLATION OF CASING AND CORNER BEADS

A. Install casing beads wherever board terminates against dissimilar materials or where edges of board are exposed. Provide:
   1. Type with face flange to receive joint compound except where semi-finishing is indicated.
   2. L-type trim where gypsum board is tightly abutted to other construction.
   3. Special kerf-type where other construction is kerfed to receive long leg of L-type trim.
   4. U-type trim where edge is exposed, revealed, gasketed, or sealant filled, including expansion joints.

B. Install metal corner bead reinforcement at outside corners.

C. Where board partitions intersect masonry walls:
   1. Provide control joints no less than 1/4 inch nor more than 3/8 inch wide between board and masonry.
   2. Finish exposed edges of board with square-nose metal casing bead and caulk space between casing bead and masonry with continuous sealant.

D. Secure corner beads with same fasteners used for applying wallboard, spaced 8 inches maximum apart on each flange of bead with nails opposite.

3.08 INSTALLATION OF CONTROL JOINTS

A. Discontinue gypsum board at control joints.

B. In ceiling construction, discontinue gypsum board and framing at control joints.

C. In partitions, discontinue gypsum board and install framing studs on each side of control joints.

D. Position control joints to intersect light fixtures, air diffusers, door openings and other areas of stress concentration.

E. Isolate gypsum board construction at following locations:
   1. Where partitions or ceilings of dissimilar construction meet and remain in same plane.
   2. Where wings of "L," "U," and "T" shaped ceiling areas are joined.
   3. When expansion or control joints occur in base building construction.

F. Space control joints at following maximum distances:
   1. Partitions: 30 feet in either direction.
   2. Interior ceilings with perimeter relief: 50 feet in either direction.
   3. Interior ceilings without perimeter relief: 30 feet in either direction.
   4. Exterior ceilings: 30 feet in either direction.

G. Extend control joints to ceiling from both corners of door frames where control joints are required.

H. Cut end joints square, align to provide neat fit.

I. Staple control joint to board at maximum 6 inches on center in each flange.

3.09 JOINT COMPOUND

A. Mix joint and topping compound in accordance with instructions on package.

B. Apply thin layer of joint compound uniformly approximately 4 inches wide over each joint.

C. Center tape over joint and embed into compound, leaving sufficient joint compound under tape to provide proper bond.

D. Reinforce wall angles and inside corner angles with tape folded to conform to angle and embedded into compound.

E. Apply skim coat of compound immediately after embedding tape.

F. After compound is thoroughly dry, cover tape with coat of joint compound or topping compound. Spread over tape and approximately 3 inches beyond edges of tape. Feathered out edge.

G. After compound is thoroughly dry, cover tape with coat of joint compound or topping compound. Spread over tape and approximately 3 inches beyond edges of previous coat. Feathered out edge.

H. Coat inside corners with minimum of one coat of joint compound or topping compound with edges feathered out.

I. Apply 3 coats of compound to nail and screw head dimples.

J. Conceal flanges of wallboard corner beads with minimum of 2 coats of compound.
   1. Apply joint compound for first coat.
   2. Apply joint compound or topping compound for second coat.
      a. Feathered out second coat approximately 9 inches on both sides of exposed metal nose of corner bead.

K. Clean excess compound from board surface.

L. Sand coats as necessary after each application of compound has dried.
   1. Leave board uniformly smooth ready to receive texturing, to extent that after painting, board shows no distinguishable difference in appearance between taped and untaped surfaces.

3.10 TEXTURING

A. Verify that gypsum board surfaces have been primed in accordance with Section 09960.

B. Clean surfaces of dust, dirt, and oil before application.

C. Mix and apply specified materials in accordance with manufacturer's recommendation to produce texture similar to accepted sample.

D. Apply orange peel or sprayed knockdown texture to interior walls.

E. Remove texture droppings or overspray from adjacent completed construction.

3.11 TOLERANCES

A. Offsets between planes of board faces: Maximum 1/16 inch.

B. Flatness: Maximum 1/8 inch in 96 inches.

C. Variation from plumb: Maximum 1/8 inch in 96 inches.

END OF SECTION

SECTION 09310

CERAMIC TILING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Thin set ceramic tile for walls and floors and associated materials.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 07900 - Joint Sealants.
      b. Section 09250 - Gypsum Board.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. A108.5 – Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
   2. A108.10 - Installation of Grout in Tilework.
   3. A118.4 – American National Standard Specifications for Latex-Portland Cement Mortar.
   4. A137.1 - American National Standard Specifications for Ceramic Tile.

B. ASTM International (ASTM):
   1. A82 - 07 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

C. Tile Council of Northern America (TCNA):
   1. TCNA Handbook for Ceramic Tile Installation.

1.03 SUBMITTALS

A. Product data: Include manufacturer's standard colors.

B. Samples: Tile and grout on minimum 24-inch square waterproof boards showing range of ENGINEER's selected colors.

1.04 MAINTENANCE

A. Extra materials: Minimum 2 percent of each type, size, and color tile installed, but not less than enough to cover 4 square foot area.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Ceramic tile: One of following or equal:
   1. American Olean Tile Company.
   2. DalTile Corp.
   3. United States Ceramic Tile Company.

B. Setting materials and grout: One of the following or equal:
   1. C-Cure.
   2. Custom Building Products.
   3. Laticrete International, Incorporated.
   4. Mapei.
   5. Upco Company.

2.02 CERAMIC TILE

A. Floor tile: ANSI A137.1, 2 inch square by 1/4 inch thick, ceramic mosaic, unglazed, colors as selected by ENGINEER.

B. Base tile: Coved, match floor tile, colors as selected by ENGINEER.

C. Wall tile: ANSI A137.1, 4 inch square by 5/16-inch thick, glazed, colors as selected by ENGINEER.

2.03 RELATED MATERIALS

A. Mortar: ANSI A118.4 latex-portland cement type.

B. Grout: ANSI A118.4, latex portland cement, factory-prepared mixes, containing fungus and bacteria inhibiting agents, colors as selected by ENGINEER.

C. Expansion joint sealant and backing: Polyurethane, specified in Section 07900.

D. Shower pans: Formed lead, copper, or non-plasticized polyethylene concealed waterproofing membrane, minimum 40-mil thick, preformed corners.

E. Mesh reinforcement for shower receptor: ASTM A 82, 2-inch-by-2-inch, 16/16-gauge galvanized welded wire mesh.

F. Gypsum board: Water-resistant type specified in Section 09250.

G. Glass mesh mortar units.

H. Floor sealer:
   1. Manufacturers: One of the following or equal:
      a. Hillyard, Seal 341.
      b. Huntington, Terrazzo Seal.
      c. Aqua Mix Inc., Penetrating Sealer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that wall surfaces to receive ceramic tile are free of coatings, oil, and wax.

B. Verify that concrete or masonry surfaces are flat within 1/8-inch in 8 feet, sloped to drain when indicated on the Drawings, clean and well cured.

C. Before shower pans are installed, verify that subflooring is smooth and continuous and free of loose objects and projections, such as nail heads and rough edges of aggregate.

D. Verify that concrete has fine broom finish, and is free of curing compounds.

3.02 INSTALLATION

A. Install in accordance with ANSI A108.5 and A108.10, TCNA Handbook, and manufacturer's instructions.

B. Carefully lay out and center tile on each wall or section of wall.

C. Rub cut tile edges smooth.

D. Make joints approximately 1/16-inch wide and accurately align.

E. Lay exposed edges with bull nose cap or edge units.

F. Lay external corners with bull nose corner units.

G. Lay vertical internal corners square.

H. Align wall, coved base, and wall joints.

I. Extend tile into recesses and under equipment and fixtures to form complete, uninterrupted covering.

J. Carefully grind and neatly fit tile around fixtures and fittings.

K. Terminate tile neatly at obstructions, edges, and corners without disrupting pattern or joint alignment.

L. Sound tile after setting.
   1. Reset hollow sounding tile.

M. Remove and replace cracked, chipped, and broken tile.

N. Provide expansion and control joints over those in walls or as otherwise recommended in TCNA Handbook.

O. Allow tile to set for at least 48 hours before grouting.

P. Clean joints and grout full depth, without voids.

Q. Tool joints barely concave, nearly flat.

R. Remove surplus mortar and grout before hardening.
   1. Keep faces of tile clean.

S. Protect tile surfaces from rapid drying by keeping moist for 72 hours minimum after tile installation.

3.03 SHOWER PANS

A. Flash and seal shower pans to floor drains.

B. Surround drains with broken pieces of tile or crushed stone to prevent mortar from blocking weep holes in drains.

C. Test for leaks by plugging floor drain and filling pan with minimum 3 inches of water and letting water stand for 24 hours.
   1. When pan does not leak, proceed with installation.

D. Install mortar bed with mesh reinforcement and tile.

3.04 TOLERANCES

A. Flatness of Tile Surface: Maximum variance of 1/8 inch from 10-foot straightedge.

3.05 CLEANING AND PROTECTION

A. Thoroughly clean tile with non-acidic masonry cleaner.

B. After cleaning:
   1. Thoroughly wash tile surfaces with clear water.
   2. Protect floors with continuous cover of non-staining, waterproof paper.
   3. Leave paper in place until final cleaning.

C. Where stains are not removable by reasonable washings, replace tile.

D. After completion of installation and just before final inspection, remove protective coverings, inspect floor surface and repair defects, then thoroughly clean, seal, and polish.

3.06 SEALING

A. Apply 2 coats of floor sealer in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09652

RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Rubber base and resilient accessories.

1.02 PRODUCT DATA AND SAMPLES

A. Product data.

B. Samples: Include 6 inch by full height or width sections for each type or color base and accessory.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Maintain substrate at minimum 70 degrees Fahrenheit 72 hours prior to, during, and for 72 hours after installation.

B. Store materials in area of application.
   1. Allow 3 days for material to reach equal temperature as area.

1.04 EXTRA MATERIALS

A. Deliver the following to OWNER when directed by the ENGINEER: Minimum 2 percent, but not less than 24 lineal feet, of each type and color of base or accessory installed.

PART 2 PRODUCTS

2.01 RESILIENT BASE AND ACCESSORIES

A. Base: Manufacturers: One of the following or equal:
   1. Flexco Co., Rubber; Coved; 1/8-inch gauge; 4-inch height; top set where abutting hard floor surfaces, flat where abutting carpeting; with pre-molded outside corners and end stops; colors as selected.
   2. Mercer Plastics Co., Inc., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

B. Reducer strips: Manufacturers: One of the following or equal:
   1. Flexco Co., No. 29; Vinyl; with butting edge height equaling abutting flooring depth; colors as selected.
   2. Mercer Plastics Co., Inc., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

C. Stair treads: Manufacturers: One of the following or equal:
   1. Flexco Co., No. 110, Standard Safety Rib Rubber; 1/8-inch gauge, 1-1/4-inch deep, square noising; 12 inches deep, trimable; colors as selected.
   2. Mercer Plastics Co., Inc., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

D. Stair treads: Square nosing, 1/4-inch thick at front edge, 1/8-inch thick at back edge. Manufacturers: One of the following or equal:
   1. AFCO, Orbitred II.
   2. Musson, No. 787 Disc-O-Tred.

E. Landing tile: Matching stair treads; approximately 24 inches square. Manufacturers: One of the following or equal:
   1. AFCO, Orbitred II.
   2. Musson, No. 788 Disc-O-Tred.

F. Stair risers: Manufacturers: One of the following or equal:
   1. Flexco Co., No. RSR; Rubber; 1/8-inch gauge, 7-inch height; colors as selected.
   2. Mercer Plastics Co., Inc., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

G. Stair stringers: Manufacturers: One of the following or equal:
   1. Flexco Co., No. STR; Rubber; 1/8-inch gauge, 10-inch height, trimable; colors as selected.
   2. Mercer Plastics Co., Inc., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

H. Cove stick: Manufacturers: One of the following or equal:
   1. Flexco Co., No. 95; Vinyl; Black.
   2. Mercer Plastics Co., Inc., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

I. Carpet reducer: Manufacturers: One of the following or equal:
   1. Mercer Plastics Co., No. 900; 3/16 by 1 inch; colors as selected.
   2. Flexco Co., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

J. Edge moldings for tackless carpet stripping: Manufacturers: One of the following or equal:
   1. Mercer Plastics Co., No. 1; Royal Custom/Edge; colors as selected.
   2. Flexco Co., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

K. Edge moldings for direct glue down carpeting: Manufacturers: One of the following or Equal:
   1. Mercer Plastics Co., No. 34, Self-Stick Quick Edge; colors as selected.
   2. Flexco Co., equivalent product.
   3. R. C. Musson Rubber Co., equivalent product.

L. Patching material:
   1. Patching compound powder: Fast-setting, cement based patching compound. Manufacturers: One of the following or equal:
      a. Mapei Arizona Inc., Tempe, AZ, Plani/Patch.
      b. Ardex Inc., Coraopolis, PA, equivalent product.
      c. Sonneborn Building Products Division, Minneapolis, MN, equivalent product.
   2. Mixing:
      a. Mix patching compound in accordance with manufacturer's instructions.
      b. Using a clean mixing container, pour 4 quarts water per 25 pounds powder and 1.4 quarts per 10 pounds powder and gradually add patching compound powder while slowly mixing.
         1) Mix to smooth lump-free consistency.
         2) Avoid prolonged mixing.
      c. Mix no more material than can be finished within 8 to 10 minutes.
      d. Do not overwater or let material slake

M. Leveling material for interior surfaces:
   1. Leveling powder: High compressive strength self-leveling underlayment. One of the following or equal:
      a. Mapei Arizona Inc., Tempe, AZ, Ultra/Plan.
      b. Ardex Inc., Coraopolis, PA, equivalent product.
      c. Sonneborn Building Products Division, Minneapolis MN, equivalent product.
   2. Mixing:
      a. Mix materials in accordance with manufacturer's instructions.
      b. Using clean mixing container, pour in 6-1/2 quarts water per 50 pounds of leveling powder.
      c. Gradually add powder.
      d. Mix with low speed mixer.
         1) Avoid air entrapment and prolonged mixing.
         2) Mix to homogeneous, almost soupy, lump-free consistency.
      e. Do not let mixture slake

N. Adhesives and wax:
   1. Types recommended by resilient material manufacturer for material types and location.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify the following:
   1. Substrate surfaces has solid backing, is smooth and flat within 1/8 inch in 10 feet.
   2. Concrete and masonry surfaces have maximum 7 percent moisture content and negative alkalinity, without carbonization or dusting.

3.02 PREPARATION

A. Prepare substrate in accordance with manufacturer's instructions.

B. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with patching and leveling materials.

C. Clean surfaces and apply, trowel, and float filler to leave smooth, flat, and hard surface.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Spread cement evenly.
   1. Ensure adhesion over entire area of sheet.
   2. Spread only enough adhesive for installation of flooring before initial set of adhesive.

C. Fit base joints tight and vertical.

D. Maintain minimum measurement of 18 inches between base joints.

E. Miter internal base corners.

F. Install pre-molded base sections with minimum 2-inch returns for external corners and exposed ends.

G. Scribe and fit base to door frames and other obstructions.

H. Where base abuts concrete stairs, install special matching base at wall above stairs. Notch to fit stair profile.
   1. Form continuous base through stair assemblies.

I. Install base straight and level to within 1/8 inch over 10 feet.

J. Install reducer strips at unprotected or exposed edges where flooring terminates.

K. Install stair treads in one piece per stair width.

L. Adhere resilient base and accessories tightly to substrate.

3.04 CLEAN-UP

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

END OF SECTION

SECTION 09656

RESILIENT SHEET FLOORING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Resilient sheet flooring.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 09652 - Resilient Base and Accessories.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   2. F 970 - Standard Test Method for Static Load Limit.

B. Resilient Floor Covering Institute (RFCI):
   1. FloorScore Program.

1.03 SUBMITTALS

A. Product data.

B. Samples: Nominal 8- by 10-inch samples of each sheet vinyl flooring in color and pattern selected.

C. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Installer qualifications: Manufacturer-approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store materials in area of application.
   1. Allow 3 days for material to reach same temperature as substrate.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain flooring substrate at minimum 65 degrees Fahrenheit for minimum 48 hours before, during, and 48 hours after installation.

1.07 EXTRA MATERIALS

A. Deliver extra resilient sheet flooring to OWNER when and where directed.
   1. Include at least 2 percent, but not less than one 6- by 10-foot sheet, of sheet flooring installed.

PART 2 PRODUCTS

2.01 MATERIALS

A. Resilient sheet flooring:
   1. Certified under the RFCI FloorScore Program.
   2. Wear layer: 50-mil thick vinyl composition wear layer with small scale chips in vinyl matrix.
   3. Backing layer: 35-mil thick filled fibrous composition backing.
   4. Static load limit: Sufficient density to withstand 500 pounds per square inch static load, as tested in accordance with ASTM F 970.
   5. Flame spread: 75 or less when tested in accordance with ASTM E 84.
   6. Manufacturers: One of the following or equal:
      a. Armstrong World Industries, Inc., Connection Corlon Series; Color as selected.
      b. Congoleum Corp., equivalent product.
      c. Flexco Company, equivalent product.
      d. Vinyl Plastics, Inc., equivalent product.

B. Patching and self-leveling materials: As specified in Section 09652.

C. Adhesives and finish materials:
   1. Types recommended by resilient flooring material manufacturer for material types and location.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect and verify the following:
   1. Smooth steel troweled substrate.
   2. Brushed clean substrate without foreign materials.
   3. Flat substrate within 1/8 inch in 10 feet.
   4. Concrete and masonry surfaces have maximum 7 percent moisture content and negative alkalinity, without carbonization or dusting.

3.02 PREPARATION

A. Prepare substrate in accordance with resilient sheet flooring manufacturer's instructions.

B. Remove subfloor ridges and bumps.
   1. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.

C. Clean floor and apply, trowel and float filler to leave smooth, flat, hard surface.
   1. Prohibit traffic until filler is cured.

D. Layout sheet flooring so minimum 1/3 full material width is installed with sheet parallel to length of room.

3.03 INSTALLATION

A. Install products in accordance with sheet vinyl flooring manufacturer's instruction.

B. Spread adhesive evenly.
   1. Ensure adhesion over entire area of sheet.
   2. Spread only enough adhesive for installation of flooring before initial set of adhesive.

C. Set flooring in place.
   1. Press with heavy roller to ensure full adhesion without bubbles or buckles.

D. Lay flooring with joints and seams parallel to building lines with minimum number of seams.

E. Double cut sheet and continuously seal seams.

F. Terminate resilient flooring at centerline of door openings where adjacent floor finish is dissimilar.

G. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

H. Remove excess adhesive from sheet floor and adjacent surfaces while laying flooring.

3.04 PROTECTION

A. Apply light coat of finish material immediately after installation.

B. Prohibit traffic from floor finish for 48 hours after installation.

3.05 CLEAN-UP

A. Protect resilient sheet flooring until final acceptance.

B. Thoroughly clean flooring and accessories and apply finish material within 1 week of inspection for final acceptance.

END OF SECTION

SECTION 09714

METAL FACED ACOUSTICAL PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Metal-faced acoustical panels, and associated materials and accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 05500 - Metal Fabrications.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C 423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   2. E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 SYSTEM DESCRIPTION

A. Sound absorption: Minimum, expressed in sabins, at following octave band center frequencies for 30- by 120-inch panels with 2-inch thick wrapped acoustical insulation, when tested in accordance with ASTM C 423:
   1. 125 hertz: 4.5.
   2. 250 hertz: 14.1.
   3. 500 hertz: 26.7.
   4. 1,000 hertz: 28.6.
   5. 2,000 hertz: 26.3.
   6. 4,000 hertz: 29.2.

B. Fire ratings: Flame spread of 10, smoke developed of 5 when tested in accordance with ASTM E 84.

1.04 SUBMITTALS

A. Product data.

B. Shop drawings: Include panel layout and mounting details.

C. Test reports: Results of sound absorption tests by independent acoustical laboratory.

D. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal-faced acoustical panels: One of the following or equal:
   1. Industrial Noise Control, Inc., Panelsorb.
   2. Eckel Industries, Inc., Cambridge, MA, Model EFP, for ceiling or wall mounting.
   3. United McGill, WA-1000.

2.02 MATERIALS

A. Metal facing: Sheet steel, minimum 22 gauge, hot-dipped galvanized, embossed.

B. Framing members: Sheet steel, minimum 20 gauge, hot-dipped galvanized.

C. Fastener inserts: Blind threaded, 1/4 inch, 20 threads per inch, minimum 200-pound tensile strength.

D. Mounting brackets: Sheet steel, minimum 18 gauge, hot-dipped galvanized, for low frequency.

E. Framing member fasteners: Bolts, Type 316 stainless steel, 1/4 inch, 20 threads per inch, 3/4-inch long.

F. Anchors: Type 316 stainless steel, suitable for application as specified in Section 05500.

G. Acoustical insulation: 2 inch thick, fine fibered, fibrous glass, having a density of not less than 1.5 pounds per cubic foot.

2.03 FABRICATION

A. Perforate metal facing with nominal 3/32-inch holes on nominal 5/32-inch staggered centers, providing minimum 33 percent open area.

B. Break facings to wrap around insulation on long edges.

C. Fabricate 20- or 30-inch wide by 120 -inch long panels.

D. Break and punch holes for fastener inserts:
   1. Panel shall be attached to the framing member using set screws or rivets.
   2. Submit a detail of the method of attachment of the framing members to the panel.

E. Wrap and secure acoustical insulation within framing members or facings.

F. Break mounting brackets.
   1. Punch fastener holes.
   2. Furnish brackets loose for fastening in field.
   3. Furnish 2 additional brackets for ceiling hung panels.

G. Finish: Manufacturer's standard polyurethane enamel; Color as selected by Engineer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install acoustical panels in accordance with manufacturer's instructions.

B. Avoid interference with doors, windows, piping, louvers, exhaust fans, control panels, light fixtures, and other electrical or mechanical equipment when locating panels.

C. Space panels equally and symmetrically whenever possible.

D. Install panels plumb or level.

E. Anchor mounting brackets to substrate and fasten mounting brackets to framing members.

END OF SECTION

SECTION 09960

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Field applied coatings.

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01140 - Work Restrictions.
   b. Section 01312 - Project Meetings.
   c. Section 01330 - Submittal Procedures.
   d. Section 01600 - Product Requirements.
   e. Section 01770 - Closeout Procedures.
   f. Section 07190 - Water Repellents.
   g. Section 15075 - Equipment Identification.
   h. Section 16075 - Electrical Identification.

1.02 REFERENCES

A. ASTM International (ASTM):
1. D 16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
2. D 4541 - Standard Test Method for Pull-off Strength of Coatings Using Portable Adhesion Testers.

B. NACE International (NACE):
1. SP0178 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
2. SP0188-06 - Discontinuity (Holiday) Testing of Protective Coatings.

C. National Association of Pipe Fabricators (NAPF):
1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings Receiving Special External Coatings and/or Special Internal Linings.

D. NSF International (NSF):
1. 61 - Drinking Water System Components - Health Effects.

E. Society for Protective Coatings (SSPC):
   1. SP COM - Surface Preparation Commentary for Steel and Concrete Substrates.
   2. SP-1 - Solvent Cleaning.
   3. SP-2 - Hand Tool Cleaning.
   4. SP-3 - Power Tool Cleaning.
   5. SP-5 - White Metal Blast Cleaning.
   6. SP-6 - Commercial Blast Cleaning.
   7. SP-7 - Brush-Off Blast Cleaning.
   8. SP-10 - Near-White Blast Cleaning.

F. U.S. Environment Protection Agency (EPA):
   1. Method 24 - Surface Coatings.

1.03 DEFINITIONS

A. Submerged metal: Steel or iron surfaces below tops of channel or structure walls which will contain water even when above expected water level.

B. Submerged concrete and masonry surfaces: Surfaces which are or will be:
   1. Underwater.
   2. In structures which normally contain water.
   3. Below tops of walls of water containing structures.

C. Exposed surface: Any metal or concrete surface, indoors or outdoors that is exposed to view.

D. Dry film thickness (DFT): Thickness of fully cured coating, measured in mils.

E. Volatile organic compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon, as determined by EPA Method 24.

F. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys except stainless steel.

G. Where SSPC surface preparation standards are specified or implied for ductile iron pipe or fittings, the equivalent NAPF surface preparation standard shall be substituted for the SSPC standard.

1.04 PERFORMANCE REQUIREMENTS

A. Coating materials shall be especially adapted for use in wastewater treatment plants.

B. Coating materials used in contact with potable water supply systems shall be certified to NSF 61.

1.05 SUBMITTALS

A. General: Submit in accordance with Section 01330.

B. Shop drawings:
   1. Schedule of proposed coating materials.
   2. Schedule of surfaces to be coated with each coating material.

C. Product Data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips:
   1. Regulatory requirements: Submit data concerning the following:
      a. Volatile organic compound limitations.
      b. Coatings containing lead compounds and PCBs.
      c. Abrasives and abrasive blast cleaning techniques, and disposal.
      d. NSF certification of coatings for use in potable water supply systems.

D. Samples: Include 8-inch square drawdowns or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.

E. Certificates: Submit in accordance with requirements for Product Data.

F. Manufacturer's Instructions: Include the following:
   1. Special requirements for transportation and storage.
   2. Mixing instructions.
   3. Shelf life.
   4. Pot life of material.
   5. Precautions for applications free of defects.
   6. Surface preparation.
   7. Method of application.
   8. Recommended number of coats.
   9. Recommended dry film thickness (DFT) of each coat.
   10. Recommended total dry film thickness (DFT).
   11. Drying time of each coat, including prime coat.
   12. Required prime coat.
   13. Compatible and non-compatible prime coats.
   14. Recommended thinners, when recommended.
   15. Limits of ambient conditions during and after application.
   16. Time allowed between coats (minimum and maximum).
   17. Required protection from sun, wind, and other conditions.
   18. Touch-up requirements and limitations.
   19. Minimum adhesion of each system submitted in accordance with ASTM D 4541.

G. Manufacturer's Representative’s Field Reports.

H. Operations and Maintenance Data: Submit as specified in Section 01770.
   1. Reports on visits to project site to view and approve surface preparation of structures to be coated.
   2. Reports on visits to project site to observe and approve coating application procedures.
   3. Reports on visits to coating plants to observe and approve surface preparation and coating application on items that are “shop coated.”

I. Quality Assurance Submittals:
   1. Quality Assurance plan.
   2. Qualifications of coating applicator including List of Similar Projects.
   3. UV exposure certification of top coat(s) for vinyl ester.
   4. Top coat(s) for vinyl ester should also be chemical resistant.
   5. Coating Applicator Licensing: Submit approval and licensing by manufacturer of vinyl ester coating system that Applicator is approved to apply this product.

J. Certifications:
   1. Submit notarized certificate that:
      a. All paints and coatings to be used on this project comply with current federal, state, and local VOC regulations.
   2. California certifications:
      a. All paints and coatings to be used on this project comply with the current VOC regulations of the State of California Air Management District in which the coatings will be used.

1.06 QUALITY ASSURANCE

A. Applicator qualifications:
   1. Minimum of 5 years experience applying specified type or types of coatings under conditions similar to those of the Work:
      a. Provide qualifications of applicator and references listing 5 similar projects completed in the past 2 years.
   2. Manufacturer approved applicator when manufacturer has approved applicator program.
   3. Approved and licensed by vinyl ester coating manufacturer to apply vinyl ester coating system.
   4. Approved and licensed by polymorphic polyester resin manufacturer to apply polymorphic polyester resin coating system.
   5. Approved and licensed by elastomeric polyurethane (100-percent solids) manufacturer to apply 100-percent solids elastomeric polyurethane system.
   6. Applicator of off-site application of coal tar epoxy shall have successfully applied coal tar epoxy on similar surfaces in material, size, and complexity as on the Project.

B. Regulatory requirements: Comply with governing agencies regulations by using coatings that do not exceed permissible volatile organic compound limits and do not contain lead:
   1. Do not use coal tar epoxy in contact with drinking water or exposed to ultraviolet radiation.

C. Certification: Certify that applicable pigments are resistant to discoloration or deterioration when exposed to hydrogen sulfide and other sewage gases and product data designates coating as suitable for wastewater service.

D. Field samples:
   1. Prepare and coat a minimum 100-square-foot area between corners or limits such as control or construction joints of each system.
   2. Approved field sample may be part of Work.
   3. Obtain approval before painting other surfaces.

E. Pre-installation conference: Conduct as specified in Section 01312.

F. Compatibility of coatings: Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.

G. Services of coating manufacturer's representative: Arrange for coating manufacturer's representative to attend pre-installation conferences. Make periodic visits to the project site to provide consultation and inspection services during surface preparation and application of coatings, and to make visits to coating plants to observe and approve surface preparation procedures and coating application of items to be "shop primed and coated."

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products as specified in Section 01600.

B. Remove unspecified and unapproved paints from Project site immediately.

C. Deliver new unopened containers with labels identifying the manufacturer's name, brand name, product type, batch number, date of manufacturer, expiration date or shelf life, color, and mixing and reducing instructions.
   1. Do not deliver materials aged more than 12 months from manufacturing date.

D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.

E. Take precautions to prevent fire and spontaneous combustion.

1.08 PROJECT CONDITIONS

A. Surface moisture contents: Do not coat surfaces that exceed manufacturer specified moisture contents, or when not specified by the manufacturer, the following moisture contents:
   1. Plaster and gypsum wallboard: 12 percent.
   2. Masonry, concrete, and concrete block: 12 percent.
   3. Interior located wood: 15 percent.
   4. Concrete floors: 7 percent.

B. Do not apply coatings:
   1. Under dusty conditions or adverse environmental conditions, unless tenting, covers, or other such protection is provided for structures to be coated.
   2. When light on surfaces measures less than 15 foot-candles.
   3. When ambient or surface temperature is less than 55 degrees Fahrenheit unless manufacturer allows a lower temperature.
   4. When relative humidity is higher than 85 percent.
   5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
   6. When surface temperature exceeds the manufacturer's recommendation.
   7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
   8. Apply clear finishes at minimum 65 degrees Fahrenheit.

C. Provide fans, heating devices, dehumidifiers, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.

D. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 55 degrees Fahrenheit for 24 hours before, during and 48 hours after application of finishes.

1.09 SEQUENCING AND SCHEDULING

A. Sequence and Schedule: As specified in Section 01140.

1.10 MAINTENANCE

A. Extra materials: Deliver as specified in Section 01770. Include minimum 1 gallon of each type and color of coating applied:
   1. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory.
   2. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type, and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Special coatings: One of the following or equal:
   1. Carboline: Carboline, St. Louis, MO.
   2. Ceilcote: International Protective Coatings, Berea, OH.
   3. Dampney: The Dampney Company, Everett, MA.
   4. Devoe: International Protective Coatings, Louisville, KY.
   5. Dudick: Dudick, Inc., Streetsboro, OH.
   6. GET: Global Eco Technologies, Pittsburg, CA.
   7. Henkel: Henkel North America, Madison Heights MI.
   8. IET: Integrated Environmental Technologies, Santa Barbara, CA.
   9. PPC: Polymorphic Polymers Corp., N. Miami, FL.
   10. PPG Amercoat: PPG Protective & Marine Coatings, Brea, CA.
   11. Rustoleum: Rustoleum Corp., Sommerset, NJ.
   12. Sanchem: Sanchem, Chicago, IL.
   13. Superior: Superior Environmental Products, Inc., Addison, TX.
   14. S-W: Sherwin-Williams Co., Cleveland, OH.
   15. Tnemec: Tnemec Co., Kansas City, MO.
   16. Wasser: Wasser High Tech Coatings, Kent, WA.
   17. ZRC: ZRC Worldwide Innovative Zinc Technologies, Marshfield, MA.

2.02 PREPARATION AND PRETREATMENT MATERIALS

A. Metal pretreatment: As manufactured by one of the following or equal:
   1. Henkel: Galvaprep 5.
   2. International: AWLGrip Alumiprep 33.

B. Surface cleaner and degreaser: As manufactured by one of the following or equal:
   1. Carboline Surface Cleaner No.3.
   2. Devoe: Devprep 88.
   3. S-W: Clean and Etch.

2.03 COATING MATERIALS

A. Alkali resistant bitumastic: As manufactured by one of the following or equal:
   1. As specified for Coal Tar Epoxy Substitute.

B. Wax coating: As manufactured by the following or equal:
   1. Sanchem: No-Ox-Id A special.

C. Epoxy repair mortar: As manufactured by one of the following or equal.
   1. PPG: Amercoat 114.
   2. Tnemec: Series 218 Mortarclad.

D. 100-percent solids epoxy sealer: As manufactured by one of the following or equal:
   1. PPG: Amerlock Sealer.

E. 100-percent solids modified epoxy: As manufactured by one of the following or equal:
   1. PPG: Novagard 840.
   2. Tnemec: Series 22 Epoxoline.

F. High solids epoxy (self priming) not less than 72 percent solids by volume: As manufactured by one of the following or equal:
   1. Carboline: Carboguard 891.
   2. Devoe: Bar Rust 233H.
   3. PPG Amercoat: Amerlock 2.
   4. S-W: Macropoxy 646.
   5. Tnemec: HS Epoxy Series 104.

G. Aliphatic or aliphatic-acrylic polyurethane: As manufactured by one of the following or equal:
   1. Carboline: Carbothane 134 VOC.
   2. Devoe: Devthane 379.
   3. PPG Amercoat: Amershield VOC.
   4. Non-submerged: S-W High Solids Polyurethane CA.
   5. Tnemec: Endura-Shield II Series 1075 (U).

H. Polymorphic polyester resin coating system: 2 component, modified styrene based thermoset resin, EPA approved for potable water, with 100-percent solids and maximum 10 grams per liter volatile organic compounds. As manufactured by one of the following or equal:
   1. IET: IET Prime Coat DS-101, Intermediate Coat DS-301, and Finish Coat DS-401.
   2. PPC: PPC Prime Coat, IC-Filler Coat, and FC-Final Coat.

I. High temperature coating 150 to 350 degrees Fahrenheit: As manufactured by one of the following or equal:
   1. Carboline: Thermaline 4900.

2. Dampney: Thermalox 245 Silicone - Zinc Dust.
3. PPG Amercoat: Amerlock 2/400 GFK.

J. High temperature coating 400 to 1,000 degrees Fahrenheit (dry): As manufactured by one of the following or equal:
1. Carboline: Thermaline 4700.
2. Dampney: Thermolox 230C Series Silicone.
3. Devoe: HT-12, High Heat Silicone.

K. High temperature coating up to 1,400 degrees Fahrenheit: As manufactured by the following or equal:
1. Dampney: Thermalox 240 Silicone Ceramix.

L. Asphalt varnish: AWWA C 500.

M. Coal tar: Where coal tar, coal tar epoxy, or coal tar mastic are specified or indicated on the Drawings, use coal tar epoxy substitute in their place. Coal tar shall not be allowed.

N. Coal tar epoxy substitute: As manufactured by one of the following or equal:
1. Devoe: Devtar 5A HS.
2. S-W: Macropoxy 646 Black.

O. Vinyl ester: Glass mat reinforced, total system 125 mils DFT. As manufactured by one of the following and no equal:
1. Carboline: Semstone 870.
2. Ceilcote: 6640 Ceilcrete.
3. Dudick: Protecto-Flex 800.

P. Elastomeric polyurethane, 100-percent solids, ASTM D 16, Type V, (Urethane P): As manufactured by the following or equal:
1. GET: Endura-Flex EF-1988.

Q. Concrete floor coatings: As manufactured by one of the following or equal:
1. Carboline: Semstone 140SL.
2. Devoe: Devran 124.
3. Dudick: Polymer Alloy 1000.
4. Tnemec: Tneme-Glaze Series 282.

R. Waterborne acrylic emulsion: As manufactured by one of the following or equal:
1. S-W: DTM Acrylic B66W1.
2. Tnemec: Tneme-Cryl Series 6.

S. Galvanizing Zinc Compound: As manufactured by one of the following or equal:
1. ZRC: Cold Galvanizing Compound.

2.04 MIXES

A. Mix in accordance with manufacturer's instructions.

PART 3 EXECUTION

3.01 GENERAL PROTECTION

A. Protect adjacent surfaces from coatings and damage. Repair damage resulting from inadequate or unsuitable protection:

B. Protect adjacent surfaces not to be coated from spatter and droppings with drop cloths and other coverings:
   1. Mask off surfaces of items not to be coated or remove items from area.

C. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being coated and in particular, surfaces within storage and preparation area.

D. Place cotton waste, cloths, and material which may constitute fire hazard in closed metal containers and remove daily from site.

E. Remove electrical plates, surface hardware, fittings, and fastenings, prior to application of coating operations. Carefully store, clean, and replace on completion of coating in each area. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

3.02 GENERAL PREPARATION

A. Prepare surfaces in accordance with coating manufacturer's instructions, unless more stringent requirements are specified in this Section.

B. Protect following surfaces from abrasive blasting by masking, or other means:
   1. Threaded portions of valve and gate stems, grease fittings, and identification plates.
   2. Machined surfaces for sliding contact.
   3. Surfaces to be assembled against gaskets.
   4. Surfaces of shafting on which sprockets are to fit.
   5. Surfaces of shafting on which bearings are to fit.
   6. Machined surfaces of bronze trim, including those slide gates.
   7. Cadmium-plated items except cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment requiring abrasive blasting.
   8. Galvanized items, unless scheduled to be coated.

C. Protect installed equipment, mechanical drives, and adjacent coated equipment from abrasive blasting to prevent damage caused by entering sand or dust.

D. Concrete:
   1. Allow new concrete to cure for minimum of 28 days before coating.
   2. Clean concrete surfaces of dust, mortar, fins, loose concrete particles, form release materials, oil, and grease. Fill voids so that surface is smooth. Etch or brush off-blast clean in accordance with SSPC SP-13 to provide surface profile equal to 40 to 60-grit sandpaper, or as recommended by coating manufacturer. All concrete surfaces shall be vacuumed clean prior to coating application.

E. Ferrous metal surfaces:
   1. Remove grease and oil in accordance with SSPC SP-1.
   2. Remove rust, scale, and welding slag and spatter, and prepare surfaces in accordance with appropriate SSPC standard as specified.
   3. Abrasive blast surfaces prior to coating.
      a. When abrasive blasted surfaces rust or discolor before coating, abrasive blast surfaces again to remove rust and discoloration.
      b. When metal surfaces are exposed because of coating damage, abrasive blast surfaces and feather in to a smooth transition before touching up.
      c. Ferrous metal surfaces not to be submerged: Abrasive blast in accordance with SSPC SP-10, unless blasting may damage adjacent surfaces, prohibited or specified otherwise. Where not possible to abrasive blast, power tool clean surfaces in accordance with SSPC SP-3.
      d. Ferrous metal surfaces to be submerged: Unless specified otherwise, abrasive blast in accordance with SSPC SP-5 to clean and provide roughened surface profile of not less than 2 mils and not more than 4 mils in depth when measured with Elcometer 123, or as recommended by the coating manufacturer.
   4. All abrasive blast cleaned surfaces shall be blown down with clean dry air and or vacuumed.

F. Ductile iron pipe and fittings to be lined or coated: Abrasive blast clean in accordance with NAPF 500-03.

G. Sherardized, aluminum, copper, and bronze surfaces: Prepare in accordance with coating manufacturer's instructions.

H. Galvanized surface:
   1. Degrease or solvent clean (SSPC SP-1) to remove oily residue.
   2. Power tool or hand tool clean or whip abrasive blast.
   3. Test surface for contaminants using copper sulfate solution.
   4. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded physically, such as bolts, nuts, or preformed channels.

I. Shop primed metal:
   1. Certify that primers applied to metal surfaces in the shop are compatible with coatings to be applied over such primers in the field.
   2. Remove shop primer from metal to be submerged by abrasive blasting in accordance with SSPC SP-10, unless greater degree of surface preparation is required by coating manufacturer’s representative.
   3. Correct abraded, scratched, or otherwise damaged areas of prime coat by sanding or abrasive blasting to bare metal in accordance with SSPC SP-2, SP-3, or SP-6, as directed by the Engineer.
   4. When entire shop priming fails or has weathered excessively (more than 25 percent of the item), or when recommended by coating manufacturer’s representative, abrasive blast shop prime coat to remove entire coat and prepare surface in accordance with SSPC SP-10.
   5. When incorrect prime coat is applied, remove incorrect prime coat by abrasive blasting in accordance with SSPC SP-10.

6. When prime coat not authorized by Engineer is applied, remove unauthorized prime coat by abrasive blasting in accordance with SSPC SP-10.
7. Shop applied bituminous paint or asphalt varnish: Abrasive blast clean shop applied bituminous paint or asphalt varnish from surfaces scheduled to receive non-bituminous coatings.

J. Cadmium-plated, zinc-plated, or sherardized fasteners:
1. Abrasive blast in same manner as unprotected metal when used in assembly of equipment designated for abrasive blasting.

K. Abrasive blast components to be attached to surfaces which cannot be abrasive blasted before components are attached.

L. Grind sharp edges to approximately 1/16-inch radius before abrasive blast cleaning.

M. Remove and grind smooth all excessive weld material and weld spatter before blast cleaning in accordance with NACE SP0178.

N. PVC and FRP Surfaces:
1. Prepare surfaces to be coated by light sanding (de-gloss) and wipe-down with clean cloths, or by solvent cleaning in strict accordance with coating manufacturer's instructions.

O. Cleaning of previously coated surfaces:
1. Utilize cleaning agent to remove soluble salts such as chlorides and sulfates from concrete and metal surfaces:
   a. Cleaning agent: Biodegradable non-flammable and containing no volatile organic compounds.
   b. Manufacturer: The following or equal:
      1) Chlor-Rid International, Inc.
2. Cleaning of surfaces utilizing the decontamination cleaning agent may be accomplished in conjunction with abrasive blast cleaning, steam cleaning, high-pressure washing, or hand washing as approved by the coating manufacturer's representative and the Engineer.
3. Test cleaned surfaces in accordance with the cleaning agent manufacturer's instructions to ensure all soluble salts have been removed. Additional cleaning shall be carried out as necessary.
4. Final surface preparation prior to application of new coating system shall be made in strict accordance with coating manufacturer's printed instructions.

3.03 MECHANICAL AND ELECTRICAL EQUIPMENT PREPARATION

A. Identify equipment, ducting, piping, and conduit as specified in Section 15075 and Section 16075.

B. Remove grilles, covers, and access panels for mechanical and electrical system from location and coat separately.

C. Prepare and finish coat-primed equipment with color selected by the Engineer.

D. Prepare and prime and coat insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are covered with prefinished coating.

E. Replace identification markings on mechanical or electrical equipment when coated over or spattered.

F. Prepare and coat interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.

G. Prepare and coat dampers exposed immediately behind louvers, grilles, convector and baseboard cabinets to match face panels.

H. Prepare and coat exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.

I. Prepare and coat both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

J. Color code equipment, piping, conduit, and exposed ductwork and apply color banding and identification, such as flow arrows, naming and numbering, in accordance with Contract Documents.

3.04 GENERAL APPLICATION REQUIREMENTS

A. Apply coatings in accordance with manufacturer's instructions.

B. Coat metal unless specified otherwise:
   1. Aboveground piping to be coated shall be empty of contents during application of coatings.

C. Verify metal surface preparation immediately before applying coating in accordance with SSPC SP COM.

D. Allow surfaces to dry, except where coating manufacturer requires surface wetting before coating.

E. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with manufacturer's recommended special primer.

F. Prime shop primed metal surfaces. Spot prime exposed metal of shop primed surfaces before applying primer over entire surface.

G. Multiple coats:
   1. Apply minimum number of specified coats.
   2. Apply additional coats when necessary to achieve specified thicknesses.
   3. Apply coats to thicknesses specified, especially at edges and corners.
   4. When multiple coats of same material are specified, tint prime coat and intermediate coats with suitable pigment to distinguish each coat.
   5. Lightly sand and dust surfaces to receive high gloss finishes, unless instructed otherwise by coating manufacturer.
   6. Dust coatings between coats.

H. Coat surfaces without drops, overspray, dry spray, runs, ridges, waves, holidays, laps, or brush marks.

I. Remove spatter and droppings after completion of coating.

J. Apply coating by brush, roller, trowel, or spray, unless particular method of application is required by coating manufacturer's instructions or these Specifications.

K. Plural component application: Drums shall be premixed each day. All gauges shall be working order prior to the start of application. Ratio checks shall be completed prior to each application. A spray sample shall be sprayed on plastic sheeting to insure set time is complete prior to each application. Hardness testing shall be preformed after each application.

L. Spray application:
   1. Stripe coat edges, welds, nuts, bolts, difficult to reach areas by brush before beginning spray application, as necessary, to ensure specified coating thickness along edges.
   2. When using spray application, apply coating to thickness not greater than that recommended in coating manufacturer's instructions for spray application.
   3. Use airless spray method, unless air spray method is required by coating manufacturer's instruction or these Specifications.
   4. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist, fumes, or overspray.

M. Drying and recoating:
   1. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.
   2. For submerged service the Contractor shall provide a letter to the Engineer that the lining system is fully cured and ready to be placed into service.
   3. Limit drying time to that required by these Specifications or coating manufacturer's instructions.
   4. Do not allow excessive drying time or exposure which may impair bond between coats.
   5. Recoat epoxies within time limits recommended by coating manufacturer.
   6. When time limits are exceeded, abrasive blast clean and de-gloss clean prior to applying another coat.
   7. When limitation on time between abrasive blasting and coating cannot be met before attachment of components to surfaces which cannot be abrasive blasted, coat components before attachment.
   8. Ensure primer and intermediate coats of coating are unscarred and completely integral at time of application of each succeeding coat.
   9. Touch up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.
   10. Leave no holidays.
   11. Sand and feather in to a smooth transition and recoat and recoat scratched, contaminated, or otherwise damaged coating surfaces so damages are invisible to naked eye.

N. Concrete:
   1. Apply first coat (primer) only when surface temperature of concrete is decreasing in order to eliminate effects of off-gassing on coating.

3.05 ALKALI RESISTANT BITUMASTIC

A. Preparation:
   1. Prepare surfaces in accordance with general preparation requirements.

B. Application:
   1. Apply in accordance with general application requirements and as follows:
      a. Apply at least 2 coats, 8 to 14 mils dry film thickness each.

3.06 WAX COATING

A. Preparation:
   1. Prepare surfaces in accordance with general preparation requirements.

B. Application:
   1. Apply in accordance with general application requirements and as follows:
      a. Apply at least 1/32-inch thick coat with 2-inch or shorter bristle brush.
      b. Thoroughly rub coating into metal surface with canvas covered wood block or canvas glove.

3.07 100-PERCENT SOLIDS MODIFIED EPOXY SYSTEM

A. Preparation:
   1. Prepare surfaces in accordance with general preparation requirements for concrete and in accordance with coating manufacturer's recommendations.

B. Application:
   1. Trowel apply epoxy repair mortar to fill rough and irregular concrete surfaces to be coated.
   2. Seal surfaces with epoxy sealer if required by coatings manufacturer.
   3. Spray apply 100-percent solids modified epoxy 35 mils DFT.

3.08 HIGH SOLIDS EPOXY SYSTEM

A. Preparation:
   1. Prepare surfaces in accordance with general preparation requirements and as follows:
      a. Abrasive blast ferrous metal surfaces to be submerged at jobsite in accordance with SSPC SP-5 prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP-10.
      b. Abrasive blast non-submerged ferrous metal surfaces at jobsite in accordance with SSPC SP-10, prior to coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP-6.
      c. Abrasive blast clean ductile iron surfaces at jobsite in accordance with SSPC SP-7.

B. Application:
   1. Apply coatings in accordance with general application requirements and as follows:
      a. Apply minimum 2-coat system with minimum total dry film thickness (DFT) of 12 mils.

b. Recoat or apply succeeding epoxy coats within time limits recommended by manufacturer. Prepare surfaces for recoating in accordance with manufacturer's instructions.
c. Coat metal to be submerged before installation when necessary, to obtain acceptable finish, and to prevent damage to other surfaces.
d. Coat entire surface of support brackets, stem guides, pipe clips, fasteners, and other metal devices bolted to concrete.
e. Coat surface of items to be exposed and adjacent 1 inch to be concealed when embedded in concrete or masonry.

3.09 HIGH SOLIDS EPOXY AND POLYURETHANE COATING SYSTEM

A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements and as follows:
a. Prepare concrete surfaces in accordance with general preparation requirements.
b. Touch up shop primed steel and miscellaneous iron.
c. Abrasive blast ferrous metal surfaces at jobsite prior to coating. Abrasive blast clean rust and discoloration from surfaces.
d. Degrease or solvent clean, whip abrasive blast, power tool, or hand tool clean galvanized metal surfaces.
e. Lightly sand (de-gloss) fiberglass and poly vinyl chloride (PVC) pipe to be coated and wipe clean with dry cloths, or solvent clean in accordance with coating manufacturer's instructions.
f. Abrasive blast clean ductile iron surfaces.

B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
a. Apply 3 coat system consisting of:
1) Primer: 4 to 5 mils dry film thickness high solids epoxy.
2) Intermediate coat: 4 to 5 mils dry film thickness high solids epoxy.
3) Topcoat: 2.5 to 3.5 mils dry film thickness aliphatic or aliphatic-acrylic polyurethane topcoat.
2. Recoat or apply succeeding epoxy coats within 30 days or within time limits recommended by manufacturer, whichever is shorter. Prepare surfaces for recoating in accordance with manufacturer's instructions.

3.10 POLYMORPHIC POLYESTER RESIN SYSTEM

A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements and as follows:
2. Prepare concrete to obtain clean, open pore with exposed aggregate in accordance with manufacturer's instructions.
3. Prepare ferrous metal surfaces in accordance with SSPC SP-5, with coating manufacturer's recommended anchor pattern.
4. Complete abrasive blast cleaning within 6 hours of applying prime coat. Dew point shall remain 5 degrees above dew point 8 hours after application of coating. When cleaned surfaces rust or discolor, abrasive blast surfaces in accordance with SSPC SP-5.

5. When handling steel, wear gloves to prevent hand printing.
6. Adjust pH of concrete to within 5.5 to 8.0 before applying prime coat.

B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
2. Apply minimum dry film thickness system consisting of primer, tie coat and top coat in accordance with manufacturer's instructions as follows:
   a. Steel: 35 mils.
   b. Concrete: 45 mils.

3.11 HIGH TEMPERATURE COATING

A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements and as follows:
   a. Abrasive blast surface in accordance with SSPC SP-10.

B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
   a. Apply number of coats in accordance with manufacturer's instructions.

3.12 ASPHALT VARNISH

A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements.

B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
   a. Apply minimum 2 coats.

3.13 PROTECTIVE COAL TAR

A. Preparation:
1. Prepare surfaces in accordance with general preparation coal tar requirements.

B. Application:
1. Apply coatings in accordance with general application requirements and as follows:
   a. Apply minimum 20 mils dry film thickness coating.

3.14 COAL TAR EPOXY SUBSTITUTE

A. Preparation:
1. Prepare surfaces in accordance with general preparation requirements and in accordance with the coating manufacturer's printed instructions.

B. Application:
1. Apply 2 coats at 6 mils to 8 mils each, for a minimum total DFT of 12 mils.

3.15 VINYL ESTER

A. Preparation:
   1. Prepare surfaces in accordance with coating manufacturer's recommendations and as directed and approved by coating manufacturer's representative.

B. Application:
   1. Apply prime coat, as required by coating manufacturer, base coat, glass mat, and topcoat to total dry film thickness of 125 mils minimum:
      a. Final topcoat on floors shall include non-skid surface, applied in accordance with manufacturer's instructions.
   2. Perform high voltage holiday detection test in accordance with SP0188-06, over 100 percent of coated surface areas to ensure pinhole free finished coating system.
   3. All work shall be accomplished in strict accordance with coating manufacturer's instructions and under direction of coating manufacturer's representative.

3.16 ELASTOMERIC POLYURETHANE (100-PERCENT SOLIDS)

A. Preparation:
   1. Prepare surfaces in strict accordance with coating manufacturer's instructions and as directed and approved by coating manufacturer's representative.

B. Application:
   1. Apply epoxy primer at DFT of 1 to 2 mils, in strict accordance with manufacturer's instructions.
   2. Apply polyurethane coating at minimum total DFT as follows:
      a. Steel: 60 mils DFT.
      b. Ductile iron and ductile iron pipe coating and lining: 30 mils DFT.
      c. Concrete: 120 mils DFT.
      d. Or as recommended by the coating manufacturer and accepted by the Engineer.
   3. For concrete application, provide saw cutting for coating terminations in strict accordance with manufacturer's instructions:
      a. For application to damaged concrete, receive additional direction from the Engineer.
   4. Perform high voltage holiday detection test in accordance with SP0188-06, over 100 percent of coated surface areas to ensure pinhole free finished coating system.

3.17 CONCRETE FLOOR COATINGS

A. Preparation:
   1. Prepare surfaces in accordance with general application requirements and in strict accordance with coating manufacturer’s instructions.

B. Application:
   1. Apply primer if required by coating manufacturer.
   2. Apply 1 or more coats as recommended by coating manufacturer to receive a minimum total dry film thickness of 25 mils, color as selected by Owner.

C. Final topcoat shall include non-skid surface, applied in strict accordance with coating manufacturer's instructions.

3.18 WATERBORNE ACRYLIC EMULSION

A. Preparation:
   1. Remove all oil, grease, dirt, and other foreign material by Solvent Cleaning in accordance with SSPC SP-1.
   2. Lightly sand all surfaces and wipe thoroughly with clean cotton cloths before applying coating.

B. Application:
   1. Apply 2 or more coats to obtain a minimum dry film thickness (DFT) of 5.0 mils.

3.19 FIELD QUALITY CONTROL

A. Each coat will be inspected. Strip and remove defective coats, prepare surfaces and recoat. When approved, apply next coat.

B. Control and check dry film thicknesses and integrity of coatings.

C. Measure dry film thickness with calibrated thickness gauge.

D. Dry film thicknesses on ferrous-based substrates may be checked with Elcometer Type 1 Magnetic Pull-Off Gage or Positector 6000.

E. Verify coat integrity with low-voltage sponge or high-voltage spark holiday detector, for submerged service, in accordance with SP0188 06. Allow Engineer to use detector for additional checking.

F. Check wet film thickness before coal tar epoxy coating cures on concrete or non-ferrous metal substrates.

G. Arrange for services of coating manufacturer's field representative to provide periodic field consultation and inspection services to ensure proper surface preparation of facilities and items to be coated, and to ensure proper application and curing:
   1. Notify Engineer 24 hours in advance of each visit by coating manufacturer's representative.
   2. Provide Engineer with a written report by coating manufacturer's representative within 48 hours following each visit.

3.20 SCHEDULE OF ITEMS NOT REQUIRING COATING

A. General: Unless specified otherwise, the following items do not require coating:
   1. Items that have received final coat at factory and not listed to receive coating in field.
   2. Aluminum, brass, bronze, copper, plastic (except PVC pipe), rubber, stainless steel, chrome, Everdur, or lead.
   3. Buried or encased piping or conduit.
   4. Exterior concrete.

5. Galvanized electrical conduits, galvanized pipe trays, galvanized cable trays, and other galvanized items:
    a. Areas on galvanized items or parts where galvanizing has been damaged during handling or construction shall be repaired as follows:
        1) Clean damaged areas by SSPC SP-1, SP-2, SP-3, or SP-7 as required.
        2) Apply 2 coats of a Galvanizing Zinc Compound in strict accordance with manufacturer's instructions.
6. Grease fittings.
7. Fiberglass ducting or tanks in concealed locations.
8. Steel to be encased in concrete or masonry.

3.21 SCHEDULE OF SURFACES TO BE COATED IN THE FIELD

A. In general, apply coatings to steel, iron, galvanized surfaces, and wood surfaces unless specified or otherwise indicated on the Drawings. Coat concrete surfaces and anodized aluminum only when specified or indicated on the Drawings. Color coat all piping as specified in Section 15075.

B. Following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Verify questionable surfaces.

C. Concrete:
1. High solids epoxy:
    a. Safety markings.
2. 100-percent solids modified epoxy system:
    a. UV Facility: All concrete surfaces inside three UV channels and the common effluent channel including wall surfaces, top of wall surfaces, and floors.
3. Polymorphic polyester resin system:
    a. None.
4. Coal tar epoxy:
    a. None.
5. Coal tar epoxy substitute:
    a. None.
6. Vinyl ester:
    a. Secondary containment: All concrete surfaces inside chemical containment areas in Chemical Facility and Dewatering Building, including inside wall surfaces, top of wall surfaces, sump area, tank fill area, including equipment pads, tote pads, and tank pads.
        1) Suitable for 72 hours submerged in:
            a) 12 percent to 15 percent sodium hypochlorite.
            b) 48.5 percent aluminum sulfate.
            c) Cationic polymer.
        2) Concrete floor surfaces in chemical containment areas shall have a non-skid surface.
    b. UV Facility: Concrete floor surfaces in UV Bank washdown area.
        1) Concrete floor surfaces in UV Bank washdown area shall have a non-skid surface.
7. Elastomeric polyurethane (100-percent solids):
    a. None.

8. Concrete floor coating:
    a. Concrete floor surface inside Server Room at Administration Building.
    b. All concrete floor surfaces at Maintenance Building, including the outside covered area but excluding inside the office and the restroom.
9. Concrete masonry units:
    a. Apply water repellent as specified in Section 07190.

D. Metals:
1. Alkali resistant bitumastic:
    a. Aluminum surfaces to be placed in contact with wood, concrete, or masonry.
2. Wax coating:
    a. None.
3. High solids epoxy and polyurethane system: Interior and exterior non-immersed ferrous metal surfaces including:
    a. Doors, doorframes, ventilators, louvers, grilles, exposed sheet metal, and flashing.
    b. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports.
    c. Motors and motor accessory equipment.
    d. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment.
    e. Valve and gate operators and stands.
    f. Structural steel including galvanized structural steel.
        1) Exposed metal decking.
    g. Monorail, bridge crane, and hoist rails.
    h. Exterior of tanks and other containment vessels.
    i. Mechanical equipment supports, drive units, and accessories.
    j. Pumps not submerged.
    k. Other miscellaneous metals.
4. High solids epoxy system:
    a. Field priming of ferrous metal surfaces with defective shop prime coat where no other prime coat is specified; for non-submerged service.
    b. Bell rings, underside of manhole covers and frames.
    c. Sump pumps and grit pumps, including underside of base plates and submerged suction and discharge piping.
    d. Chlorine diffuser supports.
    e. Exterior of submerged piping and valves other than stainless steel or plastic piping.
    f. Submerged pipe supports and hangers, except stainless steel.
    g. Stem guides.
    h. Vertical shaft mixers and aerators below supports.
    i. Other submerged iron and steel metal unless specified otherwise.
    j. Interior surface of suction inlet and volute of submersible influent pumps. Apply coating prior to pump testing.
    k. Submerged piping.
    l. Exterior of influent pumps and influent pump submerged discharge piping.
5. Polymorphic polyester resin system:
    a. Surfaces where indicated on the Drawings following a short cure time.
6. High temperature coating 150 to 350 degrees Fahrenheit):
    a. None.

7. High temperature coating 400 to 1,000 degrees Fahrenheit):
    a. None.
8. High temperature coatings up to 1,400 degrees Fahrenheit:
    a. None.
9. Asphalt varnish:
    a. Underground valve boxes.
10. Protective coal tar:
    a. Underground pipe flanges, excluding pipe, corrugated metal pipe couplings, flexible pipe couplings and miscellaneous underground metals not otherwise specified to receive another protective coating.
11. Coal tar epoxy:
    a. None.

K. Fiberglass and Plastic pipe surfaces:
1. Waterborne acrylic emulsion.
    a. Exterior of fiberglass ducting and fan housings.
    b. Fiberglass expose to sunlight.
    c. Exterior and exposed PVC and CPVC piping.
    d. ABS piping as determined by Engineer.

END OF SECTION

SECTION 09974

COATING FOR WELDED STEEL WATER STORAGE TANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Surface preparation and application of protective coatings to welded steel water storage tanks, including accessories, exposed piping, valves, and miscellaneous appurtenances:
   1. Provide full coating of all roof structure elements, including top flange of roof structure, prior to erection of tank.
   2. Provide caulking of bottom chine of tank at exterior prior to application of exterior coating.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.
      b. Section 01757 - Disinfection.
      c. Section 01770 - Closeout Procedures.
      d. Section 01782 - Operation and Maintenance Data.

C. CONTRACTOR shall furnish all material, equipment, labor, and services required for all surface preparation and application of protective coatings to project water storage tank, including accessories, exposed piping, valves, and miscellaneous appurtenances.

D. Preparation and application of coatings specified in this Section shall be in strict accordance with coating manufacturer's instructions as supplemented by these specifications.
   1. CONTRACTOR shall have a minimum of 5 years practical experience and successful history in application of protective coatings to steel storage tanks used for storage of potable water.
   2. CONTRACTOR shall substantiate this requirement by furnishing a list of references.

E. All materials and applications for coating interior surfaces of water storage tank shall be certified in accordance with NSF International (NSF) Standard 61.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

B. Environment Protection Agency (EPA):
   1. 524.2 - Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry.

C. NACE International:
   1. SP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

D. National Fire Protection Association (NFPA):
   1. 70 - National Electric Code (NEC).

E. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

F. Occupational Safety and Health Administration (OSHA).

G. Society for Protective Coatings (SSPC):
   1. PA 1 - Shop, Field, and Maintenance Painting of Steel.
   2. PA Guide 10 - Safety and Health Requirements.
   3. PS 17.00 – Guide for Selecting Urethane Painting Systems.
   4. SP-10 - Near-White Blast Cleaning.
   5. VIS 1 - Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.

H. Underwriters' Laboratory, Inc. (UL).

I. San Luis Obispo County APCD:
   1. Rules and Regulations.

1.03 SUBMITTALS

A. General: Submit as specified in Section 01330.

B. Shop drawings:
   1. Schedule of proposed coating materials.
   2. Schedule of surfaces to be coated with each coating material.

C. Product Data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips:
   1. Regulatory requirements: Submit data concerning the following:
      a. Volatile organic compound limitations.
      b. Coatings containing lead compounds and PCBs.
      c. Abrasives and abrasive blast cleaning techniques, and disposal.
      d. NSF certification of coatings for use in potable water supply systems.

D. Samples: Include 8-inch square drawdowns or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.

E. Manufacturer's Instructions: Include the following:
   1. Special requirements for transportation and storage.
   2. Mixing instructions.
   3. Shelf life.
   4. Pot life of material.
   5. Precautions for applications free of defects.
   6. Surface preparation.
   7. Method of application.
   8. Recommended number of coats.
   9. Recommended dry film thickness (DFT) of each coat.
   10. Recommended total dry film thickness (DFT).
   11. Drying time of each coat, including prime coat.
   12. Required prime coat.
   13. Compatible and non-compatible prime coats.
   14. Recommended thinners, when recommended.
   15. Limits of ambient conditions during and after application.
   16. Time allowed between coats (minimum and maximum).
   17. Required protection from sun, wind, and other conditions.
   18. Touch-up requirements and limitations.
   19. Minimum adhesion of each system submitted in accordance with ASTM D 4541.

F. Manufacturer's Representative's Field Reports.

G. Operations and Maintenance Data: Submit as specified in Section 01782.
   1. Reports on visits to project site to view and approve surface preparation of structures to be coated.
   2. Reports on visits to project site to observe and approve coating application procedures.
   3. Reports on visits to coating plants to observe and approve surface preparation and coating application on items that are "shop coated."

H. Quality Assurance Submittals:
   1. Quality Assurance plan.
   2. Qualifications of coating applicator including List of Similar Projects.

I. Certifications:
   1. Submit notarized certificate that:
      a. All paints and coatings to be used on this project comply with current federal, state, and local VOC regulations.
      b. All paints and coatings in contact with potable water have NSF or UL certification.
      c. All paints and coatings to be used on this project comply with the current VOC regulations of the State of California Air Management District in which the coatings will be applied.
      d. Coating is properly cured and ready for service.

1.04 QUALITY ASSURANCE

A. Quality assurance procedures and practices shall be used to monitor all phases of surface preparation, application of coatings, and inspection through project duration.
   1. Procedures or practices not specifically defined in this Section may be used, provided they meet recognized and acceptable professional standards and are accepted by ENGINEER:
      a. Services of coating manufacturer’s representative:
         1) Arrange for coating manufacturer’s representative to attend preconstruction conferences and make periodic visits at the construction site to provide consultation and inspection services during surface preparation work and application of coatings.

B. All materials furnished shall be subject to inspection by ENGINEER.
   1. Data for all coating materials, solvents, and thinners to be used on project shall be submitted.
   2. Hold strictly to true intent of specifications in regard to quality of materials, workmanship, and diligent execution of Contract:
      a. Compatibility of coatings: Use products by the same manufacturer for all coats on same surface, unless specified otherwise.

C. Water tank interior surface preparation shall be based upon compliance with SSPC-VIS 1, and as described below.
   1. Anchor profile for prepared surfaces shall be measured by using a nondestructive instrument such as a Keane-Tater Surface Profile Comparator or Testex Press-O-Film System.
   2. Provide said items for measuring anchor profile.

D. Apply coatings in strict accordance with manufacturer's material data sheets with particular attention to curing and drying times and temperatures.
   1. Apply no coating when surrounding air temperature of surface to be coated is below minimum temperature allowed by manufacturer's recommendations for coating application or when it is expected that air temperature will drop below minimum 8 hours after coating application.
   2. Apply no coating when surrounding air temperature is forecasted to be less than 5 degrees F above dew point within 8 hours after coating application.
   3. Apply no coating to steel which is 5 degrees F below air temperature or which is at a temperature over 125 degrees F, nor shall coating be applied to steel which is at a temperature that will cause blistering or porosity or otherwise will be detrimental to the life of the coating.
   4. No coating shall be applied to wet or damp surfaces or in rain, snow, fog, or mist.
   5. Coating shall not be applied on frosted or ice-coated surfaces.
   6. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables or equivalent:
      a. Exterior tank surfaces:
         1) If above conditions are prevalent, coating application shall be delayed or postponed until conditions are favorable.
         2) Complete day's coating application time to permit coating sufficient drying time prior to damage by atmospheric conditions.
      b. Interior tank surfaces: If above conditions are prevalent, CONTRACTOR shall provide fans, heaters, and dehumidification equipment as necessary

to provide suitable conditions for application and curing of coating products in strict accordance with coating manufacturer's instructions.

E. Thickness of coatings shall be checked with a nondestructive, magnetic-type thickness gauge.
   1. Use an instrument such as a Tooke Gauge if a destructive tester is deemed necessary.
   2. Test coating integrity of all interior wetted surfaces with an approved inspection device.
   3. Holiday detectors shall not exceed voltage recommended by manufacturer of coating system.
   4. For thickness between 10 and 20 mils, add a non-sudsing type wetting agent to water prior to wetting detector sponge.
   5. No pinholes or other irregularities will be permitted in final coating:
      a. Holiday detection testing: Shall be accomplished over 100 percent of coated surfaces, and in strict accordance with NACE SP0188.

F. Inspection of applied coating will be accomplished as a joint effort involving CONTRACTOR and ENGINEER.

G. Provide following testing devices to be jointly used on this project by CONTRACTOR and ENGINEER. Devices shall remain property of CONTRACTOR during and after project:
   1. Surface profile Comparator or Testex Tape to measure surface profile prior to coating application.
   2. Psychrometer and psychometric tables or charts for humidity/dew point determination.
   3. Dry film thickness gauge and calibration blocks for coating thickness testing.
   4. Wet film thickness gauge for coating thickness testing.
   5. 10 times magnifier for examination.
   6. Holiday detector and associated equipment for coating defect determination.
   7. Combustible gas analyzer (sniffer) for safety.

H. ENGINEER will witness all testing as performed by CONTRACTOR.

I. Preparation of all surfaces and application of coatings specified in this Section shall be in strict accordance with coating manufacturer's instructions as supplemented by these specifications.
   1. CONTRACTOR shall have a minimum of 5 years practical experience and successful history in application of protective coatings to steel water tanks used for storage of potable water.
   2. Upon request, CONTRACTOR shall substantiate this requirement by furnishing a list of references:
      a. CONTRACTOR shall substantiate this requirement by furnishing a list of references.

J. Unless otherwise specified, all materials and applications for coating interior surfaces of water tank shall be certified in accordance with NSF 61.

1.05 WARRANTY INSPECTION

A. A warranty inspection shall be conducted during the eleventh month following completion of all coating work.
   1. CONTRACTOR shall be present at inspection.
   2. All defective work shall be repaired in strict accordance with coating manufacturer's instructions, this Specification, and to satisfaction of ENGINEER.

B. Notification:
   1. OWNER shall establish date for inspection at least 30 days in advance.
   2. If an inspection date has not been established within 12 months after coating work was completed, first anniversary inspection shall be considered to be waived, and CONTRACTOR's work completed.

C. OWNER shall drain water tank and CONTRACTOR shall provide, at his own expense, suitable and necessary scaffolding and ladders, suitable lighting, and ventilation for inspection:
   1. Inspection-interior:
      a. Entire interior coating system shall be visually inspected as specified in Quality Assurance.
      b. All defective coating, as well as damaged and rusting spots in water tank shall be satisfactorily repaired by and at sole expense of CONTRACTOR.
   2. Inspection-exterior:
      a. Entire exterior coating system shall be inspected as specified in Quality Assurance.
      b. All defective, damaged, or rusting areas shall be satisfactorily repaired by and at sole expense of CONTRACTOR.
   3. Coating manufacturer's representative: CONTRACTOR shall have coating manufacturer's representative present during inspection of work to assist with assessment of condition of interior and exterior coating and make recommendations for methods of repair of coating systems as may be required.

D. Inspection Report: Prepare and submit an inspection report covering first anniversary inspection, setting forth number and type of failures observed, percentage of surface area where failures have occurred, and names of persons making inspection.

E. Schedule:
   1. Upon completion of inspection and receipt of an Inspection Report as noted in this Section, OWNER shall establish a date for CONTRACTOR to proceed with remedial work.
   2. Any delay on part of CONTRACTOR to meet schedule established by OWNER shall constitute breach of this Contract and OWNER may proceed to have defects remedied, with costs involved paid by the CONTRACTOR.

F. Remedial work:
   1. Any location where coating has peeled, bubbled, or cracked, and any location where rusting is evident shall be considered to be a failure of coating system. CONTRACTOR shall make repairs at all points where failures are observed by

removing deteriorated coating, cleaning surface, and recoating with same coating system.

2. If area of failure exceeds 25 percent of total coated surface, entire coating system may be required to be removed and recoated in accordance with original Specification.

G. Costs:
   1. All costs for CONTRACTOR's testing, all costs for coating manufacturer's visits, and all costs for repair shall be borne by CONTRACTOR.
   2. In preparing his bid, CONTRACTOR shall include an appropriate amount for testing and repair.
   3. No additional allowance will be paid by OWNER for said testing and repair.

1.06 SAFETY AND HEALTH REQUIREMENTS

A. Conform with all safety requirements set forth by regulatory agencies applicable to construction industry and coating manufacturer's printed instructions and appropriate technical bulletins and manuals.
   1. Provide and require use of personal protective life-saving equipment for persons working in or about project site.

B. Observe proper safety precautions to protect against potential toxicity and flammability of coatings.
   1. Safe handling and application practices are required and should include, but not be limited to, provisions of:
      a. SSPC-PA Guide 10.
      b. SSPC-PS17.00.
      c. Coating Manufacturer's Material Safety Data Sheets.

C. Ladders, scaffolding, and rigging shall be designed for intended uses.
   1. Erect ladders and scaffolding where requested by ENGINEER to facilitate inspection and be moved by CONTRACTOR to locations requested by ENGINEER.

D. Where ventilation is used to control hazardous exposure, all equipment shall be explosion proof.
   1. Ventilation shall reduce concentrations of air contaminants to ensure that a hazard does not exist.
   2. Continue air circulation and exhausting of solvent vapors until coatings have fully cured.
   3. Forced air ventilation during surface preparation and coating application operations is mandatory.
   4. Operate ventilation during entire period of application and continue after spraying has been halted until there is no coating vapor present.
   5. Air in enclosed coating space shall be safe at all times from fire and explosion hazards:
      a. When required, utilize dehumidification equipment to provide proper temperature and humidity conditions inside the water tank, as recommended by coating manufacturer, to ensure proper application and curing of coatings.

E. During coating application, capacity of ventilating fans shall be at least 300 cubic feet per minute per gallon of coating applied per hour.

F. Continuous forced ventilation at a rate of at least 1 complete air change every 4 hours shall be provided for at least 48 hours after coating application is completed or until coating is completely cured, in accordance with coating manufacturer's recommendations.

G. Air shall be exhausted from lowest portions of water tank with top openings kept open and clear.
   1. During blasting operations, nozzle-men shall wear air-supplied helmets and all other persons who are exposed to blasting dust shall wear filter-type respirators and safety goggles.

H. When coatings are applied inside water tank, all persons exposed to toxic vapors shall wear air-supplied masks.

I. Provide 2 sets of filter-type respirators and safety goggles, and an air-supplied mask to be used by OWNER's personnel and ENGINEER when required for inspection purposes.
   1. All devices shall be kept in good working condition.

J. Ground hoses to prevent accumulation of charges of static electricity.
   1. All nozzles shall be equipped with dead man triggers.
   2. Dead man triggers shall be in good working condition and shall not be tied down or otherwise modified by any means that prohibits functioning of automatic feature of nozzle.

K. Provide spark-proof artificial lighting for all work in confined spaces.
   1. Light bulbs shall be guarded to prevent breakage.

L. Lighting fixtures and flexible cords used in any coating operation shall comply with requirements of NEC for atmosphere in which they will be used.
   1. Whenever required by ENGINEER, provide additional illumination and necessary supports to cover all areas to be inspected.
   2. Level of illumination for inspection purposes shall be determined by ENGINEER.

M. Maximum allowable concentration of vapor shall be kept below maximum safe concentration for 8-hour exposure.

N. When handling and mixing coatings, workmen shall wear protective clothing required by OSHA and/or recommended by coating manufacturer.

O. During mixing and application of coatings, all flames, welding, and smoking shall be prohibited in vicinity.
   1. Appropriate type fire extinguishers shall be kept nearby.

P. Whenever occupational noise exposure exceeds the maximum allowable sound level, provide and require use of approved ear protective devices for all persons exposed to the noise, including OWNER personnel.

Q. Maintain a solvent drum on-site to store all used solvents.
   1. Do not dump solvents and/or thinners on ground.
   2. Remove solvent drum from job site by and at sole expense of CONTRACTOR.

R. Enclosure of the exterior of the storage tank shall be required during coating operation to contain abrasive blast material and paint overspray.
   1. Enclosure shall be in accordance with SSPC requirements for safety and ventilation in accordance with SSPC PA Guide 10.

1.07 AIR QUALITY PERMITS

A. Apply for, obtain, pay for, and comply with all permits required by the local Air Pollution Control District and the California Air Resources Board.
   1. Permits shall cover, but not be limited to, surface preparation, coating materials and storage, and coating application.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials shall be brought to job site in original sealed containers with manufacturer's name, brand, color, and identification number clearly legible.
   1. Containers shall not be opened or used until ENGINEER has physically inspected contents and obtained necessary data from information printed on containers or labels.
   2. Materials exceeding storage life recommended by manufacturer shall be rejected.

B. Manufacturer shall identify flammability, toxicity, and allergenic properties.
   1. Any other characteristics requiring field precautions and specific safety practices shall be stipulated.

C. All coatings shall be stored in enclosed structures for protection from weather and excessive heat or cold.
   1. Flammable coatings must be stored to conform with city, county, state, and federal safety codes for flammable coating and paint materials.

D. All coating products shall be from same manufacturer.

E. Submit coating samples prior to ordering any coating products.
   1. All interior and exterior coating products shall bear same batch numbers.
   2. Do not mix batch numbers.

2.02 INTERIOR COATING MATERIALS

A. Epoxy coating materials used for interior of water tank shall be in accordance with the NSF 61 and shall be certified by NSF for use in potable water.
   1. Coatings shall have a minimum solids-by-volume content of not less than 80 percent, and conform to requirements of local and state air pollution regulatory agencies.

B. Coating system shall be one of the following or equal.

Manufacturer	Interior Coating System	Min. Number of Coats	Thickness of Each Coat	Minimum Total Thickness	Intermediate Coating Color	Final Coating Color
Ameron	Amercoat® 395FD Epoxy	3	Minimum 5 mils dry film thickness	Minimum 15 mils dry film thickness	Each coat shall have a contrasting color	White
Devoe	Bar-Rust 233H®	3	Minimum 5 mils dry film thickness	Minimum 15 mils dry film thickness	Each coat shall have a contrasting color	White
Sherwin-Williams	Tank Clad HS	3	Minimum 5 mils dry film thickness	Minimum 15 mils dry film thickness	Each coat shall have a contrasting color	White

C. References:
1. Proposed “or equal” coating systems shall have been used in at least 5 potable water reservoirs and been in place for 5 years or more in at least 3 of those reservoirs having impressed current cathodic protection systems.
2. Submit references for the 3 above reservoirs.

2.03 EXTERIOR COATING MATERIALS

A. Coating materials for exterior of water tanks shall consist of a minimum 2-coat system using 1 or more coats of a 2-component high solids epoxy coating with a minimum solids content of 80 percent by volume, and 1 or more coats of a 2-component aliphatic acrylic polyurethane finish coating with a minimum solids content of 60 percent by volume.
1. Finish coating used shall provide superior color and gloss retention, resistance to splash from acid, alkaline chemicals, chemical fumes, and severe weathering.
2. Coatings used shall conform to requirements of local and state air pollution regulatory agencies.
3. Coating system used shall be one of following listed systems.
4. Finish coat color shall be per OWNER’s choice and must be accepted by ENGINEER prior to ordering of coating.

B. Coating system shall be one of the following listed systems:

Manufacturer	Exterior Coating System First Coat	Minimum Thickness	Exterior Coating System (Finish Coat)	Minimum Thickness (Finish Coat)
Ameron	Amerlock® 400	Minimum 5 mils dry film thickness	Amershield Aliphatic, Acrylic Polyurethane	Minimum 3 mils dry film thickness
Devoe	Bar-Rust 233H®	Minimum 5 mils dry film thickness	Devthane® 379	Minimum 3 mils dry film thickness
Sherwin-Williams	Macropoxy® HS6	Minimum 5 mils dry film thickness	Acrolon™ 218HS	Minimum 3 mils dry film thickness

PART 3 EXECUTION

3.01 GENERAL

A. All surface preparation and coating application shall conform to applicable SSPC standards and coating manufacturer's printed instructions.
   1. Material applied prior to acceptance of surface by the ENGINEER shall be removed and reapplied to satisfaction of ENGINEER at expense of CONTRACTOR:
      a. Coating manufacturer’s representative shall be present at the project site at beginning of surface preparation operations and at beginning of coating application operations, to approve CONTRACTOR procedures and provide direction as may be required.

B. All work shall be performed by skilled craftsmen qualified to perform required work in a manner comparable with best standards of practice.

C. Dust, dirt, oil, grease, or any foreign matter that will affect adhesion or durability of coatings must be removed by washing with clean cloths dipped in an approved cleaning solvent and wiped dry with clean cloths.

D. Coating application equipment shall be designed for application of materials specified and shall be maintained in first-class working condition.

E. Compressors shall have suitable traps and filters to remove water and oils from air. Equipment shall be subject to acceptance by ENGINEER.

F. Application of first coat shall follow immediately after surface preparation and cleaning within an 8-hour working day.
   1. Any cleaned areas not receiving first coat within an 8-hour period shall be recleaned prior to application of the coat.

3.02 SURFACE PREPARATION

A. General surface preparation:
   1. All surfaces shall be prepared in accordance with coating manufacturer's current Product Data Sheets and as described below.
   2. Weld splatter:
      a. Weld splatter shall be removed using a chipping hammer, spud bar, or scraper.
      b. Tightly adhering weld splatter may require removal by grinding.
   3. Sharp edges:
      a. Remove sharp edges, such as those normally occurring on rolled structural members or plates, as well as those resulting from flame cutting, welding, grinding, and especially shearing, by any suitable method such as grinding, mechanical sanding, and filing.
      b. Ensure that during removing operations new sharp edges are not created.
   4. Pits: Deep corrosion pits, gouges, clamp marks, or other surface discontinuities may require grinding prior to coating application, and will require filling with seam sealer or equal.

5. Laminations, slivers:
    a. Rolling discontinuities (laps) with sharp protruding edges, deep penetrating crevices, and such defects shall be eliminated prior to coating.
    b. Eliminate minor slivers by scraping and grinding. All sharp fins, projections, or edges shall be removed.
6. All surfaces shall be prepared in accordance with coating manufacturer's instructions.
    a. All steel surfaces to be coated must be abrasive blast cleaned to a minimum "Near White Metal" in accordance with SSPC SP10.
    b. A "Near White Metal" blast is removal of all rust, mill scale, paint, and other foreign matter to a near white metal.
    c. Limit staining to less than 5 percent of surface area.
7. A profile or anchor pattern is required to assure best possible adhesion of coating system to steel.
    a. Use proper mesh size angular abrasive to obtain profile required for each individual type of coating system.
    b. Profile shall be 2.0 mils.
    c. Only clean, fresh grit, or abrasive shall be used.
8. In general, select smallest size abrasive that will produce desired cleaning results.
9. After abrasive blasting, remove all dust, foreign particles, and spent abrasives by blowing down with clean, dry, oil free air, brushing, and vacuum cleaning.
10. All workers and/or inspectors who will be in contact with abrasive blasted surfaces shall wear clean gloves, clothing, and shoe coverings to prevent contamination of abrasive blasted surfaces.
11. Apply primer or first coat of coating system as soon as possible after abrasive blasting operation is finished and before surface starts to rust.
    a. If abrasive blasted surface changes, color or rust bloom begins to form, re-blast surface to "Near White Metal."
12. Clean and coat ladders, pipes, pipe connections, flanges, and any other structures in or connected to water tank.
    a. All edges shall be brush striped prior to spray application of coating.
13. Blast a sample area with abrasive to be used to check surface preparation and proposed equipment to ensure that surface can be cleaned according to specification and that abrasive will provide a profile suitable for application of coating to be used.
14. No coating work shall begin before prepared surfaces and manner of preparation is accepted by ENGINEER.

3.03 COATING APPLICATION

A. Coating application shall be in accordance to requirements of SSPC-PA 1, latest revision, coating manufacturer’s printed literature, and as specified.

B. Thinning of coating materials shall only be permitted as recommended by manufacturer and accepted by ENGINEER.

C. Apply each application of coating evenly, free of brush marks, sags, and runs, and with no evidence of poor workmanship.
    1. Coating shall be sharply cut to lines.
    2. Finished surfaces shall be free from defects and blemishes.

D. Protective coverings and drop cloths shall be used to protect floors, fixtures, equipment, prepared surfaces, and previously applied coatings.
   1. Personnel entering water tank or walking on exterior roof of water tank shall take precautions to prevent damage or contamination of coated surfaces.
   2. Exercise care to prevent coating from being spattered onto surfaces that are not to be coated.
   3. Recoat surfaces from which material cannot be removed satisfactorily as required to produce a finish acceptable to ENGINEER.

E. Welds, seams, edges, and irregular surfaces shall receive a brush (stripe) coat prior to spray application of coating.

F. Application of first coat shall follow immediately after surface preparation and cleaning within an 8-hour period.

G. Coating components shall be mixed in exact proportions as specified by manufacturer.
   1. Ensure all materials are removed from containers during mixing and metering operations.

H. Thoroughly mix coatings utilizing an approved slow-speed power mixer until all components are thoroughly combined and are of a smooth consistency.
   1. Do not apply coatings beyond pot-life limits specified by manufacturer.

I. Add thinners to coating materials only as required in accordance with manufacturer's printed literature and in presence of ENGINEER.

J. Strictly observe drying time between coats as stated in manufacturer's printed instructions.

K. When 2 or more coats are specified, each coat shall contain sufficient approved color additive to act as an indicator of coverage, or coats must be of contrasting color.

L. Upon completion of coating operations, perform coating thickness tests and holiday detection testing using a non-destructive, magnetic type thickness gauge, and an approved holiday detection device.
   1. Pinholes or other irregularities are not permitted in the coating:
   2. Holiday detection testing shall be accomplishes over 100 percent of coated surfaces.

M. Perform mixing, thinning, application, coating thickness testing, and holiday detection testing of coatings in presence of ENGINEER.

N. Required cure duration shall be based on applied thickness, temperature, and relative humidity during curing period before placing epoxy-coating systems into service.
   1. Allow time element equivalent to 7 days curing time at 70 degrees F and 50 percent relative humidity.
   2. CONTRACTOR shall provide minimum 7 days curing.

O. CONTRACTOR to furnish letter to ENGINEER stating coating is properly cured and ready for service. ENGINEER may perform tests to verify proper cure.

P. ENGINEER will perform aesthetic tests (T&O).

3.04 DISINFECTION

A. Disinfect as specified in Section 01757.

END OF SECTION

SECTION 10155

METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Floor-mounted metal toilet compartments and wall-hung bracket supported urinal screens.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 05500 - Metal Fabrications.
      b. Section 06100 - Rough Carpentry.
      c. Section 10810 - Toilet Accessories.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   2. A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.03 SYSTEM DESCRIPTION

A. Performance requirements: Doors shall be adjustable to permit rest position at any angle within a 270-degree arc.

1.04 SUBMITTALS

A. Shop drawings and product data: Include floor plans, elevations and details indicating partition layouts, swing of doors, anchorage and mounting details, components hardware, finishes, relevant dimensions.

B. Samples: Include selected color samples on minimum 3- by 6-inch base metal.

C. Manufacturer's installation instructions.

D. Operation and maintenance data.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed products for minimum 5 years with satisfactory performance record of minimum 5 years.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate installation of toilet accessories as specified in Section 10810. Make appropriate accommodations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal toilet compartments and urinal screens: One of the following or equal:
   1. Accurate Partitions, Fresno, CA.
   2. American Sanitary Partition Corp., Ocoee, FL.
   3. Global Steel Products, Inc., City of Commerce, CA.
   4. Knickerbocker Partitions Corp., Freeport, NY.
   5. Mills Co., Cleveland, OH.
   6. Sanymetal Products Corp., Cleveland, OH.

2.02 TOILET COMPARTMENTS AND URINAL SCREENS

A. Partition type: Sanyacrylic Normadie, floor-mounted.

B. Urinal screen type: Type A, wall hung, bracket supported.

C. Finish: Baked enamel.

D. Colors: As selected from manufacturer's standard colors.

2.03 COMPONENTS

A. Panels:
   1. Material: Type 304 stainless steel, stretcher-leveled standard of flatness in accordance with ASTM A 666.
   2. Sound-deadening cores enclosed by galvanized bonderized steel faces with formed edges welded at 18 inches on center and sealed with surrounding oval-crown locking strip, mitered, welded, and finished at corners; finished with vitreous porcelain.

B. Doors:
   1. Panels with minimum 18 gauge faces; 1-inch thick; 58 inches high; minimum 24 inches wide for typical compartments; minimum 32 inches wide for handicapped accessible compartments.

C. Partition panels: Panels with minimum 18 gauge faces; 1-inch thick; 58 inches high; width for compartment depth.

D. Urinal screens: Panels with minimum 18 gauge faces; 1-inch thick; 18 inches wide by 42 inches high.

E. Pilasters: Panels with minimum 18 gauge faces; 1-1/4-inch thick; height from floor to 70 inches above finish floor; width for compartment width.

F. Top hinges: Secured at 3 points with door hinge fittings fully flush with faceplates of door.

G. Coat hook and bumpers: No. 7810, chrome plated cast alloy, 1 per door.

H. Concealed latches: No. 8800 with bolt of stainless steel permitting exterior access, 1 per door.

I. Stop and keepers: No. 8801, 1-piece chrome plated, 1 per door.

J. Gravity hinges: No. 7961, concealed controlled power bearing, 1 per door.

K. Thrust bearings: Concealed within door thickness and capable of carrying weight of door.

L. Pilaster hinge brackets: Zamac alloy, factory mounted flush to pilaster.

M. Pilaster shoes: ASTM A 167; Type 302/304, No. 4 polished finish; stainless steel; 3 inches high.

N. Stirrup brackets: Heat-treated, polished anodized aluminum, type to suit condition.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install products plumb and square.

C. Secure pilasters to structure.
   1. Attach anchoring device for leveling and tightening.

D. Rigidly secure components to walls, backings, and to each other with stirrup brackets.

E. Hang doors with uniform 3/16-inch clearance at vertical edges from top to bottom.

F. Adjust hinges so in-swinging doors are partially open and out-swinging doors are in closed position when unlatched.

G. Mount urinal screens 12 inches above finish floor.

H. Install balance of hardware.

3.02 CLEANING

A. Do not attempt to touch-up scratches or defaced finishes.
   1. Replace defective units with undamaged units.

B. Remove protective maskings.
   1. Clean surfaces until free of oil and foreign substances.

C. Remove excess materials, equipment, and debris.

END OF SECTION

SECTION 10290

PLASTIC SPIKE BIRD DETERRENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes plastic spike bird deterrent system used to prevent birds from landing and roosting on specified surfaces.

B. Design Requirements: Select appropriate size as determined by site conditions to prevent birds from landing and roosting on specified surfaces.

C. Bird Deterrent shall be installed on the bottom flange of all wide flange beams and channels on all steel and aluminum canopies shown on structural drawings.

1.02 SUBMITTALS

A. Product data: Submit manufacturer's descriptive literature and product specifications for each product including catalogs, installation instructions other descriptive material.

B. Provide warranty on material and installation.

C. Provide samples of each type of spike excluding proposed fastening methods.

D. Provide statement by official indicating that they are a certified installation company.

1.03 QUALITY ASSURANCE

A. Single source responsibility: Furnish products from one manufacturer for entire project.

B. Obtain all technical information from the manufacturer.

C. Utilize manufacturer-authorized installers who are knowledgeable in selected product installations.

D. Installer shall visit the site to gather all information of existing site conditions.

1.04 DELIVERY, HANDLING, AND STORAGE

A. Protect plastic spike bird deterrent system from damage before, during, and after the installation.

1.05 SEQUENCING AND SCHEDULING

A. Visit site and field measure prior to fabrication and delivery of materials.

1.06 WARRANTY

A. Product shall carry a minimum 5-year guarantee against ultraviolet (UV) breakdown.

B. Installation shall be guaranteed for 2 years.

1.07 MAINTENANCE

A. Spare parts and special tools: One set for each type and size of each plastic spike bird deterrent system component shall be provided.

PART 2 PRODUCTS

2.01 PLASTIC SPIKE BIRD DETERRENT SYSTEM

A. Manufacturers: The following or equal:
   1. Bird-B-Gone, Inc., Mission Viejo, CA, Bird-B-Gone Polycarbonate Bird Spike™.

B. Model Designation:
   1. Bird-B-Gone Polycarbonate Bird Spike™ - 3 inches, 5 inches or 7 inches:
      a. Width of Coverage:
         1) BBG2000-3: 1-inch to 5-inch widths.
         2) BBG2000-5: 5-inch to 7-inch widths.
         3) BBG2000-7: 6-inch to 9-inch widths.
      b. Height: 4-1/2 inches.
      c. Base: Flexible:
         1) Glue trough feature (underside) for ease of attachment with adhesive:
            a) Offset pre-drilled holes, for ease of attachment with screws and/or adhesive.
      d. Length: 2-foot sections.
      e. Packaging: 50 feet per box. 25 2-foot sections per box.
      f. Color: As designated by the project Specifications.
      g. Number of Rows: As determined by the manufacturer and based on project conditions.
      h. Mounting System: As determined by the manufacturer and based on project conditions.

C. Product made in the United States of America.

D. Materials:
   1. Material: UV-stabilized Polycarbonate. Heat and weather resistant (+310 degrees F to –200 degrees F). Non-conductive and will not interfere with electronic security systems or transmissions.
   2. Construction: Rigid 1-piece construction, available in 7 standard colors including crystal clear.
   3. Adaptation:
      a. “Break Away” points are located between each set of screw holes.
      b. Tin snips, hacksaw, etc. can also be used to cut the product to the desired length.
   4. Color: Selected by OWNER and approved by ENGINEER from manufacturers standard colors.

E. Mounting systems:
   1. Wood: Use Number 8 wood screws.
      a. For every 2-foot section of plastic spike bird deterrent system, 10 Number 8 wood screws are required.
   2. Steel, brick, stone or concrete:
      a. Use an outdoor construction adhesive that is not silicone based.
      b. Purchase from the manufacturer or call for recommended adhesives.
      c. If mounting surface warrants, screw or bolt down plastic spike bird deterrent system in conjunction with using the adhesive.
   3. Pipes or poles:
      a. Ty-wraps can be used alone or in conjunction with an outdoor construction adhesive.
      b. For UV-protected ty-wraps, purchase directly from the manufacturer or call for recommended products.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation area and note any detrimental or hazardous work conditions. Notify ENGINEER of the detrimental work conditions.

B. Do not proceed with installation until conditions are corrected.

3.02 SURFACE PREPARATION

A. Surface should be thoroughly cleaned and free of bird droppings, nesting materials, rust, peeling paint or other debris.

B. Remove or repair articles that may damage the plastic spike bird deterrent system after installation, including overhanging foliage, brush, and loose parts on the structure.

3.03 INSTALLATION

A. Install plastic spike bird deterrent system as recommended by the manufacturer.

B. Plastic spike bird deterrent system should be installed correctly, covering the entire depth of the surface, not just the perimeter.
   1. Follow the contours and angles closely; cut or break away to fit properly.
   2. Space materials in accordance with manufacturer's recommendations.

3.04 INSPECTION

A. Visually inspect plastic spike bird deterrent system for any signs of poor installation, including loose screws, fasteners, and un-removed debris.

B. Immediately correct and repair as necessary.

END OF SECTION

SECTION 10400

SIGNAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Plastic and metal signs for building and site use.

1.02 SUBMITTALS

A. Product data:

B. Shop drawings: Include lists of sign types, sizes, text, and colors; mounting details; locations; and cast metal plaque rubbings and templates.

C. Samples: Include actual materials.

D. Manufacturer's installation instructions.

1.03 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed products for minimum 5 years with satisfactory performance record of minimum 5 years.

B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 10 projects of similar scope as Project with satisfactory performance record.

C. Regulatory requirements: Provide signage in accordance with Americans with Disabilities Act as published in the Federal Register, Volume 56, No. 144, Friday, July 26, 1991.

PART 2 PRODUCTS

2.01 PLASTIC SIGNAGE SYSTEM

A. Manufacturers:
   1. One of the following or equal:
      a. Best Manufacturing Sign Systems, Montrose, CO; System 900013.
      b. Andco Industries Corp., Greensboro, NC; equivalent product.
      c. Vomar Products, Inc., Sepulveda, CA; equivalent product.

B. Attachment:
   1. Vinyl tape, self-adhering.

C. Lettering:
   1. Helvetica medium, 3/4 inches high.

D. Material for interior use:
   1. Plastic 1/8-inch thick raised letters.

E. Material for exterior use:
   1. Fiberglass 1/4 inch thick with high gloss finish, raised letters, blasted from single piece of fiberglass for integral letter and background.
   2. No adhesive as mechanical fastening of letters shall be allowed.

F. Colors:
   1. As selected by Engineer from manufacturer's standard colors.

G. See Schedule A for specific sign size, location, text, pictogram, and quantity.

2.02 METAL SAFETY SIGNS

A. Manufacturer: Meeting OSHA Requirements; 40-mil thick aluminum with baked enamel finish. One of the following or equal:
   1. Seton Name Plate Co., Branford, Connecticut, Special Wording.
   2. Emedco, Buffalo, New York.

B. Danger sign colors:
   1. Background: White.
   2. Heading: White lettering on red oval with white border in black rectangular panel.
   3. Message: Black lettering on white.
   4. Size: As scheduled.

C. Caution sign colors:
   1. Background: Yellow.
   2. Heading: Yellow lettering on black rectangular panel.
   3. Message: Black lettering on yellow.
   4. Size: As scheduled.

D. Safety instruction signs:
   1. Background: White.
   2. Heading: White lettering on green rectangular panel.
   3. Message: Black lettering.
   4. Size: As scheduled.

E. Warning sign colors:
   1. Background: Orange.
   2. Heading: Black lettering on orange diamond in black rectangular panel.
   3. Message: Flack lettering on orange.
   4. Size: As scheduled.

F. Notice information signs:
   1. Background: White.
   2. Heading: White lettering on blue rectangular panel.
   3. Message: Black lettering.
   4. Size: As scheduled.

G. Fasteners: Round head stainless steel bolts or screws.

H. See Schedule B for specific sign size, location, text, and quantity.

2.03 HAZARD MATERIAL SIGNALS

A. Manufacturer: One of the following or equal:
   1. Seton Name Plate Co., Branford, Connecticut.
   2. Emedco, Buffalo, New York.

B. Hazard material signals: In accordance with NFPA 704, 2007; 40-mil thick aluminum with baked enamel finish panels, letters, and symbols with pressure sensitive adhesive, sizes as required for viewing distances, letters and symbols in accordance with Schedule C.

2.04 CAST ALUMINUM LETTERS

A. Manufacturers:
   1. One of the following or equal:
      a. Metal Arts, Mandan, ND.
      b. Southwell Company, San Antonio, TX.
      c. OMC Industries, Bryan, TX.

B. Material:
   1. Cast aluminum.

C. Text Size and Font: Helvetica medium, 5-inch letter height.

D. Finish:
   1. Black duranodic coating.

E. Mounting:
   1. Projected jamb nut mounting, concealed.

2.05 DECAL SIGNS ON GLASS

A. Provide decal signs of the international symbol for accessibility, in accordance with requirements of CBC 1127B.3 for entry signs. Signs to comply with CBC 1117B.5 through 1117B.5.9. Locate signs as required.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect adjacent surfaces which may be damaged by installation of signs.

B. Prepare substrates in accordance with sign manufacturer's instructions.

C. Remove scale, dirt, grease, and other contaminates from substrates.

3.02 INSTALLATION

A. Install signs in accordance with sign manufacturer's instructions.

B. Fasten signs securely in level, plumb, and true to plane positions.

C. Install signs as indicated in the following schedules.

3.03 SCHEDULES

A. Plastic Signage System Schedule.

B. Metal Safety Sign Schedule.

C. Hazard Material Signals.

D. Cast Aluminum Letters.

END OF SECTION

SCHEDULE A

PLASTIC SIGNAGE SYSTEM SCHEDULE

A. Toilet Doors:
   1. Location: On wall outside room adjacent to latch side of doors or when not enough space on latch side, on nearest adjacent wall.
   2. Height: 60 inches above floor to center of sign.
   3. Size: 6 inches wide by 8 inches high.
   4. Colors: White letters and pictogram on blue background.
   5. Pictogram: International symbol for men or women to suit application.
   6. Text: Braille Characters and MEN or WOMEN as appropriate.

B. Fire Extinguishers:
   1. Location: Adjacent to fire extinguishers.
   2. Height: 60 inches above floor to center of sign.
   3. Size: 6 inches square.
   4. Colors: White letters on OSHA Red background.
   5. Text: FIRE EXTINGUISHER

C. Sodium Hypochlorite Tank Fill Connection:
   1. Location: Wall mounted in front of sodium hypochlorite loading station.
   2. Size: 12 inches wide, 6 inches high.
   3. Colors: As selected by Engineer.
   4. Sign Text: "SODIUM HYPOCHLORITE ONLY
      Tanker must be parked within each designated loading area"

D. Sodium Hypochlorite DOT Classification Code:
   1. Location: Tank Wall.
   2. Size/Colors: Per OSHA Standard.

E. Citric or Phosphoric Acid Tank:
   1. Location: Wall mounted in front of UV Disinfection cleaning tank.
   2. Size: 12 inches wide, 6 inches high.
   3. Colors: As selected by Engineer.
   4. Sign Text: "CITRIC/PHOSPHORIC ACID ONLY"

F. Citric or Phosphoric Acid DOT Classification Code:
   1. Location: Tank Wall.
   2. Size/Colors: Per OSHA Standard.

G. Dewatering Sump Locations:
   1. Location: Rail-mounted directly above each dewatering sump in Oxidation Ditch and Sludge Storage Tanks.
   2. Size: 12 inches wide, 6 inches high.
   3. Colors: As selected by Engineer.
   4. Sign Text: "DEWATERING SUMP BELOW"

H. Diesel Tank Fill Connection:
   1. Location: Wall mounted in front of diesel loading station.
   2. Height: 60 inches above grade to center of sign.

3. Size: 12 inches wide by 6 inches high.
4. Heading: NOTICE
5. Wording: DIESEL ONLY
   Tanker must be parked within the designated loading area

I. Secondary Clarifier Polymer Panel:
   1. Location: Mount on polymer panel located on the Oxidation Ditch.
   2. Height: Refer to Drawings for mounting location.
   3. Size: As required for lettering.
   4. Colors: As selected by Engineer.
   5. Sign Text: “SECONDARY CLARIFIER POLYMER”

J. Secondary Clarifier Polymer Panel:
   1. Location: Mount on polymer panel located on the Oxidation Ditch.
   2. Height: Refer to Drawings for mounting location.
   3. Size: As required for lettering.
   4. Colors: As selected by Engineer.
   5. Sign Text: “SECONDARY CLARIFIER N0. 1 POLYMER FEED”

K. Secondary Clarifier Polymer Panel:
   1. Location: Mount on polymer panel located on the Oxidation Ditch
   2. Height: Refer to drawings for mounting location.
   3. Size: As required for lettering.
   4. Colors: As selected by Engineer.
   5. Sign Text: “SECONDARY CLARIFIER NO. 2 POLYMER FEED”

L. Oxidation Ditch Chlorine Feed Panel
   1. Location: Mount on chlorine feed panel located on the Oxidation Ditch.
   2. Height: Refer to Drawings for mounting location.
   3. Size: As required for lettering.
   4. Colors: As selected by Engineer.
   5. Sign Text: “OXIDATION DITCH CHLORINE FEED PANEL”

M. Oxidation Ditch Chlorine Feed Panel:
   1. Location: Mount on chlorine feed panel located on the Oxidation Ditch.
   2. Height: Refer to Drawings for mounting location.
   3. Size: As required for lettering.
   4. Colors: As selected by Engineer.
   5. Sign Text: “CHLORINE FEED: OXIDATION DITCH NO. 1”

N. Oxidation Ditch Chlorine Feed Panel:
   1. Location: Mount on chlorine feed panel located on the Oxidation Ditch.
   2. Height: Refer to Drawings for mounting location.
   3. Size: As required for lettering.
   4. Colors: As selected by Engineer.
   5. Sign Text: “CHLORINE FEED: OXIDATION DITCH NO. 2”

O. Non-Potable Water Storage Tank:
   1. Location: Inconspicuously on side of tank, viewable from equipment pad.
   2. Height: 60 inches from grade to center of sign.
   3. Size: As required for lettering.
   4. Colors: As selected by Engineer.
   5. Sign Text: “NON-POTABLE WATER STORAGE”

P. Potable Water Storage Tank:
   1. Location: Inconspicuously on side of tank, viewable from equipment pad.
   2. Height: 48 inches from top of slab to center of sign.
   3. Size: As required for lettering.
   4. Colors: As selected by Engineer.
   5. Sign Text: “POTABLE WATER STORAGE”

END OF SCHEDULE A
PLASTIC SIGNAGE SYSTEM SCHEDULE

SCHEDULE B

METAL SAFETY SIGN SCHEDULE

A. PLANT WATER:
   1. Location: At impure water hose valves in accordance with Typical Detail M273 and M276.
   2. Height: In accordance with Typical Detail.
   3. Size: 10 inches wide by 7 inches high.
   4. Heading: CAUTION
   5. Wording: RECYCLED WATER DO NOT DRINK

B. NON-POTABLE WATER:
   1. Location: At non-potable water (W2) hose valves in accordance with Typical Detail M273 and M276.
   2. Height: In accordance with Typical Detail.
   3. Size: 10 inches wide by 7 inches high.
   4. Heading: CAUTION
   5. Wording: NON-POTABLE WATER DO NOT DRINK

C. REMOTELY CONTROLLED AUTOMATIC EQUIPMENT:
   1. Location: On front and back of equipment that starts automatically by remote control.
   2. Height: On front and back of equipment as required.
   3. Size: 9 inches wide by 5 inches high
   4. Heading: DANGER
   5. Wording: THIS EQUIPMENT STARTS AUTOMATICALLY BY REMOTE CONTROL

D. HIGH VOLTAGE WARNING:
   1. Location: On front and back of equipment, adjacent to doors to rooms containing devices, and devices that operate at 600 volts or greater.
   2. Height: 60 inches from floor to center of sign on walls. On front and back of equipment as required.
   3. Heading: DANGER
   4. Wording: HIGH VOLTAGE
KEEP OUT

E. EYEWASH/SHOWER STATION:
   1. Location: At each safety shower and eyewash station.
   2. Height: 60 inches from above floor level.
   3. Size: 10 inches wide by 7 inches tall.
   4. Heading: SAFETY FIRST (white letters on green rectangular background).
   5. Wording: Safety shower and eyewash station (black letters on white background).

F. EXIT:
   1. Location: All exterior doors, on interior side.
   2. Height: 5 inches.
   3. Size: 9 inches.
   4. Wording: EXIT

G. NO SMOKING INFORMATIONAL SIGNS:

1. Location: On exterior face of wall, adjacent to each entry point (exterior door) to all buildings.
2. Height: 60 inches above floor to center of sign. Where metal safety signs are also located adjacent to entry points, place no smoking signs below these signs.
3. Size: 6 inches square.
4. Heading: None.
5. Wording: None.
6. Pictogram: International “No Smoking” symbol.

H. NO SMOKING WITHIN 25 FEET OF BUILDING ENTRY:

1. Location: Adjacent to all doors on buildings.
2. Height: Pole mounted with top of sign at 5 feet above grade.
3. Size: 14 inches wide by 10 inches high.
4. Heading: NOTICE
5. Wording: NO SMOKING WITHIN 25 FEET OF BUILDING.
6. Pictogram: International “No Smoking” symbol.

I. ACCESSIBLE PARKING SIGN (POST MOUNTED AND REFLECTORIZED):

1. Location: Centered on the parking space reserved for persons with disabilities in accordance with UBC 1129B5.
2. Height: 60 inches from the bottom of sign to parking space finished grade, in accordance with UBC 1129B5.
3. Size: Not smaller than 70 square inches.
4. Wording: As required to suit local regulations.
5. Pictogram: Symbol of accessibility in white on dark blue.

J. UV DISINFECTION VIEWING HATCH:

1. Location: UV disinfection viewing hatches.
2. Height: On top of each hatch.
3. Size: 9 inches wide by 5 inches high
4. Heading: CAUTION
5. Wording: HIGH INTENSITY UV LIGHT
   WEAR EYE PROTECTION

END OF SCHEDULE B
METAL SAFETY SIGN SCHEDULE

SCHEDULE C

HAZARD MATERIAL SIGNALS

A. HAZARD SIGNAL FOR SODIUM HYPOCHLORITE 12.5 PERCENT:
   1. Location: At entrances to locations where stored and on storage tanks.
   2. Height: 60 inches above floor to center of sign.
   3. View Distance: 25 feet
   4. Health: 2
   5. Flammability: 0
   6. Reactivity: 1
   7. Special: COR

B. HAZARD SIGNAL FOR ALUMINUM SULFATE (ALUM) 45 PERCENT:
   1. Location: At entrances to locations where stored and on storage tanks.
   2. Height: 60 inches above floor to center of sign.
   3. View Distance: 25 feet.
   4. Health: 2
   5. Flammability: 0
   6. Reactivity: 1
   7. Special: COR

C. HAZARD SIGNAL FOR DIESEL FUEL:
   1. Location: At entrances to locations where stored and on storage tanks.
   2. Height: 60 inches above floor to center of sign.
   3. View Distance: 25 feet.
   4. Health: 2
   5. Flammability: 2
   6. Reactivity: 0
   7. Special: -

END OF SCHEDULE C
HAZARD MATERIAL SIGNALS

SCHEDULE D

CAST ALUMINUM LETTERS

A. Building Identification:
   1. Above main doors as follows:
      a. Administration building: “ADMINISTRATION BUILDING”
      b. Dewatering building: “DEWATERING BUILDING”
      c. Electrical building: “ELECTRICAL BUILDING”
      d. Maintenance building: “MAINTENANCE BUILDING”

B. Structure Identification:
   1. Inconspicuously on each structure as follows:
      a. Oxidation ditch 1: “OXIDATION DITCH 1”
      b. Oxidation ditch 2: “OXIDATION DITCH 2”
      c. Secondary clarifier 1: “SECONDARY CLARIFIER 1”
      d. Secondary clarifier 2: “SECONDARY CLARIFIER 2”

END OF SCHEDULE D
CAST ALUMINUM LETTERS

SECTION 10500

LOCKERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Lockers and locker benches.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01600 - Product Requirements.

1.02 SUBMITTALS

A. Shop drawings and product data: Include dimensions to adjacent surfaces, fillers, trim, base, accessories, and numbering sequence.

B. Samples: Include minimum 6-inch square sample of selected finish on actual substrate.

C. Manufacturer's installation instructions.

1.03 QUALITY ASSURANCE

A. Provide lockers which are standard products of a single manufacturer and which have interchangeable parts including mounting accessories, fittings, and fastenings.

B. Manufacturer qualifications: Manufacturer of proposed products for minimum 5 years with satisfactory performance record of minimum 5 years.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal lockers and benches when building is enclosed and securable.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Lockers: One of following or equal:
   1. Lyon Metal Products, Inc., Aurora, IL.

2. Medart, Inc., Greenwood, MS.
3. Penco Products, Inc., Oaks, PA.
4. Republic Steel Corp., Canton, OH.

2.02 LOCKERS

A. Type: Single tier, 12 inches wide by 15 inches deep by 60 inches high.

B. Sheet steel: Commercial grade, mild annealed, cold rolled and stretcher leveled, with following thicknesses:
   1. Bodies and shelves: Minimum 24 gauge.
   2. Door frames: Minimum 16 gauge.
   3. Tops and trim: Minimum 18 gauge.
   4. Sloped tops: Minimum 20 gauge.

C. Hinges: Minimum 2 inches high, 0.050-inch thick steel, 5 knuckle with spun over pin ends.

D. Fittings:
   1. Recessed locking handles with provisions for user furnished padlocks.
   2. Double prong coat hook, fastened with 2 rust-retardant treated bolts to underside of shelves.
   3. Three single prong coat hooks, each fastened with 2 rust-retardant treated bolts on walls.
   4. Aluminum door number plates with embossed or etched, minimum 3/8-inch high numbers. Number sequence as directed.
   5. Rubber bumpers.

E. Bodies: Formed and flanged.

F. Door frames: Formed channel shape, welded and ground flush.

G. Doors: 1 piece with vertical edges channel shaped, top and bottom, flanged at 90-degree angle, 3 hinges welded to door and bolted to frame, and ventilation louvers at top and bottom.

H. Hat shelves: Approximately 9 inches from top of each locker with flanged sides; front flanges turned 45 degrees for safety.

I. Bases: 4-inch high cabinet style closed section; capable of being anchored to floor with provisions for adjustment.

J. Sloped tops: Lengths as long as possible, but not less than 4 lockers long; slope at approximately 25 degrees; closed ends where exposed.

K. Fasteners and anchors: As recommended by locker manufacturer.

L. Finish:
   1. Preparation: Clean, degrease, and neutralize.
   2. Paint materials and application: Electrostatically sprayed with heavy coat high quality enamel and baked at 300 degrees Fahrenheit, capable of withstanding rigid hammer test without chipping and flanking.
   3. Color: As selected from manufacturer's standard colors.

2.03 LOCKER ROOM BENCHES

A. Tops: Clear hardwood, 9-1/2 inches wide by 1-1/4 inches thick by indicated lengths, finished with 3 coats of clear sealer.

B. Pedestals: Steel standards, fastened to tops at 12 inches from ends and equally spaced at maximum 60 inches on center, 16-1/2 inches high, painted to match lockers.

C. Fasteners and anchors: As recommended by bench manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that condition of substrates are satisfactory for installation of products as specified in Section 01600.

B. Take site measurements to verify adequacy of spaces for lockers and benches.

3.02 PREPARATION

A. Assemble locker units. Secure units together.

3.03 LOCKER INSTALLATION

A. Install lockers in accordance with manufacturer's instructions.

B. Install lockers plumb, level, rigid, and flush.

C. Secure fastenings through backup reinforcing plates.
   1. Avoid metal distortion.

D. Install trim, cabinet base, sloping top units, metal filler panels and end panels with flush, hairline joints using concealed fasteners.

3.04 BENCH INSTALLATION

A. Install benches in accordance with manufacturer's instructions.

B. Install benches plumb, level, rigid, and secure.

3.05 ADJUSTING

A. Adjust and lubricate locker doors and latches to operate easily without binding.

B. Verify that integral latching devices are operating properly.

3.06 PROTECTION

A. Touch-up marred finishes that can be restored to factory-finished appearance.

B. Use materials recommended or furnished by locker manufacturer.

C. Replace damaged lockers and benches that cannot be restored to factory-finished appearance with good, undamaged products.

END OF SECTION

SECTION 10520

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Fire extinguishers and cabinets.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 04220 - Concrete Unit Masonry.
      b. Section 06100 - Rough Carpentry.
      c. Section 09250 - Gypsum Board.

1.02 REFERENCES

A. National Fire Protection Association (NFPA).

B. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Product Data.

B. Manufacturer's Installation Instructions.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed products for minimum 5 years with satisfactory performance record of minimum 5 years.

B. Regulatory requirements:
   1. Comply with UL requirements for classification type.
   2. Provide fire-rated cabinet tubs where required to maintain fire rating of walls.

1.05 SEQUENCING AND SCHEDULING

A. Coordinate installation of anchoring devices.

B. Coordinate preparation of openings for fire extinguisher cabinets in accordance with cabinet manufacturer's instructions and as specified in Section 09250.

C. Coordinate installation of blocking for anchoring of accessories in accordance with Sections 04220 and 06100.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire extinguisher and cabinets: One of the following or equal:
   1. J.L. Industries, Bloomington, MN.
   2. Larsen's Manufacturing Company, Minneapolis, MN.
   3. Modern Metal Products by Muckle, Owatonna, MN.
   4. Watrous, Incorporated, Northbrook, IL.

2.02 FIRE EXTINGUISHERS

A. Type FE05: UL 2A:10B:C with 5-pound capacity of dry chemical with ammonium phosphate base for extinguishing ABC fires.

B. Type FE10: UL 4A:60B:C with 10-pound capacity of dry chemical with ammonium phosphate base for extinguishing ABC fires.

C. Type FE20: UL 20A:120B:C with 20-pound capacity of dry chemical with ammonium phosphate base for extinguishing ABC fires.

D. Type EFE10: UL 1A:10B:C with 10-pound capacity of colorless, odorless, electrically non-conductive liquefied gas, or clean agent as defined by NFPA, for extinguishing electrical fires without leaving residue.

E. Type EFE15: UL 2A:10B:C with 15-pound capacity of colorless, odorless, electrically non-conductive liquefied gas, or clean agent as defined by NFPA for extinguishing electrical fires without leaving residue.

2.03 WALL BRACKETS

A. Type: Standard as manufactured by fire extinguisher manufacturer.

2.04 FIRE EXTINGUISHER CABINETS

A. Manufacturers: One of the following or equal:
   1. J. L. Industries.

B. Cabinets: Recessed or surface mounted as indicated; stainless steel at wet areas, steel elsewhere:
   1. Tub:
      a. Trim: Recessed, 1-1/4-inch face trim.
      b. Material: Cold-rolled steel.
      c. Finish: Semi-gloss epoxy, white.

C. Door:
   1. Type: Clear Vu Series.
   2. Style: Full acrylic.
   3. Glazing: Clear bubble, 1/8-inch thick.
   4. Stiles and rails: 1 inch wide.
   5. Metal material: Same as for tub.
   6. Metal finish: Same as for tub.
   7. Pull: Manufacturer's standard.
   8. Catch: Self-adjusting roller type.

2.05 OPERATING HARDWARE

A. Hinges: Continuous heavy duty hinge.

B. Lock:
   1. Five pin-tumbler Special Purpose Cabinet Lock with solid cam that will not break or bend away. Key shall be removable in locked position only.
   2. Manufacturer: One of the following or equal:
      a. Yale, Model.

2.06 ACCESSORIES

A. Extinguisher brackets: Formed steel, corrosion resistant finish, size and type to suit extinguisher.

B. Cabinet signage: Black painted lettering, 1-inch high, indicating cabinet function; "FIRE EXTINGUISHER" or "FIRE HOSE" as appropriate. Place lettering vertically on hinge side of door.

C. Cabinet mounting hardware: Appropriate to cabinet.

D. Fasteners: Fasteners exposed in the final installation, with the door open and closed, shall be tamper-proof fasteners.

2.07 FABRICATION

A. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim.

B. Pre-drill for anchors.

C. Hinge doors for 180-degree opening.

D. Weld, fill, and grind components smooth.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's recommendations.

B. Install products plumb, square, and level.

C. Place extinguishers: Locate 1 extinguisher in each cabinet and elsewhere as indicated.

3.02 SCHEDULE

A. Install fire extinguisher on wall brackets when fire extinguisher are indicated without cabinets.

B. Install fire extinguisher in cabinets when fire extinguisher cabinets are indicated.

C. Furnish and install as scheduled below.

Facility	Extinguisher Type	Extinguisher Quantity	Locations	Wall Bracket or Cabinet
Administration Building	As indicated on the Drawings	As indicated on the Drawings	As indicated on the Drawings	As indicated on the Drawings
Maintenance Building	As indicated on the Drawings	As indicated on the Drawings	As indicated on the Drawings	As indicated on the Drawings
Dewatering Building	As indicated on the Drawings	As indicated on the Drawings	As indicated on the Drawings	As indicated on the Drawings
Electrical Building	As indicated on the Drawings	As indicated on the Drawings	As indicated on the Drawings	As indicated on the Drawings
Chemical Facility	Type FE05	2	As directed by ENGINEER, 1 per each chemical containment area	Wall Bracket

END OF SECTION

SECTION 10810

TOILET ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Toilet accessories.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 06100 - Rough Carpentry.

1.02 REFERENCES

A. Americans with Disabilities Act (ADA).

B. ASTM International (ASTM):
   1. A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

C. California Code of Regulation (CCR):
   1. 24 - Building Standards Code.

1.03 SUBMITTALS

A. Shop drawings: Include schedule of proposed products.

B. Product data: Include dimensions gauge, profiles, materials, fabrication details, manufacturer's installation instructions including setting drawings where cutouts are required, templates, substrate preparation instructions and directions for preparing cutouts for installation of accessories.

C. Special samples:
   1. Include 1 of each accessory type.
   2. Special samples acceptable to ENGINEER may be installed in the Work.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed products for minimum 5 years with satisfactory performance record of minimum 5 years.

B. Installer qualifications:
   1. Manufacturer-approved installer of products similar to specified products on minimum 5 projects with satisfactory performance record.
   2. Furnish toilet accessories by 1 manufacturer, unless scheduled otherwise.

C. Requirements of regulatory agencies: In accordance with ADA, CCR Title 24, Part 2, for provisions for the physically handicapped; materials and installation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Maintain protective coatings or coverings on units until installation is complete.

1.06 SEQUENCING AND SCHEDULING

A. Coordinate installation of blocking for anchoring of accessories as specified in Section 06100.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Toilet accessories: One of following or equal:
   1. Bobrick Washroom Equipment Co., Inc., North Hollywood, CA.
   2. General Accessory Manufacturing Co., Durant, OK.
   3. McKinney/Parker, Essex Ind., Inc., San Francisco, CA.
   4. Watrous, Div. of Lansbrie Corp., Northbrook, IL.

2.02 MATERIALS

A. Stainless steel: ASTM A 240, Type 304 or 316; minimum 28 gauge.

2.03 TOILET ACCESSORIES

A. Manufacturer: Bobrick Washroom Equipment Co., Inc.

B. Types:
   1. Combined toilet seat cover dispenser, toilet paper holder: B-347, type to suit application.
   2. Combined toilet seat cover dispenser, napkin disposal, toilet paper holder: B-357, type to suit application.
   3. Grab bars: B-6106 (exposed fasteners) or B6806 (concealed fasteners), sizes and shapes indicated, with appropriate anchors.
   4. Mirror with 3/4- by 3/4-inch frame: B-290, sizes as indicated on the Drawings.
   5. Mirror with 3/4-by 3/4-inch frame and shelf: B-292, sizes as indicated.
   6. Mop and broom holder: B-223, x 24 inches, 3 holders.
   7. Paper towel dispenser/waste receptacle, semi-recessed, plastic liner: B-3944.
   8. Paper towel dispenser/waste receptacle, surface mounted, plastic liner: B-3949.
   9. Soap dispenser, counter mounted, liquid soap: B-8221, with 16 fluid ounce polyethylene container.

10. Toilet paper holder, double, surface mounted: B-2888.
11. Waste receptacle, free standing: B-2250.

C. Fasteners: Concealed or tamperproof, sized to suit application.

2.04 FABRICATION

A. Weld and grind smooth joints of fabricated components.

B. Form exposed surfaces from single sheet of stock, free of joints.

C. Form surfaces flat without distortion.
1. Maintain flat surfaces without scratches or joints.

D. Shop assemble components and package complete with anchors and fittings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for the installation of accessory items.

B. Verify that supports and reinforcements are in place and proper for accessory installation.

C. Do not begin installation until conditions are satisfactory.
1. Beginning installation means acceptance of existing conditions.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site at the appropriate time for building-in.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install units plumb and level.
1. Firmly anchor accessories.

C. Install grab bar connectors or support angles between studs securely enough to withstand horizontal pull of 300 pounds.

D. Accurately position grab bar connector assemblies and tighten to support angles before application of wall finish.
1. After completion of wall surface, secure concealed mounting plate to connector assembly with stainless steel machine screws.

E. Use through-bolted connection for grab bars on toilet compartments.

3.04 ADJUSTING

A. Adjust accessories for proper operation and verify that mechanisms operate smoothly.

B. Replace damaged or defective products with good products.

END OF SECTION

SECTION 11122

RESERVOIR MIXER

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: the requirements to furnish, install, and place into operation a potable tank mixer in the new, onsite water reservoir.

B. Tag Number:
   1. 60-MIX-714: Reservoir Mixer.

C. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.
      b. Section 01740 - Warranties and Bonds.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 01782 - Operation and Maintenance Data.
      e. Section 15050 - Common Work Results for Mechanical Equipment.
      f. Section 15958 - Mechanical Equipment Testing.

1.02 REFERENCES

A. Occupational Safety and Health Administration, OSHA.

B. Department of Transportation, DOT.

C. NSF/ANSI Standard 61.

D. Underwriters Laboratories, Inc., UL 508.

1.03 QUALITY ASSURANCE

A. Continuous Operation Equipment: The mixer shall operate continuously using 120 VAC as the power source.

B. No Visual Defects: The mixer shall have no visual defects, and shall have high quality welds, assembly, and corrosion resistant finish.

C. Qualified Manufacturer: The manufacturer of the mixer shall have at least 5 years of experience in the production of such equipment for mixing in water reservoirs.

D. Mixer: The furnished model shall be a model that has been in continuous service under similar service conditions for at least 3 years. Provide references for 3 such installations.

E. Factory Start-up Services: Start-up services shall be included. Factory services shall be performed by full-time factory employees experienced in the operation of this equipment and who have completed OSHA safety trainings applicable to this type of installation.

F. Warranty:
   1. The mixer shall be warranted to be free of defects in materials and workmanship for a period of 2 years. The warranty shall commence from the date specified in Section 01740.
   2. The mixer shall be warranted to completely mix and maintain the tank's contents in a non-stratified condition and without dead spots at all water depths between 6 feet and the overflow elevation. Complete mix is defined as: the chemical composition at any point shall not vary by more than 5 percent from that at any other point.
   3. The mixer design shall be such that the entire contents of the reservoir shall be turned over at least once every 6 hours.

1.04 SUBMITTALS

A. The CONTRACTOR shall provide the following documents per Section 01330:
   1. A qualification statement demonstrating compliance with Article 1.03.
   2. Shop drawings for the mixer.
   3. Manufacturer's literature, illustrations, and specification sheets defining materials of construction, dimensions, and weights.
   4. Material clearly demonstrating that the mixer will provide the degree of mixing specified in a reservoir of the actual dimensions shown on the Drawings. The material shall be a CFD model or other material acceptable to ENGINEER.
   5. A copy of the warranty statement.
   6. Panel Construction and wiring details per Section 01782.

B. Final submittals shall include:
   1. A complete installation, operation, and maintenance manual.

1.05 FIELD SERVICES

A. Factory Personnel: The start-up shall be performed by full-time factory employees trained in the operation of the mixer.

B. Safety: Installation personnel shall have received job-specific safety training.

C. Refer to Part 3 of this Section for additional field services requirement.

PART 2 PRODUCT SPECIFICATIONS

2.01 MANUFACTURER

A. Specified Equipment: The mixer shall be manufactured by SolarBee©, Inc. of Dickinson, ND, or equal.

B. Alternative(s): Alternatives to the specified equipment will be considered on the following basis only:
   1. No material difference in quality of equipment or in vendor support. The application should include:
      a. A thorough description of how the offered alternative does or does not meet each of the specifications in this document.
      b. A statement of the science and support background of the supplier of the alternative equipment, so that the benefits and costs of the alternative equipment to the OWNER can be estimated by the ENGINEER.

2.02 PERFORMANCE AND FEATURES

A. Number of Units Required: To meet the project objectives, the following number of machines is required:

Qty	Model
1	GridBee Model GS-12-type potable tank mixer

B. Required Flow Rating: Upon request, the manufacturer shall provide, at no additional cost, CFD modeling supporting the flow rate of the mixer, with water of 1.00 specific gravity, to be 38,000 gpm of upward flow in a 70,000 to 122,000 gallon tank of approximate dimensions 35 feet in diameter by 17 feet deep.

C. Complete Mix: The manufacturer guarantees that the subject tank will be completely mixed by the mixer. In continuous operation of the mixer:
   1. At least once per 6 hours, all water temperatures within the tank shall converge to within 0.8 degrees C.
   2. At least once per 6 hours, all chlorine concentrations within the tank shall converge to within 0.20 mg/L.

D. Continuous Operation with 120 VAC Power Supply: The mixer shall operate continuously.

E. Stainless Steel Construction: The mixer shall be constructed primarily of Type 316 stainless steel.

F. Motor: The mixer shall be mechanically operated by a submersible motor that meets the following criteria:
   1. Direct drive, with no gearbox and no lubrication maintenance required.
   2. Designed for submersible operation.
   3. Designed for continuous operation without overheating or compromising motor life expectancy.
   4. Certified for running continuously in water at a depth of 8 inches.
   5. Power and control wires and their termination at the motor shall be armored, waterproof cable attached to the motor with waterproof fittings. Cable length to reach from the motor to the junction box mounted on the reservoir roof plus 15 feet. No splices shall be permitted.
   6. Motor shall have a service factor of at least 1.15 under all operating conditions.
   7. NEMA design B with Class F insulation.
   8. Motor Power: 0.75 horsepower, minimum.

G. Low Elevation Intake: The mixer shall be supplied with an intake capable of being positioned at the lowest elevation of the tank or reservoir floor. The intake level shall bring water into the mixer at horizontal layer within 6 inches of the reservoir floor.

H. The complete mixing system shall be NSF/ANSI Standard 61 and NSF Annex G listed for safe contact with potable water.

I. Maintenance Requirements: The mixer shall operate normally with the following maintenance features:
   1. No scheduled lubrication is required of any system components including motor.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Section 15050.

3.02 FIELD QUALITY CONTROL

A. Witnessing: All field testing shall be witnessed by the ENGINEER; provide advanced notice of field testing as specified in Sections 01660 and 15958.

B. Inspection and checkout: As specified in Sections 15050 and 15958.

C. Equipment performance test: Test for complete mixing; test as specified in this Section and per Section 15958.

D. Operational testing: As specified in Section 01660. Temperature, noise, and vibration testing specified within the general equipment performance and pump performance test sections is not required.

3.03 MANUFACTURER'S FIELD SERVICE

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and in Sections 15050 and 15958.

B. Training: as specified in Section 01660.

END OF SECTION

SECTION 11212

POTABLE WATER STORAGE AND BOOSTER SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes: Package potable water storage and booster system with all internal piping and instrumentation as described herein.

B. The Work to be provided by the SUPPLIER of the potable water storage and booster system includes the following:
   1. Submission of shop drawings and other descriptive information.
   2. Furnishing all equipment described herein.
   3. Factory testing.
   4. Delivery of the equipment to the Project site or designated storage location as directed by the CONTRACTOR.
   5. Installation assistance, quality control, quality assurance, and inspection.
   6. Follow-up services as specified.

C. The SUPPLIER shall coordinate with the CONTRACTOR for shipment and delivery of the equipment provided in this section. The CONTRACTOR will be responsible for installing the SUPPLIER's equipment, unless otherwise noted in this specification.

D. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01612 - Seismic Design Criteria.
      b. Section 01614 - Wind Design Criteria.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 01740 - Warranties and Bonds.
      e. Section 01782 - Operation and Maintenance Data.
      f. Section 09960 - High-Performance Coatings.
      g. Section 11312L - Vertical Multistage Centrifugal Pumps.
      h. Section 13206F - Hydropneumatic Bladder Tank.
      i. Section 15052 - Common Work Results for General Piping.
      j. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division 1.

B. American Society for Testing and Materials ASTM International (ASTM):
   1. D 1998 - Standard Specification for Polyethylene Upright Storage Tanks.

C. NSF International Standard (NSF)/American National Standard(ANSI):
   1. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

1.03 SUPPLIERS

A. One of the following SUPPLIERS, or equal:
   1. Dawson Co., Pomona, CA.
   2. Pump Tech, Inc., Bellevue, WA.

1.04 SUBMITTALS

A. CONTRACTOR is responsible for completing the Pressure Vessel Inspection Request Form that can be found at the California's Department of Industrial Relations website http://www.dir.ca.gov/dosh/pressure.html#PresureVessel.

B. CONTRACTOR shall coordinate point of contact with OWNER.

C. Product data: List of materials and coatings used.

D. Shop drawings and calculations:
   1. Detail drawings or manufacturer's literature to indicate compliance with the specified requirements.
   2. Shop drawings: Dimensional drawings indicating vessel dimensions, wall thickness, mounting, and anchorage requirements.
   3. Provide anchor bolt details, embedment depth, edge distance, calculations, and installation instructions stamped by a Registered Civil or Structural Engineer meeting the requirements of Section 01612 – Seismic Design Criteria and Section 01614 – Wind Design Criteria. CONTRACTOR is responsible to coordinate the anchor bolt design with the footing design shown on the Contract Drawings. The anchor bolts shall be designed to work with the footing dimensions as shown on the Contract Drawings.
   4. Calculations: Copy of structural, seismic, and wind loading calculations for the support system sealed and signed by a Professional Structural Engineer licensed in the state where the project is located.

E. Test reports and certifications:
   1. Certification and ASME Code data reports in accordance with the ASME Code and other similar codes.
      a. The certification shall include certification of post weld heat treatment, joint radiography, and hydrostatic testing.
   2. Signed pressure test report from hydropneumatic tank fabricator.

F. Close-out submittals:
   1. Operation and Maintenance Manuals, as specified in Section 01782.

2. OWNER's manual:
   a. Test reports and certifications: The certification shall include certification of post weld heat treatment, joint radiography, and hydrostatic testing.
   b. Certification and ASME Code data reports in accordance with the ASME Code and other similar codes.
   c. Fabrication drawings.
   d. Copy of structural, seismic, and wind loading calculations for the support system signed by a Structural Engineer registered in the state where the Project is located.

1.05 WARRANTY

A. The SUPPLIER shall guarantee that the materials and/or the workmanship of the package system supplied be free of defects for a period of 2 years from the date specified in Section 01740.

PART 2 PRODUCTS

2.01 SKID

A. All components of this system to be mounted on a single skid and weatherproof.

B. NEMA rating for electrical enclosures per Section 16050.

C. Water contact components must be NSF 61 certified.

D. Potable Water Storage Tank (Tag number: 60-TNK-760):
   1. 1,000 gallon capacity polyethylene tank
      a. Tank wall thickness:
         1) Calculated in accordance with ASTM D 1998 using design specific gravity of 1.3.
         2) Not be less than 0.187 inches thick.
   2. Roof hatch for air gap inlet. Inlet piping to be provided by the CONTRACTOR.
   3. Roof vent.
   4. Flange outlet.
   5. Drain.
   6. Liquid level indicator: As specified in Section 17206. Mounting to be provided by SUPPLIER, level indicator to be provided by the CONTRACTOR.
   7. 1-inch female NPT port for chemical injection, located 2 feet from tank bottom.
   8. Isolation valve to be provided by SUPPLIER, immediately downstream of tank outlet, before pump suction header.

E. Booster Pumps (Tag numbers: 60-PMP-761, 60-PMP-762, 60-PMP-763):
   1. Three vertical multistage centrifugal pumps in rotating Lead-Lag-Standby positions.
   2. See Section 11312L for design and performance requirements of pumps.

F. Hydropneumatic Tank (Tag number: 60-TNK-765):
   1. Bladder-type design.
   2. See Section 13206F for design and performance requirements.

G. Piping:
   1. All piping on skid will be GALV, Sch. 40.

2. Piping and instrumentation immediately downstream of connection to the hydropneumatic tank will be provided by the CONTRACTOR. All other piping on skid to be provided by the SUPPLIER.

H. Wiring:
1. All wiring to comply with Section 16050.
2. Wiring on skid to be provided by the CONTRACTOR.

PART 3 EXECUTION

3.01 SHIPMENT

A. The packaged system will remain as fully assembled as possible during shipment.

3.02 INSTALLATION

A. CONTRACTOR will verify system dimensions and tolerances per shop drawings and report any discrepancies to ENGINEER within the first 5 days of inspection by the SUPPLIER. CONTRACTOR will provide report to ENGINEER and SUPPLIER.

B. Installation of the equipment will be by the CONTRACTOR in accordance with the Contract Documents and the SUPPLIER's engineering drawings and instructions.

C. Should any components become damaged in any way until equipment is accepted by the CONTRACTOR, SUPPLIER shall remove and replace them before field testing begins.

D. SUPPLIER shall provide the following on-site field visits:
1. 1 day for the following:
   a. Inspection of all equipment with piping fully installed.
   b. Training of CONTRACTOR system operation.
2. 1 day for startup, testing, optimization, and training of OWNER's staff.
3. 1 additional day during the Commissioning Phase as specified in Section 01660.
4. Service time spent remedying equipment deficiencies/problems provided by the SUPPLIER shall not count toward the listed service days and trips.

3.03 FIELD TESTING

A. Field Checks:
1. Prior to the final acceptance field testing, the SUPPLIER shall field verify that all components are installed properly and function as specified herein. These checks for proper installation and alignment shall include, but not be limited to:
   a. Storage tank and hydropneumatic tank installation.
   b. Internal piping.
   c. Booster pumps.

B. Upon completion of these checks, the SUPPLIER shall submit to the OWNER, written certification that the equipment and components associated with SUPPLIER's scope of work have been properly installed, are in good condition, are functioning properly, and are in accordance with the Contract Documents.

END OF SECTION

SECTION 11223A

SUBMERGED TURBINE MIXERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Mechanical submerged turbine mixers for use in the oxidation ditch anoxic zone. Each mixer includes the following components:
   1. Drive motor.
   2. Gear reducer.
   3. Impeller shaft and impeller.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01610 - Project Design Criteria.
      b. Section 01660 - Testing, Training, and Commissioning.
      c. Section 09960 - High-Performance Coatings.
      d. Section 15050 - Common Work Results for Mechanical Equipment.
      e. Section 15958 - Mechanical Equipment Testing.
      f. Section 16050 - Common Results for Electrical.
      g. Section 16222 - Low Voltage Motors up to 500 Horsepower.

1.02 REFERENCES

A. American Bearing Manufactures Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Gear Manufacturers Association (AGMA).

C. ASTM International (ASTM):
   1. A 36 - Standard Specification for Carbon Structural Steel.
   2. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. American Welding Society (AWS).

E. National Electrical Manufacturer's Association (NEMA).

F. Steel Structures Painting Council (SSPC):
   1. SP 1 - Solvent Cleaning.
   2. SP 10 - Near-White Blast Cleaning.

1.03 DEFINITIONS

A. As specified in Section 15050.

1.04 SYSTEM DESCRIPTION

A. As specified in Section 15050.

B. Design Criteria

Equipment Tag Numbers	**20-MIX-090** **20-MIX-100**
Number of Anoxic Zones	1 per Oxidation Ditch
Number of Mixers per Anoxic Zone	1
Liquid Being Mixed	Mixed Liquor
Mixed Liquor Suspended Solids (MLSS)	3,400 mg/L
Anoxic Zone Volume	224,000 gallons
Liquid Level	12.25 feet(1)
Minimum Motor Nameplate Power	10 hp(2)
Maximum Nominal Motor Speed	1,800 rpm
Material of Wetted Parts	316 Stainless Steel or FRP
Impeller Type	3 Bladed Anti-Ragging Hyperfoil or Hyperbolic
Notes: 1. In storage mode, the water in the ditch will rise by 7 inches to a maximum side water depth (SWD) of 12.83 feet. The mixer shall keep the solids in suspension. 2. The motor horsepower for the mixer shall be non-overloading at the maximum SWD.	

1.05 SUBMITTALS

A. As required by Section 15050.

B. Furnish motor submittals as specified in Section 16222.

C. Product data:
   1. Catalog data and manufacturers' specifications.
   2. Material specifications.

D. Shop Drawings:
   1. Certified shop and working drawings.
   2. Shop drawing data for accessory items.
   3. Templates or certified setting plans, with tolerances for anchor bolts

E. Calculations: As required by Section 15050.

F. Quality control submittals: As required by Section 15050.

G. Operation and maintenance manuals: As required by Section 15050.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Manufacturer qualifications:
   1. Consideration will be given only to the mixers of manufacturers who are regularly engaged in such work and thoroughly experienced in the design and manufacture of submerged turbine mixers of the size and type specified which have been in successful and continuous operation in United States for not less than 5 years.
   2. Manufacturers shall submit a certified list of installations and references for verification including start-up dates.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 SEQUENCING AND SCHEDULING

A. As specified in Section 15050.

1.09 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.10 MAINTENANCE

A. Spare equipment:
   1. Motor and gear reducer bearings: 1 set.
   2. Oil sensing gear reducer cutout level switch: 1.
   3. Flexible motor coupling: 1.
   4. Gear reducer: 1, complete, suitable for operation in either direction.
   5. Motor: 1.

1.11 WARRANTY

A. As specified in Section 15050.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following or equal:
   1. Chemineer.
   2. Philadelphia Mixing Solutions Limited (PMSL).
   3. Invent Environmental Technologies, Inc. – Hyperbolic Mixer.

2.02 MATERIALS

A. Design for long, continuous, and uninterrupted service; easy adjustment or replacement of parts; minimum 1/4-inch thickness, steel members; minimum 1/2-inch diameter, structural bolts.

B. Structural steel in accordance with ASTM A36.

C. Iron castings in accordance with ASTM A48.

2.03 MOTORS

A. Motors: As specified in Section 16222 and as follows:
   1. Chemical or severe duty.
      a. Enclosure: Suitable for area classification as defined in Section 16050.
      b. Voltage/Hertz/Phase: 460/60/3.
      c. Speed: 1,800 rpm.
      d. NEMA Premium efficient.
      e. P-base or C-face for mounting to the gear reducer.
      f. Motor winding heaters.
      g. Winding temperature detectors.
   2. Motors rated at 40 degrees Celsius ambient with Class F insulation; with service factor of 1.15, complying with the applicable provision of the Standards of NEMA. ABMA 9 and 11 L10 life for bearings, 100,000 hours.
   3. Cast iron construction:
      a. Mount in a vertical position to the gearbox and furnished with a canopy cap (drip cover) and suitable lifting lugs.
      b. Connect motor to gear reducer using of a flexible coupling.
   4. The conduit boxes shall be gasketed with neoprene or equivalent material, so as to prevent moisture from entering the stator through the conduit box.
   5. Drain holes shall be suitably positioned in the lower external surface so that any accumulation of moisture can drain from the complete motor housing.
   6. Ball or roller bearings shall be supplied and shall be grease lubricated.
   7. Grease reservoirs shall be ample and provisions shall be made for regreasing with a lubrication system where grease is flushed through the bearings.
   8. The winding end turns shall be dipped and brushed with a nonhydroscopic coating.
   9. Provide protective coating per Section 16222 for corrosive environments.
   10. The nameplates shall per Section 16222.

2.04 GEAR REDUCERS

A. Design requirements:
   1. Designed for vertical output shaft operation.

2. Housing: Housing shall be all cast iron construction with provisions for attachment of suitable lifting devices.
    a. Helical meshes or spiral bevel are acceptable.
    b. Worm-gearing shall not be used.
3. Pinion and gear materials shall meet aircraft clean liners requirements per AMS 2301, through hardened, nitride hardened, or carburized and hardened, and finished by shaving or grinding to an AGMA Class 9 or better quality level.
4. All shafts shall be supported on tapered roller or double spherical roller bearings.
5. The gearbox housing shall be sealed and have a corrosion-resistant coating as specified in Section 09960 to provide maximum protection against moisture and contaminants.

B. Type: Helical gear type sized with a minimum service factor of 3.0 times the motor nameplate horsepower rating in accordance with applicable AGMA standards.

C. Bearing life:
1. The minimum L-10 bearing design life shall be 100,000 hours in accordance with ABMA 9 or ABMA 11.
2. The efficiency shall not be less than 92 percent based on the reducer input horsepower.

D. Mounting:
1. Each gear reducer shall be mounted on a steel baseplate or mounting bars with steel bolts.
2. The baseplate or mounting bars shall be mounted on 4 zinc-plated jack studs inserted in the platform structure and adequately designed to withstand all normal operating loads or as recommended by the manufacturer.

E. Gear reducer lubrication system:
1. Each gear reducer shall employ a splash-type lubrication system.
2. All gear meshes shall be oil lubricated and all bearings shall be oil or grease lubricated.
3. A dry well shall be used to prevent oil leakage down the output shaft.
    a. Special baffled breathers shall be installed.
    b. The housing shall be provided with an oil level sight glass or dipstick.
    c. Provide accessible oil drain.
4. Low oil level cut-out switch:
    a. Provide each reducer with a low oil level cutout switch.
    b. Each switch shall be externally accessible and available for connection to the motor control center to allow the control to stop the mixer drive motor in the event of a loss of lubrication.
    c. Include separate contact for alarm at remote location.

2.05 IMPELLERS AND SHAFTS

A. General:
1. The impeller shaft shall be of sufficient size and thickness to safely withstand the torque and hydraulic side forces imposed by the mixer impeller.
    a. The impeller shaft shall preclude the use of a split flange-type coupling used for mounting the impeller shaft to the gear reducer output shaft.

2. The impeller shaft shall be 2-plane dynamically balanced to ensure proper operating stability.
3. The impeller shaft shall be assembled to the impeller with ASTM A 325 high-strength bolts only.
4. The design shall preclude the use of underwater bearings to provide the required operating stability.

B. Hyperfoil Impeller type:
1. Impeller blades shall be designed with a swept profile to prevent the accumulation of rags anywhere on the impeller leading edges. They shall produce an axial flow directed downwards towards the tank bottom.
2. Design as a low-shear pump, and design to pump water with minimal air entrainment.

C. Hyperbolic Impeller type:
1. The hyperboloid mixer body shall be manufactured of FRP and be a streamlined stress-free body without any mounted or fitted parts.
2. The transport ribs which accelerate the flow shall be integrated in the mixer body (INVENT - Evolution 6 design).
3. The mixer body shall be coated with a special gel coat to provide a polished surface.
4. The hyperboloid mixer shall have laminated stainless steel insert nuts.

D. Fabrication:
1. Materials: All structural steel used in the fabrication of the mixer shall be in accordance with ASTM A 36.
2. Welding: All shop welding in accordance with AWS.
3. Fabricated assemblies shall be shipped in convenient sections as permitted by carrier installations.

2.06 RELATED EQUIPMENT

A. Anti-vortex baffles:
1. Provide 1 anti-vortex baffle fabricated of 1/4-inch steel plate for each mixer to be positioned at the water surface as close to the turbine shaft as possible.
2. Assembly bolts shall be Type 304 or 316 stainless steel.

B. Coating:
1. Shop priming gear boxes and other metal parts: Shop-priming shall consist of a coating that is compatible with the field coating as specified in Section 09960.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's installation instructions.

B. Manufacturer's representative: Furnish the services of an approved manufacturer's representative to supervise the erection, starting, operating, testing, and to instruct the operating personnel on the operation of the equipment. Include minimum of 3 days.

C. Field coating as specified in Section 09960.

3.02 FIELD TESTING

A. Provide the services of a qualified factory representative to perform tests of the installation to verify that the mixing equipment operates within acceptable vibration severity limits and to determine baseline vibration spectra for future use in identifying maintenance actions.

B. Perform Level 2 Quality Control Test per Section 15958.

C. Test results:
   1. If the results do not meet the required performance, CONTRACTOR shall have 20 days to propose changes that meet the acceptance of the OWNER, and 60 days to make these changes, at no cost to the OWNER.
   2. The system shall then be retested at CONTRACTOR's expense.
   3. If the system again fails to meet the required performance, CONTRACTOR shall replace the mixing equipment with that of another manufacturer that will perform.

3.03 TRAINING

A. Training for the mixing equipment shall be scheduled in advance.
   1. Submit training schedule and equipment delivery schedule.
   2. Base training schedule upon the projected installation schedule at that time.

B. Train operational staff completely during Testing Phase and Commissioning Phase as specified in Section 01660.

END OF SECTION

SECTION 11223B

HYPERBOLIC MIXERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Hyperbolic mixers for use in the oxidation ditch anoxic zone, complete with all accessories and appurtenances as shown on the Drawings and specified herein, and as needed for a complete installation.
   2. Provide either Hyperbolic Mixers specified herein or Submerged Turbine Mixers as specified in Section 11223A.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01610 - Project Design Criteria.
      b. Section 01660 - Testing, Training, and Commissioning.
      c. Section 09960 - High-Performance Coatings.
      d. Section 11223A - Submerged Turbine Mixers.
      e. Section 15050 - Common Work Results for Mechanical Equipment.
      f. Section 15958 - Mechanical Equipment Testing.
      g. Section 16050 - Common Work Results for Electrical.
      h. Section 16222 - Low Voltage Motors up to 500 Horsepower.

1.02 REFERENCES

A. American Bearing Manufactures Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Gear Manufacturers Association (AGMA).

C. ASTM International (ASTM):
   1. A 36 - Standard Specification for Carbon Structural Steel.
   2. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

D. American Welding Society (AWS).

E. National Electrical Manufacturer's Association (NEMA).

F. Steel Structures Painting Council (SSPC):
   1. SP 1 - Solvent Cleaning.
   2. SP 10 - Near-White Blast Cleaning.

1.03 DEFINITIONS

A. As specified in Section 15050.

1.04 SYSTEM DESCRIPTION

A. As specified in Section 15050.

B. General:
   1. Each mixer assembly shall consist of a dry installed heavy-duty speed reducer with hollow shaft, electric motor, base plate, composite FRP shaft, and composite hyperbolic mixer body.
   2. The mixer should be designed as a vertical shaft mixer, with a dry installed motor. During operation, the mixer should not generate any upward forces on the bridge construction.
   3. The mixer should have a steady stationary flow pointed downward parallel to the mixer shaft. The highest speeds and turbulent fluctuations should be produced in the bottom area. On the water surface, no or little surface turbulence should appear.

C. Design criteria:

Equipment Tag Numbers	**20-MIX-090** **20-MIX-100**
Number of Anoxic Zones	1 per Oxidation Ditch
Number of Mixers per Anoxic Zone	1
Liquid Being Mixed	Mixed Liquor
Mixed Liquor Suspended Solids (MLSS)	3,400 mg/L
Anoxic Zone Volume	224,000 gallons
Liquid Level	12.25 feet(1)
Minimum Motor Nameplate Power	10 hp(2)
Maximum Nominal Motor Speed	1,800 rpm
Material of Wetted Parts	316 Stainless Steel or FRP
Impeller Type	3 Bladed Anti-Ragging Hyperfoil or Hyperbolic

Notes:
(1) In storage mode, the water in the ditch will rise by 7 inches to a maximum side water depth (SWD) of 12.83 feet. The mixer shall keep the solids in suspension.
(2) The motor horsepower for the mixer shall be non-overloading at the maximum SWD.

1.05 SUBMITTALS

A. As required by Section 15050.

B. Furnish motor submittals as specified in Section 16222.

C. Product data:
   1. Catalog data and manufacturers' specifications.
   2. Material specifications.

D. Shop Drawings:
   1. Certified shop and working drawings.
   2. Shop drawing data for accessory items.
   3. Templates or certified setting plans, with tolerances for anchor bolts.

E. Calculations: As required by Section 15050.

F. Quality Control Submittals: As required by Section 15050.

G. Operation and Maintenance Manuals: As required by Section 15050.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Manufacturer qualifications:
   1. Mixers furnished under this Section are based on Invent Environmental Technologies, Inc.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 SEQUENCING AND SCHEDULING

A. As specified in Section 15050.

1.09 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.10 MAINTENANCE

A. Spare equipment:
   1. Rubber buffers: 1.
   2. Shaft holder: 1.
   3. Gear reducer: 1, complete, suitable for operation in either direction.
   4. Motor: 1.

1.11 WARRANTY

A. As specified in Section 15050.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following or as specified in Section 11223A:
   1. Invent Environmental Technologies, Inc. – Hyperbolic Mixer.

2.02 MATERIALS

A. Design for long, continuous, and uninterrupted service; easy adjustment or replacement of parts; minimum 1/4-inch thickness, steel members; minimum 1/2-inch diameter, structural bolts.

B. Structural steel in accordance with ASTM A36.

C. Iron castings in accordance with ASTM A48.

2.03 MOTORS

A. Motors: As specified in Section 16222 and as follows:
   1. Chemical or severe duty:
      a. Enclosure: As required to meet the area classification as defined in Section 16050.
      b. Voltage/Hertz/Phase: 460/60/3.
      c. Speed: 1,800 rpm.
      d. NEMA Premium efficient.
      e. P-base or C-face for mounting to the gear reducer.
      f. Motor winding heaters.
      g. Winding temperature detectors.
   2. Motors rated at 40 degrees Celsius ambient with Class F insulation; with service factor of 1.15, complying with the applicable provision of the Standards of NEMA. ABMA 9 and 11 L10 life for bearings, 100,000 hours.
   3. Cast iron construction:
      a. Mount in a vertical position to the gearbox and furnished with a canopy cap (drip cover) and suitable lifting lugs.
      b. Connect motor to gear reducer using of a flexible coupling.
   4. The conduit boxes shall be gasketed with neoprene or equivalent material, so as to prevent moisture from entering the stator through the conduit box.
   5. Drain holes shall be suitably positioned in the lower external surface so that any accumulation of moisture can drain from the complete motor housing.
   6. Ball or roller bearings shall be supplied and shall be grease lubricated.
   7. Grease reservoirs shall be ample and provisions shall be made for regreasing with a lubrication system where grease is flushed through the bearings.
   8. The winding end turns shall be dipped and brushed with a nonhydroscopic coating.
   9. Provide protective coating per Section 16222 for corrosive environments.
   10. The nameplates shall per Section 16222.

2.04 GEAR DRIVE

A. Design requirements:
   1. The gear drive assembly for each mixer shall consist of parallel-shaft helical gear box and motor as designed by SEW Eurodrive.

2. The gear box housing shall be cast iron.
3. The gear box speed shall not exceed 28 rpm. The calculated lifetime L10 of the bearings shall exceed 100,000 hours.

B. Mounting:
1. The mounting base of each mixer shall consist of a gear base plate mounted in rubber buffers connected permanently to the bridge/supports by bolted connection. The plate shall be able to be leveled using the threaded bolts, which can be adjusted in height.
2. The rubber buffers shall absorb start-up torque, prevent any transfer of vibrations to the bridge, and constitute the galvanic separation of the mixer from its surroundings.
3. The mounting base shall be a fastening set for the concrete bridge/walkway with threaded rods and chemical anchors, which are permanently anchored to the concrete.

C. Coatings:
1. Shop priming gear boxes and other metal parts: Shop-priming shall consist of a coating that is compatible with the field coating as specified in Section 09960.

2.05 IMPELLERS AND SHAFTS

A. Shaft:
1. The impeller shaft shall be of sufficient size and thickness to safely withstand the torque and hydraulic side forces imposed by the mixer impeller.
2. The drive shaft of the mixer shall be made from FRP.
3. At the top end of the mixer shaft, there shall be a tappet for the connection to the gear hollow shaft.
4. At the lower end there, shall be a flange connection to the mixer body itself.
5. All bolted connections shall utilize 316 stainless steel hardware.

B. Hyperboloid mixer body:
1. The hyperboloid mixer body shall be manufactured of FRP and be a streamlined stress-free body without any mounted or fitted parts.
2. The transport ribs which accelerate the flow shall be integrated in the mixer body (INVENT - Evolution 6 design).
3. The mixer body shall be coated with a special gel coat to provide a polished surface.
4. The hyperboloid mixer shall have laminated stainless steel insert nuts.

2.06 RELATED EQUIPMENT

A. Anti-vortex baffles:
1. Provide 1 anti-vortex baffle fabricated of 1/4-inch steel plate for each mixer to be positioned at the water surface as close to the turbine shaft as possible.
2. Assembly bolts shall be Type 304 or 316 stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's installation instructions.

B. Manufacturer's representative: Furnish the services of an approved manufacturer's representative to supervise the erection, starting, operating, testing, and to instruct the operating personnel on the operation of the equipment. Include minimum of 3 days.

C. Field coating as specified in Section 09960.

3.02 FIELD TESTING

A. Provide the services of a qualified factory representative to perform tests of the installation to verify that the mixing equipment operates within acceptable vibration severity limits and to determine baseline vibration spectra for future use in identifying maintenance actions.

B. Perform Level 2 Quality Control Test per Section 15958.

C. Test results:
   1. If the results do not meet the required performance, CONTRACTOR shall have 20 days to propose changes that meet the acceptance of the OWNER, and 60 days to make these changes, at no cost to the OWNER.
   2. The system shall then be retested at CONTRACTOR's expense.
   3. If the system again fails to meet the required performance, CONTRACTOR shall replace the mixing equipment with that of another manufacturer that will perform.

3.03 TRAINING

A. Training for the mixing equipment shall be scheduled in advance.
   1. Submit training schedule and equipment delivery schedule.
   2. Base training schedule upon the projected installation schedule at that time.

B. Train operational staff completely during Testing Phase and Commissioning Phase as specified in Section 01660.

END OF SECTION

SECTION 11242

DIAPHRAGM-TYPE METERING PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Positive displacement, diaphragm metering pumps for sodium hypochlorite service; accessories, drives, and control panel requirements for pumping chemical solutions.

B. Tag numbers:
   1. Refer to Pump Schedule in this Section.

C. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01450 - Quality Control.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 01740 - Warranties and Bonds.
      e. Section 01770 - Closeout Procedures.
      f. Section 01782 - Operation and Maintenance Data.
      g. Section 15050 - Common Work Results for Mechanical Equipment.
      h. Section 15117 - Specialty Valves.
      i. Section 15118 - Pressure Reducing and Pressure Relief Valves.
      j. Section 15958 - Mechanical Equipment Testing.
      k. Section 16050 - Common Work Results for Electrical.
      l. Section 16222 - Low Voltage Motors up to 500 Horsepower.
      m. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
      n. Section 17401 - Pressure/Vacuum Measurement - Diaphragm and Annular Seals.
      o. Section 17403 - Pressure/Vacuum Measurement - Switches.
      p. Section 17404 - Pressure/Vacuum Measurement - Gauges.

1.02 COST OF PRE-NEGOTIATED ITEMS

A. Cost for some of the items in this section of the Specifications has been pre-negotiated with the specified manufacturer and is included in one of the bid items in the bidding sheet. Refer to the bidding sheet and applicable pre-negotiated proposal included in Appendix H for more details. The CONTRACTOR shall provide additional items as indicated in the applicable pre-negotiated proposal included in

Appendix H, even if they are not included in the Specifications and/or Drawings. The CONTRACTOR is very strongly cautioned to carefully review the applicable pre-negotiated proposal, because the pre-negotiated proposal does not include all the items included in the Specifications and Drawings. In addition to the cost indicated for the applicable bid item in the bidding sheet, the CONTRACTOR shall include in his bid the costs for the following:

1. All items not specifically mentioned in the scope of supply of the pre-negotiated proposal, but required per Specifications and Drawings and required to complete the installation to provide an operational system.
2. All other items indicated in the pre-negotiated proposal to be provided by others, by customer, by OWNER, or any other similar designation.
    a. All freight and applicable taxes, unless specifically included in pre-negotiated proposal.
    b. All labor, materials, and all other associated costs not included in the pre-negotiated proposal but required per Specifications and Drawings and required to complete the installation to provide an operational system.

B. Supplier of pre-negotiated items shall not package the pre-negotiated item(s) with any other items or services.

C. Schedule:
1. The manufacturer/supplier has agreed to the following schedule:
    a. Deliver Shop Drawings 8 weeks following issuance of purchase order by CONTRACTOR. CONTRACTOR shall perform initial review for two weeks and allow four additional weeks for ENGINEER to review submittal.
    b. Vendor shall re-submit shop drawings within 5 weeks of receiving comments on first submittal. The second submittal shall fully address all review comments. Vendor may schedule a meeting prior to resubmittal to resolve all outstanding issues but a schedule extension will not be granted.
    c. Deliver equipment to site 12 weeks following receipt of approved Shop Drawings.
    d. Deliver draft O&M manuals 14 weeks following receipt of approved Shop Drawings.
2. The CONTRACTOR shall coordinate with the equipment supplier's delivery schedule to issue a purchase order at such time that equipment delivery will be completed at least 8 weeks in advance of the required date, as indicated in the CONTRACTOR's approved construction schedule. In addition, the CONTRACTOR shall issue the purchase order no later than September 30, 2014.

D. Liquidated Damages:
1. The manufacturer/supplier has agreed to the following liquidated damages:
    a. $100.00 per calendar day for delays of Shop Drawings as outlined in the schedule above (first submittal, second submittal - each as appropriate).
    b. $100.00 per calendar day for delays of equipment delivery as outlined in the schedule above.
    a. The liquidated damages will be capped at 5 percent of the purchase order value.

1.03 REFERENCES

A. International Society of Automation (ISA):
   1. ISA-5.4 - Instrument Loop Diagrams.

B. National Electric Code (NEC).

C. National Electrical Manufacturer's Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

D. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.04 DEFINITIONS

A. NEMA Type 4X enclosure in accordance with NEMA 250.

1.05 SYSTEM DESCRIPTION

A. General: Provide hydraulically actuated, positive displacement, diaphragm-type chemical metering pumps, accessories, and other items required for a complete and operational system. Each chemical metering pump system shall include, but not be limited to, the following items, which shall be supplied by the chemical metering pump manufacturer.
   1. Pumps.
   2. Motors.
   3. Variable frequency drive (VFD).
   4. Control stations.
   5. Calibration columns.
   6. Suction accumulators.
   7. Pulsation dampeners.
   8. External pressure relief valves.
   9. Diaphragm back pressure valves.
   10. Flow sight glasses.

B. Fluid characteristics:
   1. Sodium hypochlorite:
      a. Chemical formula: NaOCl.
      b. Solution concentration: 12.5 percent by weight.
      c. Solution pH: 11 to 13.
      d. Solution specific gravity: 1.198.

C. Design requirements:
   1. Pump performance characteristics:
      a. As specified in Pump Schedule in this Section.
      b. Dry self-priming, capable of being run dry without damaging effects to pump.
   2. Motor characteristics:
      a. As specified in this Section and in Section 16222.
      b. Minimum acceptable motor size is 1/3 horsepower.
   3. VFD characteristics: As specified in this Section.

4. Shafting and couplings: Design shafting and couplings to withstand a minimum of 1.5 times the maximum operating torque or other imposed loads.
5. Supports:
   a. Provide pump and driver supported on a common base.
   b. Design anchor bolts to withstand a minimum of 1.5 times the maximum imposed operating loads or 1.0 times the imposed seismic loads, whichever is greater.

D. Performance requirements:
   1. Systems shall deliver the pressures and volumes listed for their respective services in the Pump Schedule in this Section.

1.06 SUBMITTALS

A. General: Submit information as specified in Sections 15050 and 16050.

B. Product data.
   1. Manufacturer's literature, illustrations, specifications, and bill of materials for each component of the system.
      a. Data shall include a complete description in sufficient detail to permit comparison.
   2. Strike data for materials and components not provided as part of the Work.

C. Shop drawings.
   1. Provide a list of parameters, ratings, or other characteristics where the proposed chemical feed systems deviate from the requirements.
   2. Dimensions, including anchor bolt layout, materials of construction, size, weight, and performance data.
   3. Drawings: Provide electrical and instrumentation drawings showing coordination with electrical control devices operating in conjunction with the associated feed system.
   4. Dimensioned inlet and outlet connections.
   5. Provide data showing chemical compatibility and history of service with the associated chemical for materials in the system.

D. Design data, test reports, certificates, manufacturer's instructions, manufacturer's field reports.
   1. Manufacturer's installation and checkout instructions for components and accessories.
   2. Chemical feed pumps:
      a. For each pump type, submit calibration charts and tables relating flow rate to stroke length and stroke rate.
      b. Submit results of source quality control testing for each pump.
         1) Confirm scheduled values or recommend new pressure setpoints for the backpressure valves and pressure relief valves listed in the Pump Schedule.
      c. Submit calculations for each metering pump showing the suitability of each pump for the suction and discharge conditions of each application point.
         1) Pump manufacturer shall recommend and size an accumulator to be piped to the suction side of each metering pump, when required based on calculations.
      d. Submit calculations recommending dimensions of pulsation dampener indicated on the Drawings.

3. Control panel shop drawings:
   a. Control panel views showing equipment arrangement, doors, equipment layout inside the panel and dimensional information.
   b. Internal interconnecting wiring diagrams showing terminal strips.
   c. Complete schematic and diagrams including terminal block and wire identification numbers and device location symbols consistent with the Contract Documents.
   d. Panel bill of material with detailed description of components and equipment data sheets.

E. Closeout documents.
   1. As specified in Section 01770.
   2. Submit copies of complete Operation and Maintenance Manuals covering each piece of equipment, including instrumentation, as specified in Section 01782.
      a. Provide all safety considerations relating to operations and handling of the associated chemical.
      b. Maintenance data shall include all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated and adjusted so that it functions economically throughout its full design life.
      c. Lubrication charts and tables of alternate lubricants.
      d. Name, address, and phone number of manufacturer and manufacturer's local service representative.

1.07 QUALITY ASSURANCE

A. As specified in Sections 01450, 15050, and 16050.

B. Manufacturer qualifications:
   1. Minimum 10 years experience in production of equipment substantially similar to the specified equipment.
   2. Submit evidence of satisfactory operation of units similar to the specified units in at least 20 separate facilities:
      a. All units on the submitted installation list shall utilize the same design for critical components as specified for this Project.
      b. At least 5 installations shall satisfy the following requirements:
         1) Years in service: Minimum 7 years.
         2) Service: Municipal water or wastewater in U.S. or Canada.
      c. Multiple units at a plant shall be considered as 1 installation toward meeting the experience requirements.
   3. Fulfillment of the specified experience requirements shall be a condition of acceptance.

C. Certifications:
   1. Supply calibration curves for each pump relating stroke length to flow rate.
      a. Capacity control shall be 0 to 100 percent with delivery repeatable within plus or minus 2 percent accuracy over at least a 10 to 1 range.
   2. Furnish a certificate signed by an officer of the manufacturer stating that the pressure rating of the pumps based on normal continuous operation is at least 150 psi.
   3. Motor and VFD supplier shall carefully review the intended application of the VFD and certify in writing that sizes provided are adequate for continuous or intermittent operations (whichever is the most severe operating condition).

D. Pre-installation meetings.

E. Hydrostatic testing following verification of proper installation by Supplier:
   1. Test and ascertain safe, normal operation of the pump in accordance with Part 3 of this Section.

1.08 DELIVERY, STORAGE AND HANDLING

A. Packing, shipping, handling and unloading:
   1. Pack for shipping and outdoor storage at the project site for up to 6 months.
      a. Apply temporary corrosion protective coatings to unpainted components and pack components to protect from the elements.
   2. Ship pump and drive completely assembled.

B. Acceptance at site:
   1. Equipment and materials shall be inspected against approved shop drawings at time of delivery.
   2. Equipment and materials damaged or not meeting requirements of the approved shop drawings shall be immediately returned to the system manufacturer for replacement or repair.

C. Storage and protection:
   1. Protect the pump system and components at the site and during installation prior to project completion.
   2. Store and safeguard equipment, material, instructions, and spare parts in a dry location in accordance with system manufacturer's written instructions.

1.09 SCHEDULING

A. As specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050 unless noted otherwise in this Section.

B. Warrant equipment free of defects in material and workmanship for a period listed below. The warranty shall commence from the date specified in Section 01740. Cover parts and labor.
   1. Drive drain: 4 years.
   2. All Other Components including electronics: 2 years.

C. Manufacturer's warranty shall be issued in the OWNER's name.

1.11 SYSTEM START-UP

A. As specified in Section 01660.

1.12 MAINTENANCE

A. Extra materials:
   1. Spare parts: Furnish the following spare parts packed and labeled for warehouse storage:
      a. Complete set of inlet and outlet ball check valves (balls, seats and gaskets) and a diaphragm for each pump.

b. 1 spare parts kit for each size and type of backpressure and pressure relief valve.
c. An initial supply of all oils, greases and lubricants required to start operations. Supply an amount of these materials equivalent to 1 year of continuous operation for each system.

PART 2 PRODUCTS

2.01 General:

A. A single pump manufacturer shall furnish and coordinate all drives and pump components specified in this Section, including motors, gears, couplings, supports, and other specified accessories and appurtenances to ensure compatibility and integrity of the individual components.

B. The manufacturer of the pumps shall have sole-source responsibility for furnishing the complete assemblies and meeting the specified performance requirements.

2.02 PUMPS

A. Manufacturer:
1. Diaphragm pumps shall be manufactured by Pulsafeeder, Inc., model as scheduled. No substitutions shall be allowed.
2. Type: Simplex chemical proportioning pumps of the positive displacement diaphragm type.
3. Materials:
   a. The metering pumps and their components and accessories shall be suitable for the following chemical concentrations, as scheduled in this Section:
      1) Sodium hypochlorite:
         a) Wetted parts shall be suitable for use with 12.5 percent sodium hypochlorite solution.
         b) Other non-specified materials are to be manufacturer's standard for continuous service with 12.5 percent sodium hypochlorite solution. Brass, bronze, steel, and stainless steel components are not acceptable for contact with sodium hypochlorite.
   b. Diaphragm materials:
      1) Flat, composite, hydraulically actuated diaphragms shall be PTFE faced vulcanized to an EPDM backing.
   c. Other parts in contact with pumped liquid: PTFE, PVDF, or other suitable thermoplastic.
4. Characteristics:
   a. Diaphragm simplex chemical proportioning pumps of the positive displacement, hydraulically balanced mechanical lost-motion, flat disc diaphragm type.
   b. The diaphragm shall be hydraulically actuated. Diaphragm shall be actuated by hydraulic pressure from a push rod piston hydraulic cylinder actuator. There shall be no mechanical connection between the fluid pumping diaphragm and actuating push rod.

c. Liquid end:
   1) Liquid end shall be sealed by means of an O-ring internally molded into the diaphragm of material compatible with the pumped liquid.
   2) Pumps for sodium hypochlorite service shall be equipped with an integral system that removes gas from the reagent head of the pump. No external tubing or piping shall be required to send the “off-gas” back to the supply tank or to a vent. Other gas-removal systems employing external tubing or piping are not acceptable as they complicate the piping installation and propose a safety hazard. Sodium hypochlorite pumps shall remove gas from the reagent head and pass it through the discharge check valve along with the liquid sodium hypochlorite being pumped. Pumps shall maintain discharge pressure in the reagent head such that liquid sodium hypochlorite can be delivered with ± 2-percent steady-state accuracy of setpoint over the entire range of the pump.

5. Components:
   a. Manually controlled external stroke controllers.
   b. Single suction and discharge, self-seating ball-type check valves.
   c. Built-in internal adjustable pressure relief valve to relieve pressure in the event of discharge line stoppage; which shall be factory set to relieve at the pressure indicated in the pump schedule.
   d. Hydraulic make-up and air bleed valves.
6. Accessories: As indicated on the Drawings, pumps shall be equipped with:
   a. Calibration column in suction piping.
   b. Diaphragm backpressure, pulsation dampener and pressure relief valve in discharge piping.
7. Tests and inspections:
   a. As scheduled in this Section.
8. Verification of performance.

2.03 PUMP GEARBOX DRIVE:

A. Pump gearboxes shall be constructed of aluminum and be water resistant and suitable for outdoor installation.
   1. Pump and gearbox housings shall be coated in high-solids epoxy; however all components of the reagent head assembly shall be PVC and uncoated.

B. Gearbox shall be oil bath lubricated.

C. All fasteners for reagent head and check valve shall be Type 316 stainless steel.

2.04 DRIVE AND MOTOR

A. Main Power Feed (Voltage/Phase/Hertz): As scheduled.

B. Type:
   1. Each chemical metering pump shall be driven by a C-face motor. Coupling enclosure shall be totally enclosed and part of the motor-mounting assembly.
   2. Pumps and motors shall be mounted on floor-mountable base plates.

C. Characteristics:
   1. Electric motors shall be as specified in Section 16222.

2. Motors and motor starters shall be furnished by the pump manufacturer and shall be coordinated with the requirements of the pumps and the following characteristics:

Horsepower (minimum)	1/3
Volts/phase/hertz	230/3/60
Speed (maximum)	1,800 revolutions per minute
Service factor	1.15
Ambient temperature	40 degrees Centigrade
Maximum temperature rise	40 degrees Centigrade
Enclosure	TEFC
Insulation	Class B, moisture resistant, inverter rated
Bearings	Spherical ball
Fasteners	Grade 3 or better steel

3. The motor shall be an induction type, premium efficiency, inverter rated, AC squirrel cage type capable of 230/460 VAC three-phase inverted power.
4. Motor shall have a thermostat for high temperature shutdown.

2.05 CONTROLS

A. Metering Pump Controller (MPC) provided by equipment manufacturer:
   1. UL and CSA approved.
   2. Rated for NEMA 4X and IP56.
   3. Base mounted control:
      a. Housed in a NEMA 4X enclosure and integral to the pump.
      b. Via combined use of AC inverter technology and intermittent motor actuation (IMA) technology.
      c. Integral closed loop speed and stroke length feedback.
   4. Operable through a removable handheld keypad and liquid crystal display (LCD), with a minimum cable length of 6 feet. Include auto/manual selection. Key pad to display:
      a. Flow rate.
      b. Flow totalizer.
      c. Stroke length setting.
      d. Stroke totalizer.
   5. Electrical connections for cable: one of the following:
      a. Compression fittings.
      b. NPT conduit connections on the enclosure.

B. Functionality:
   1. Turndown: 300:1 with a steady state accuracy of +/- 2 percent.
   2. Inputs:
      a. Analog: One 0-20 mA, 4-20 mA, or 0-5 V DC input signals for automatic control.
      b. Digital: Two digital inputs to perform two of the following functions simultaneously:
         1) Remote on/off control of metering pump.
         2) Level input from supply tank.

3) External pacing – pulse input.
4) Leak detection of the metering pump.

3. Outputs:
   a. Analog:
      1) One 0-20 mA, 4-20 mA or 1-5 mA.
      2) Reflect pump stroke length position, strokes per minute, or flow.
   b. Digital: Three outputs to perform three of the following functions simultaneously:
      1) Triggering an external relay due to a fault condition.
      2) Remote/Manual status.
      3) On/Off status.
      4) Pulse output – Indication each time the pump strokes.
4. Additional programming:
   a. Signal and flow calibration.
   b. Self diagnostics.

C. Each chemical metering pump shall be provided with a manual external stroke controller graduated in 0.25 percent increments to adjust the capacity from 0 to 100 percent while the pump is operating.

2.06 ACCESSORIES

A. Pulsation dampeners:
1. Manufacturers: One of the following or equal:
   a. Kemlon Products.
   b. Blacoh Fluid Controls, Inc.
   c. Pulsafeeder.
2. Pulsation dampeners shall be furnished and installed on each chemical metering pump's discharge lines as indicated on the Drawings and scheduled in this Section.
3. Materials:
   a. Pulsation dampeners shall have Hypalon® diaphragms and CPVC, PVC, or PVDF housings.
      1) Materials shall be compatible with the pumped liquid at the specified concentration, and suitable for outdoor use and exposure.
4. Characteristics:
   a. Pulsation dampeners shall be gas or air charged, single diaphragm-type complete with valved gas/air charge valve connection and pressure gauge graduated from 0 to 200 pounds per square inch.
   b. Pulsation dampeners shall allow no more than 6 percent discharge pressure fluctuation.
5. Dampeners shall be provided with a vented rotor type true-union ball valve for shutoff.

B. Calibration columns:
1. Materials:
   a. Materials shall be compatible with the pumped liquid and concentration specified in this Section, and suitable for outdoor use and exposure.
2. Characteristics:
   a. Furnish and install calibration columns, 1 for each chemical metering pump, on each chemical pump's inlet line as indicated on the Drawings and specified in this Section.
      1) Columns shall be translucent.

b. Provide top cap threaded connection with vent piped to floor to prevent entry of foreign materials and to direct spillage or overflow.
c. End connections shall be threaded.
d. Capacities and graduations shall be as indicated in the schedule in this Section.

C. Diaphragm backpressure valves:
1. As specified in Section 15118.
2. Manufacturer: One of the following or equal:
a. Pulsafeeder.
b. Griffco.
c. Milton Roy Company.
3. Materials:
a. Valves shall be of CPVC and other materials suitable for the pumped liquid.
4. Characteristics:
a. Ported to serve as either a backpressure valve or a pressure relief valve.
b. Relief valve shall be plumbed to the nearest chemical drain, or back to the pump suction on the non-pump side of the pump suction isolation valve, to avoid spillage, as indicated on the Drawings.
c. Valves shall be furnished and installed on each chemical metering pump's discharge lines as indicated on the Drawings and scheduled in this Section.
d. Valves shall have an adjustable spring range of 10 to 250 pounds per square inch. Valves shall be factory adjusted for the backpressure recommended by the pump manufacturer.
e. Valves shall produce a back pressure no greater than 10 pounds per square inch above valve set pressure when metering pumps are operating at full capacity, pulsating flow.

D. Diaphragm pressure relief valves:
1. Furnish and install pressure relief valves on each chemical metering pump's discharge line as indicated on the Drawings.
2. Materials:
a. Wetted materials shall be of CPVC and other materials suitable with the pumped liquid.
3. Characteristics:
a. Valves shall have an adjustable spring range of 10 to 250 pounds per square inch. Valves shall be factory adjusted for the relief pressure recommended by the pump manufacturer.

E. Flow sight glasses:
1. Provide one flow sight glass on pressure relief bypass piping for each metering pump arrangement.
2. Equip the flow sight glass with vinyl streamers or flutter device to help detect flow.
3. Materials:
a. Dual wall indicator with Pyrex glass interior and acrylic exterior.
b. Seals: Viton®.
4. Manufacturer: Plast-O-Matic Valves, Inc. or equal.

F. Additional accessories:
   1. Additional accessories required for the system but not required to be supplied by the pump manufacturer include:
      a. Diaphragm seals as specified in Section 17401, except as modified in this Section:
         1) Materials shall be compatible with the pumped liquid at the specified concentration and suitable for outdoor use and exposure.
      b. Pressure switches as specified in Section 17403.
      c. Pressure gauges as specified in Section 17404.
      d. Isolation valves as specified in Section 15117 for suction and discharge piping as indicated on the Drawings.

2.07 NAMEPLATES

A. Each pump, gearbox and motor shall have, securely affixed in a conspicuous location, a stainless steel nameplate with raised letters providing the manufacturer's model, serial number, rating, range, speed and other pertinent data.

PART 3 EXECUTION

3.01 INSTALLATION

A. Special techniques: Installation shall be as indicated on the Drawings, in accordance with written instructions of the manufacturer, and as specified in Section 15050.

3.02 SOURCE QUALITY CONTROL

A. Tests and inspections: Non-witnessed.
   1. Testing in accordance with API 675.4.1.
   2. Job inspection report.

3.03 FIELD QUALITY CONTROL

A. Site tests and inspections:
   1. Witnessing: As specified in Section 15958.
   2. Inspection and checkout: As specified in Sections 15050 and 15958.
   3. Equipment performance test: Test Level as scheduled; test as specified in Section 15958.
   4. Vibration test: Test Level as scheduled; test as specified in Section 15958.
   5. Noise test: Test Level as scheduled; test as specified in Section 15958.
   6. Operational testing: As specified in Section 01660.
   7. Hydrostatic testing: Verify pump pressure rating at 1.1 times the rated pressure of the pump using the chemical of intended use for a continuous 72 hours. CONTRACTOR shall furnish and install temporary piping and valving if necessary to undertake this testing. CONTRACTOR shall also furnish the chemical for the testing.

B. Manufacturer's field service:
   1. Furnish a factory trained field representative to supervise the start-up, adjustment, and testing of the units.

2. Coordinate field service work with the manufacturer's field representative, OWNER, and ENGINEER prior to initiating such work.
3. Require manufacturer's field representative to perform the following services as specified in Section 01660.
   a. The specified durations are the minimum required time on the job site.
   b. Additional services or longer durations shall be provided as needed at no cost to OWNER to meet the required quality of work:
      1) Installation assistance: As required to meet the specified quality.
      2) Installation inspection: 1 workday.
      3) Start-up and testing assistance: 1 workday.
      4) Training during Start-Up Phase: 1 workday.
      5) Training during Commissioning Phase: 1 workday.
      6) Final acceptance checkout: 1 workday.
      7) Post start-up checkout: 1 workday.

3.04 CLEANING

A. As specified in Sections 15050 and 16050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Sections 15050 and 16050.

3.06 PROTECTION

A. As specified in Sections 15050 and 16050.

3.07 SCHEDULES

A. Pumps:

Tag Number	**32-PMP-283, 32-PMP-284, 32-PMP-285**
Feed Point	Effluent Pump Station, Oxidation Ditches, Scum Pit
Service	Sodium Hypochlorite
Pump Type	Single Diaphragm
Number of Pumps	3
Named Manufacturer and Model	Pulsafeeder Hypo Pumps, 25HJ
Torsional Analysis	Not Required
Pump Characteristics	
Design Conditions:	
Maximum Flow, (gallons per hour)	12.2
Minimum Flow, (gallons per hour)	0.08
Normal Flow, (gallons per hour)	1.4
Pump Stroke Range (strokes per minute)	0.2 - 115

Tag Number	32-PMP-283, 32-PMP-284, 32-PMP-285
Discharge Pressure (psig)	140
Minimum Suction Lift (feet)	10
Integral Relief Valve Setting (psig) (factory setting)	165
Pump Materials	
Pump Housing/Enclosure	Aluminum
Diaphragm	PTFE faced EPDM Backed
Pump Eccentric Shaft	Tool Steel
Pump Housing Support	Aluminum
Pump Connections	150LB PVDF ANSI Flange with Viton O-Rings
Main Power Feed (Voltage/Phases/Hertz)	120/1/60
Driver Characteristics	
Driver Type	Motor with VFD
Drive Coupling	Piloted C-Face, Vertical
Minimum Driver Horsepower	0.333
Maximum Driver Speed (rpm)	1,750
Service Factor	1.0
Voltage/Phases/Hertz	230/3/60
NEMA Enclosure Type	TEFC
Source Quality Control Test	
Test Witnessing	Not Witnessed
Performance Test Level	1
Vibration Test Level	None
Noise Test Level	None
Field Quality Control Testing	
Performance Test Level	1
Vibration Test Level	1
Noise Test Level	1
Hydrostatic Testing	Required at 165 psig

1. Provide pumps that deliver the maximum capacity, listed in the above table, when at full speed and maximum stroke length.

B. Pulsation dampeners:

Quantity	Single/Double Diaphragm	Size
One per pump	As specified in this Section	As specified in this Section

C. Calibration columns:

Quantity	Graduation Volume(ml)(1)	Graduation Scale (ml)(2)
One per pump	1,000	TBD by Supplier
Notes: 1. The volume of the calibration column should be, at minimum, 100 percent of the volume delivered by the pump at maximum design flow condition for a period of 60 seconds. 2. Graduation scale shall read in gallons per hour and milliliters.		

D. Backpressure valves:

Quantity	Spring Range	Minimum Backpressure
One per pump	As specified in this Section	140

E. External pressure relief valves:

Quantity	Spring Range	Relief Pressure
One per pump	As specified in this Section	150

END OF SECTION

SECTION 11245

PERISTALTIC TUBE METERING PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Positive displacement peristaltic tubing pumps complete with drives, controls, and features specified and scheduled in this Section.

B. Tag numbers:
   1. Refer to Pump Schedule in this Section.

C. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01740 - Warranties and Bonds.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 01770 - Closeout Procedures.
      e. Section 01782 - Operation and Maintenance Data.
      f. Section 15050 - Common Work Results for Mechanical Equipment.
      g. Section 15111 - Ball Valves.
      h. Section 15958 - Mechanical Equipment Testing.
      i. Section 16222 - Low Voltage Motors up to 500 Horsepower.
      j. Section 17401 - Pressure/Vacuum Measurement - Diaphragm and Annular Seals.
      k. Section 17403 - Pressure/Vacuum Measurement - Switches.
      l. Section 17404 - Pressure/Vacuum Measurement - Gauges.

1.02 REFERENCES

A. National Electrical Manufacturer's Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

B. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

A. NEMA:
   1. Type 4X enclosure in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

A. General: Provide positive displacement, peristaltic tubing type chemical metering pumps; accessories, and other items required for a complete and operational system. Each chemical metering pump system shall include, but not be limited to, the following items, which shall be supplied by the chemical metering pump manufacturer. Pumps that have external controls in a VFD panel and exposed motor will not be accepted. All controls and the motor shall be housed in a single chemically resistant housing.
   1. Pumps.
   2. Motors.
   3. Variable speed drives.
   4. Calibration columns.

B. Fluid characteristics:
   1. Aluminum sulfate:
      a. Dry chemical formula: $Al_2(SO_4)_3$.
      b. Solution concentration: 48.5 percent by weight.
      c. Solution pH: ~3.5 (1-percent solution).
      d. Solution specific gravity: 1.335.
   2. Polyaluminum chloride:
      a. Dry chemical formula: $Al_2(OH)_xCl_{6-x}$ where $0<x<6$.
      b. Solution concentration: 8 to 24 percent by weight (as aluminum oxide).
      c. Solution pH: 0.5 to 4.4.
      d. Solution specific gravity: 1.15 to 1.4.
   3. Sodium hypochlorite:
      a. Dry chemical formula: NaOCl.
      b. Solution concentration: 10 to 16 percent by weight.
      c. Solution pH: 11 to 13.
      d. Solution specific gravity: 1.198 (12.5-percent solution at 20 degrees C).

C. Design requirements:
   1. Check valves and seals: Check valves and diaphragms are not permitted. Dynamic seals in contact with the pumped liquid are not permitted. Pumped liquid shall be contained within pump tubing and shall not directly contact any rotary or metallic components.
   2. Pumps:
      a. Dry self-priming, capable of being run dry without damaging effects to pump or tube.
      b. Maximum suction lift capability of up to 10 feet vertical water column.
      c. Pressure rating of 60 pounds per square inch, minimum.
      d. Flow shall be proportional to rotor speed and reversible in direction.
   3. Pump performance characteristics: As specified in Pump Schedule in this Section.
   4. Motor characteristics: As specified in this Section and in Section 16222.
   5. Variable speed drive characteristics: As specified in this Section.

D. Performance requirements:
   1. Systems shall deliver the pressures and volumes listed for their respective services in the Pump Schedule in this Section.

1.05 SUBMITTALS

A. Product Data:
   1. Manufacturer's literature, illustrations, specifications, and bill of materials for each component of the system. Data shall include a complete description in sufficient detail to permit comparison.
   2. Strike data for materials and components not provided as part of the Work.

B. Shop drawings:
   1. Provide a list of parameters, ratings, or other characteristics where the proposed chemical feed systems deviate from the requirements.
   2. Dimensions, including anchoring layout, materials of construction, size, weight, and performance data.
   3. Drawings: Provide electrical and instrumentation drawings showing coordination with electrical control devices operating in conjunction with the associated feed system.
   4. Dimensioned inlet and outlet connections.
   5. Current NSF 61 Certification for components to be in contact with associated chemical or potable water.
   6. Provide data showing chemical compatibility and history of service with the associated chemical for materials in the system.

C. Design data, test reports, certificates, manufacturer's instructions, and manufacturer's field reports.
   1. Manufacturer's installation and checkout instructions for components and accessories.
   2. Chemical feed pumps:
      a. For each pump type, submit calibration charts and tables relating flow rate to speed.
      b. Submit calculations for each metering pump showing the suitability of each pump for the suction and discharge conditions of each application point. Pump manufacturer shall recommend and size an accumulator to be piped to the suction side of each metering pump, when required based on calculations.

D. Closeout Documents:
   1. As specified in Section 01770.
   2. Submit copies of complete Operation and Maintenance Manuals covering each piece of equipment, including instrumentation, as specified in Section 01782.
      a. Provide all safety considerations relating to operations and handling of the associated chemical.
      b. Maintenance data shall include all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated, and adjusted so that it functions economically throughout its full design life.
      c. Lubrication charts and tables of alternate lubricants.
      d. Name, address, and phone number of manufacturer and manufacturer's local service representative.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Manufacturer qualifications:
   1. Submit evidence of satisfactory operation of units similar to the specified units in at least 25 separate facilities in accordance with the following requirements:
      a. All units on the submitted installation list shall utilize the same design for critical components as specified for this project.
      b. Service: Municipal water or wastewater in U.S. or Canada.
      c. Multiple units at a plant shall be considered as one installation toward meeting the experience requirements.
   2. Fulfillment of the specified experience requirements shall be a condition of acceptance.

C. Certifications
   1. Supply calibration curves for each application relating flow rate to speed. Capacity control shall be 0 to 100 percent with delivery repeatable within plus or minus 1 percent accuracy over at least a 10 to 1 range.

D. Pre-installation meetings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packing, shipping, handling and unloading:
   1. Pack for shipping and outdoor storage at the project site for up to 6 months. Apply temporary corrosion protective coatings to unpainted components and pack components to protect from the elements.
   2. Ship pump and drive completely assembled. Ship tubing element separately for field installation and process line connection by CONTRACTOR.

B. Acceptance at site:
   1. Equipment and materials shall be inspected against approved shop drawings at time of delivery. Equipment and materials damaged or not meeting requirements of the approved shop drawings shall be immediately returned to the system manufacturer for replacement or repair.

C. Storage and protection:
   1. Protect the pump system and components at the site and during installation prior to project completion.
   2. Store and safeguard equipment, material, instructions, and spare parts in a dry location in accordance with system manufacturer's written instructions.

1.08 SITE CONDITIONS

A. Design chemical metering pump system for indoor installation.

1.09 SCHEDULING

A. As specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050, except as follows:
   1. Warranty period shall be 5 years.
   2. Warranty period shall commence as specified in Section 01740.

1.11 SYSTEM START-UP

A. As specified in Section 01660.

1.12 MAINTENANCE

A. Extra materials:
   1. Spare parts: Furnish the following spare parts packed and labeled for warehouse storage:
      a. 4 tubing elements for each pump.
      b. 1 complete spare parts kit for each pump provided.
      c. 1 spare parts kit for each size and type of pressure relief valve.
      d. An initial supply of all oils, greases, and lubricants required to start operations. Supply an amount of these materials equivalent to 1 year of continuous operation for each system.

PART 2 PRODUCTS

2.01 GENERAL

A. A single pump manufacturer shall furnish and coordinate all drives and pump components specified in this Section, including motors, gears, couplings, supports, and other specified accessories and appurtenances to ensure compatibility and integrity of the individual components.

B. The manufacturer of the pumps shall have sole-source responsibility for furnishing the complete assemblies and meeting the specified performance requirements.

2.02 PUMPS

A. Pump manufacturer: One of the following and or equal:
   1. Watson-Marlow Bredel Pumps, model series as scheduled.
   2. Blue-White Industries, similar model.

B. Type: Simplex chemical proportioning pumps of the peristaltic tubing type.

C. Features:
   1. Replaceable tubing element design.
   2. Fixed track providing 180 degrees of contact with tubing.
   3. Guard door of a removable or hinged, breakaway design that provides a clear window for viewing rotor rotation. Guard door shall be tool-unlockable, and seal against the track or housing to contain leakage from tubing failure for direction to a waste port.
   4. Rotor assembly; one of the following:
      a. A minimum of 2 equally spaced, spring-loaded roller arms that provide complete occlusion through a swept track angle of 180 degrees. Compression rollers shall provide gradual occlusion of the tubing and compensate for tubing dimensional tolerance. Tubing shall be fully compressed at all times by a minimum of 1 roller to prevent backflow. Spring tension shall be factory set for specified fluid and Manufacturer's recommended hose. Rotor shall include non-compressing guide rollers.

b. Directly couple squeeze rollers with encapsulated ball bearings to a one-piece thermoplastic rotor. Four polymeric rollers shall be provided; two squeeze rollers for tubing compression shall be located 180 degrees apart and two guide rollers that do not compress the tubing shall be located 180 degrees apart. The roller diameters and occlusion gap shall be factory set to provide the optimum tubing compression.

5. Other required features are a waste port for leak control and a system to detect tubing failure. Upon actuation, the leak detector shall STOP the pump, light a locally visible LED and sound a remote alarm. Leak detection outside of the pump housing is not acceptable.
6. Replaceable tubing elements shall have molded fittings, be self-locating when fitted into the pump head, and be held in place on the suction and discharge by the element fittings. Tubing shall be replaceable without the use of tools and without disassembly of the pump head.
7. Gearbox: Gearbox shall be of the in-line helical design, powder epoxy coated cast aluminum or cast aluminum alloy, rated for continuous duty with a service factor of 1.4 based on the motor nameplate rating.
8. Pump, gearbox, and motor shall be direct-coupled and self-aligning.

D. Materials:
1. Housing: Fluoropolymer powder coated cast aluminum or cast aluminum alloy.
2. Track: Polyphenylene sulfide (PPS).
3. Guard door: Impact-resistant polycarbonate.
4. Rotor: Polyphenylene sulfide or fluoropolymer powder coated carbon steel.
5. Springs: Helical, stainless steel.
6. Compression rollers/shoes: Type 316 stainless steel or reinforced Delrin.
7. Bearings: Stainless steel.
8. Shafts: Type 316 stainless steel.
9. Seals: PTFE.
10. Guide rollers/shoes: Nylatron.
11. Iron or carbon steel components are not acceptable for contact with sodium bisulfite.

E. Accessories: As indicated on the Drawings, pumps shall be equipped with:
1. Calibration column in suction piping.
2. Pressure relief valve in discharge piping.

F. Source quality control:
1. Tests and inspections:
a. As specified in Sections 01660 and 15050.
b. As scheduled in this Section.
2. Verification of performance.

2.03 DRIVE

A. Rating: Continuous 24-hour operation, 40 degrees Celsius ambient.

B. Supply: 120V, 60Hz.

C. Max drive power consumption: 250VA.

D. Enclosure: NEMA 4X.

E. Housing: Cast aluminum or cast aluminum alloy with pre-treatment and exterior grade corrosion resistant polyester powder coat. By nature of the environmental conditions, unpainted housings, including Type 316 stainless steel, are not acceptable.

F. Pumps must meet the following minimum requirements for operator interface functionality:
   1. Backlit graphical LCD capable of up to four lines of text with up to 16 characters per line to display pump speed, running status, flow rate, and programming instructions.
   2. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
   3. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.
   4. Programmable “Auto Restart” feature to resume pump status in the event of power outage interruption.
   5. Programmable “Keypad Lock” to allow operator lockout of all keys except emergency start/stop.
   6. Programmable “Maximum Speed” to allow operator to set the maximum operating speed of the pump below the true maximum speed.

G. Supply auto control and monitoring features to meet the following minimum functionality requirements for use with the SCADA system. All control signal features must be located internally to the pump.
   1. Remote control inputs:
      a. Speed control:
         1) Analog 4-20 mA speed input, with input signal trimmable and speed scaleable over any part of the drive speed range.
         2) Provisions for alternative remote accessory potentiometer (if supplied by others) for speed control.
            a) Start/Stop control: Via remote dry contact in PLC cabinet.
            b) Termination: Supply screw down terminals suitable for up to 18 AWG field wire and accessible through glanded cable entry points on the pump.
   2. Status outputs:
      a. Minimum 4 relay contacts with a maximum load 5A at 120VDC NO or NC, software configurable for the following:
         1) RUN status.
         2) REMOTE/MANUAL status.
         3) DRIVE FAIL status.
         4) TUBE LEAK status.
      b. Speed output: Analog 4-20 mA.

H. Drive motor:
   1. Brushless DC motor with integral gearbox and tachometer feedback.
   2. Minimum Speed Control Range of 2,600:1 (from 0.1 to 260 rpm within 0.1 rpm throughout the range).
   3. Horsepower to meet continuous duty at maximum pump speed and pressure requirements.
   4. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 35 rpm and synchronous mode with magnetic field rotation control below 35 rpm.

5. Circuitry complete with temperature and load compensation and protection.
6. Mounting: Drive shall be self-supporting and shall not require anchoring.

2.04 ACCESSORIES

A. Flexible piping:
   1. Supply two 1-meter lengths of reinforced transparent PVC flexible hose for connection of pump to suction and discharge process lines. Each flexible hose shall have a PVDF female quick release fitting for connection to the tubing element and male quick release fitting for connection to barbed adaptor with built-in shutoff valve for ease of maintenance and connection to process lines.

B. Calibration columns:
   1. Furnish and install calibration columns, 1 for each pump, on the inlet line as indicated on the Drawings and specified in this Section. The column shall be translucent and graduated for chemical pump calibration operations. Provide a top cap threaded connection with vent to prevent entry of foreign materials and to direct spillage or overflow.
   2. Materials shall be compatible with the associated chemical and concentration and suitable for outdoor use and exposure.
   3. End connection: Threaded.
   4. Capacity as scheduled in this Section.

C. Pressure relief valves:
   1. Manufacturers: Asahi, Griffco Valve Inc., ChemLine Plastics, or equal.
   2. Materials:
      a. Lower body, seat, ball guide, and ball: CPVC.
      b. Diaphragm: PTFE faced EPDM.
      c. Seat gasket: Viton®.
      d. Adjusting bolt, locknut, control spring, and fasteners: Stainless steel.
      e. End connections: Flanged or socket weld.
   3. In-line design, size as indicated on the Drawings required by this Section. Valves shall be suitable for the service flow and pressure specified in this Section.
   4. The pump supplier shall provide all pressure relief valves associated with the chemical system.
   5. Set pressures shall be factory set at the levels scheduled in this Section. Valve settings shall be externally adjustable from 0 to 75 pounds per square inch.
   6. Provide 3-port configuration for all pressure relief valves where piping back to a tank or connection to suction or drain piping is indicated on the Drawings.

D. Flow sight glasses:
   1. Provide one flow sight glass on pressure relief bypass piping for each metering pump arrangement.
   2. Equip the flow sight glass with vinyl streamers or flutter device to help detect flow.
   3. Materials:
      a. Dual wall indicator with Pyrex glass interior and acrylic exterior.
      b. Seals: Viton®.
   4. Manufacturer: Plast-O-Matic Valves, Inc. or equal.

E. Additional accessories:
   1. Additional accessories required for the system but not required to be supplied by the pump manufacturer include:
      a. Diaphragm seals as specified in Section 17401, except as modified in this Section:
         1) Materials shall be compatible with the pumped liquid at the specified concentration and suitable for outdoor use and exposure.
         2) Shutoff valve shall be provided.
      b. Pressure switches as specified in Section 17403.
      c. Pressure gauges as specified in Section 17404.
      d. Isolation valves as specified in Section 15111 for calibration column and suction and discharge piping as indicated on the Drawings.

F. Power and control cables:
   1. As required to coordinate with the pump electrical connection box as indicated on the Drawings.
   2. Provide cable glands sized for the cables used with the pump electrical connection box.
   3. Metallic liquid-tight connectors for flexible conduit connections to the pump wiring compartment cover.

2.05 NAMEPLATES

A. Each pump, gearbox, and motor shall have, securely affixed in a conspicuous location, a stainless steel nameplate with raised letters providing the manufacturer's model, serial number, rating, range, speed and other pertinent data.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation shall be as indicated on the Drawings, in accordance with written instructions of the manufacturer, and as specified in Section 15050.

3.02 FIELD QUALITY CONTROL

A. Tests and inspections:
   1. As specified in Sections 01660 and 15050.
   2. As scheduled in this Section.

3.03 MANUFACTURER'S FIELD SERVICES

A. Furnish a qualified Manufacturer's field representative to supervise the start-up, adjustment, and testing of the units.

B. Coordinate field service work with the manufacturer's representative, OWNER, and ENGINEER prior to initiating such work.

C. The manufacturer shall inspect system before initial start-up and certify that system has been correctly installed and prepared for start-up as specified in this Section and in Sections 15050 and 15958.

D. Require manufacturer's representative to perform the following services as described below and as specified in Section 01660. The specified durations are the minimum required time on the job site. Additional services and/or longer durations shall be provided as needed at no cost to the OWNER to meet the required quality of work.
   1. Installation assistance: As required.
   2. Installation inspection: 1 workday.
   3. Start-up/testing assistance: 1 workday.
   4. Training during Testing Phase: 1 workday. The training time shall not be included in the start-up, adjusting and testing time.
   5. Training during Commissioning Phase: 1 workday.
   6. Final acceptance checkout: 1 workday.
   7. Post start-up checkout: 1 workday.

3.04 SCHEDULES

A. Pumps:

Tag Number	**32-PMP-271 32-PMP-272**	**32-PMP-281 32-PMP-282**
Feed Point	Common Discharge Header of Filter Influent Pumps	Various Locations including Potable Water Tank and Fire Water Tank
Service	Aluminum Sulfate 48.5 percent or Polyaluminum Chloride 24 percent	Sodium Hypochlorite 12.5 percent
Pump Type	Peristaltic Tubing	Peristaltic Tubing
Number of Pumps	2	2
1st Named Manufacturer's Model	Watson-Marlow Bredel 520DuN/REM	Watson-Marlow Bredel 520DuN/REM
Torsional Analysis	Not Required	Not Required
Pump Leak Detector	Required	Required
Pump Characteristics		
Design Conditions		
Maximum Flow, (gallons per hour)	7.0	2.7
Minimum Flow, (gallons per hour)	0.03	0.2
Normal Flow, (gallons per hour)	0.48	0.5
Pump rpm	0.1-260	0.1-260
Maximum Discharge Pressure (psi)	60	60
Minimum Suction Lift (feet)	10	10
Relief Valve Setting (psig)	55	55
Pump Materials		
Pump Housing/Enclosure	Article 2.02, Paragraph D	Article 2.02, Paragraph D

Tag Number	32-PMP-271 32-PMP-272	32-PMP-281 32-PMP-282
Tubing	Marprene TM tube element	Marprene TM tube element
Rotor	Article 2.02, Paragraph D	Article 2.02, Paragraph D
Pump Shaft	Article 2.02, Paragraph D	Article 2.02, Paragraph D
Pump Housing Support	N/A	N/A
Pump Connections	PVC, CPVC, or PVDF Flange	PVC, CPVC, or PVDF Flange
Driver Characteristics		
Driver Type	PWM type DC gear motor with integral controls	PWM type DC gear motor with integral controls
Drive Coupling	N/A	N/A
Minimum Driver Horsepower	N/A	N/A
Maximum Driver Speed, (rpm)	N/A	N/A
Service Factor	N/A	N/A
Voltage/Phases/Hertz	110V, 60 Hertz, 1 Phase	110V, 60 Hertz, 1 Phase
NEMA Enclosure Type	NEMA 4X	NEMA 4X
Source Quality Control Test		
Test Witnessing	Not Witnessed	Not Witnessed
Performance Test level	1	1
Vibration Test Level	None	None
Noise Test Level	None	None
Field Quality Control Testing		
Performance Test level	1	1
Vibration Test Level	None	None
Noise Test Level	None	None

B. Calibration columns:

Tag Number	Service	Graduation Volume (mL)(1)	Graduation Scale (mL)(2)
None	Aluminum Sulfate or Polyaluminum Chloride	100	TBD By Supplier
None	Sodium Hypochlorite	100	TBD By Supplier

Notes:

1. The volume of the calibration column should be, at minimum, 100 percent of the volume delivered by the pump at maximum design flow condition for a period of 60 seconds.
2. Graduation scale shall read in gallons per hour and milliliters.

SECTION 11287

LOW-PRESSURE/HIGH OUTPUT ULTRAVIOLET DISINFECTION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Specification for the equipment associated with the Ultraviolet (UV) Disinfection System. Furnish all labor, materials, equipment, and appurtenances required to provide an open-channel, gravity-flow, high-intensity, low-pressure lamp, ultraviolet (UV) light disinfection system complete with an automatic mechanical or physical/chemical cleaning system. The UV system is to be complete and operational with all control and appurtenant equipment as shown on the Drawings and specified herein.
   2. UV Disinfection System Vendor (heretofore called Vendor) shall provide installation, start-up, and operator maintenance training as described in this Section. The Vendor shall assist with commission testing and performance testing as described in this Section.

B. Tag numbers:
   1. UV Transmittance Meter, 31-AE/AIT-240.
   2. UV Channel1 Flow Meter, 31-FE/FIT-241.
   3. UV Channel 1 Inlet Valve, 31-EDM-244.
   4. UV Channel 1 Ultrasonic Level Meter, 31-LE/LIT-241.
   5. UV Channel 1 Bank 1 Cleaning Valve, Ultrasonic Level Meter, And UV Intensity Sensor, 31-DRV-241A, 31-LE-241A, and 31-AE-241A, respectively.
   6. UV Channel 1 Bank 2 Cleaning Valve, Ultrasonic Level Meter, And UV Intensity Sensor, 31- DRV-241B, 31-LE-241B, and 31-AE-241B, respectively.
   7. UV Channel 1 Bank 3 Cleaning Valve, Ultrasonic Level Meter, And UV Intensity Sensor, 31- DRV-241C, 31-LE-241C, and 31-AE-241C, respectively.
   8. UV Channel No. 1 PW Re-fill Valve, 31-EDR-247.
   9. UV Channel 2 Flow Meter, 31-FE/FIT-242.
   10. UV Channel 2 Inlet Valve, 31-EDM-245.
   11. UV Channel 2 Ultrasonic Level Meter, 31-LE/LIT-242.
   12. UV Channel 2 Bank 1 Cleaning Valve, Ultrasonic Level Meter, and UV Intensity Sensor, 31- DRV-242A, 31-LE-242A, AND 31-AE-242A, respectively.
   13. UV Channel 2 Bank 2 Cleaning Valve, Ultrasonic Level Meter, and UV Intensity Sensor, 31- DRV-242B, 31-LE-242B, AND 31-AE-242B, respectively.
   14. UV Channel 2 Bank 3 Cleaning Valve, Ultrasonic Level Meter, and UV Intensity Sensor, 31- DRV-242C, 31-LE-242C, AND 31-AE-242C, respectively.
   15. UV Channel No. 2 PW Re-fill Valve, 31-EDR-248.
   16. UV Channel 3 Flow Meter, 31-FE/FIT-243.
   17. UV Channel 3 Inlet Valve, 31-EDM-246.
   18. UV -Channel 3 Ultrasonic Level Meter, 31-LE/LIT-243.
   19. UV Channel 3 Bank 1 Cleaning Valve, Ultrasonic Level Meter, and UV Intensity Sensor, 31- DRV-243A, 31-LE-243A, And 31-AE-243A, respectively.
   20. UV Channel 3 Bank 2 Cleaning Valve, Ultrasonic Level Meter, and UV Intensity Sensor, 31- DRV-243B, 31-LE-243B, And 31-AE-243B, respectively.

21. UV Channel 3 Bank 3 Cleaning Valve, Ultrasonic Level Meter, and UV Intensity Sensor, 31- DRV-243C, 31-LE-243C, And 31-AE-243C, respectively.
22. UV Channel No. 3 PW Re-fill Valve, 31-EDR-249.

C. Related Sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents
   a. Section 01140 - Work Restrictions.
   b. Section 01330 - Submittal Procedures.
   c. Section 01612 - Seismic Design Criteria.
   d. Section 01614 - Wind Design Criteria.
   e. Section 01660 - Testing, Training, and Commissioning.
   f. Section 01740 - Warranties and Bonds.
   g. Section 01770 - Closeout Procedures.
   h. Section 01782 - Operation and Maintenance Data.
   i. Section 05120 - Structural Steel.
   j. Section 05500 - Metal Fabrications.
   k. Section 09960 - High-Performance Coatings.
   l. Section 10400 - Identification Devices.
   m. Section 15050 - Basic Mechanical Materials and Metals.
   n. Section 15075 - Equipment Identification.
   o. Section 16050 - General Requirements for Electrical Work.
   p. Section 16075 - Electrical Identification.
   q. Section 16134 - Boxes.
   r. Section 16125 - Fiber Optic Cable and Appurtenances
   s. Section 16412 - Low Voltage Molded Case Circuit Breakers
   t. Section 17050 - Process Control and Instrumentation Systems General Requirements.
   u. Section 17100 - Control Strategies.
   v. Section 17101-31 - Specific Control Strategies – UV Disinfection.
   w. Section 17720 - Control Systems – Programmable Logic Controllers Hardware.
   x. Section 17721 - Human Machine Interface Hardware.
   y. Section 17733 - Network Materials and Equipment
   z. Section 17761 - PLC Programming Software.
   aa. Section 17765 - Human Machine Interface Software.
   bb. Section 17950 - Testing, Calibration, and Commissioning.

D. Provide a complete UV Disinfection System that meets all the water quality requirements and all the UV reactor testing and design requirements as set forth by the California Water Recycling Criteria (Title 22) for disinfected tertiary recycled water and the specifications in this Section. In the event of a conflict between regulations and this Section, the UV System Vendor shall meet the more restrictive standard. Third Party Reactor Validation Testing and the related Engineering Report

for the UV reactor to be installed must be completed and Conditional Acceptance Letter issued at the time of bid.

E. The minimum UV equipment requirement is specified in Form 1 (at the end of this Section).

1.02 REFERENCES

A. California Code of Regulations (CCR-Title 22):
   1. Title 22, Divisions 4, Chapter 3 - Water Recycling Criteria.

B. National Water Research Institute (NWRI):
   1. Third Edition to UV Disinfection Guidelines for Drinking Water and Water Reuse (2012 UV Guidelines).

C. United States Environmental Protection Agency (EPA). Ultraviolet Disinfection Guidance Manual (UVDGM). 2006.

D. Institute of Electrical and Electronics Engineers (IEEE):
   1. 519 - Guide for Applying Harmonic Limits on Power Systems.

E. National Electrical Manufacturers Association (NEMA):
   1. NEMA 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

F. SAE International (SAE).

G. Underwriters Laboratories, Inc. (UL):
   1. 574 - Electric Oil Heaters.

1.03 DEFINITIONS

A. General: The terms listed below are used in this Section and shall have the following definitions.
   1. <u>UV Bank</u>: One or more UV modules that the entire flow for a given reactor train must pass through. Each bank consist of:
      a. High purity, quartz sleeves (one sleeve per lamp) to protect lamps from direct contact with the wastewater.
      b. Each UV Bank shall be connected to their ballasts by means of a multi-conductor cable fitted with a waterproof plug.
      c. UV intensity sensors to provide continuous monitoring of the reactor performance.
      d. Automatic on-line cleaning system for periodic cleaning of the quartz sleeves.
      e. Interconnection of electrical and control cabling between the UV lamps, sensors, cleaning mechanism, and reactor mounted ballast enclosures.
   2. <u>UV Channel (synonymous with UV Train)</u>: The independent combination of the UV bank, and inlet and outlet level controlling arrangements located in a concrete channel.
   3. <u>UV Disinfection Equipment System (synonymous with UV Disinfection System)</u>: The combination of all UV channels with associated controls and instrumentation.
   4. <u>Calibrated UV Sensor Control</u>: The use of calibrated UV sensors, meeting the recommendations of the United States Environmental Protection Agency's

(USEPA) Ultraviolet Disinfection Guidance Manual (UVDGM) (2006), to continuously monitor UV intensity within the reactor. The measured UV intensity is used to indicate relative lamp output due to lamp aging, fouling, and ballast power settings, and is used as an input for UV dose-monitoring algorithm programmed into the UV system's PLC. For some UV systems, the sensor reading is not utilized for dose calibration, the use of the sensors to monitor and alarm the combined effect of lamp aging and sleeve fouling can be sufficient.

5. Attenuated Lamp Conditions: Conditions where the lamps are at the end of their guaranteed lives and the lamp sleeves are fouled (i.e., consistent with the Lamp Age Factor and Sleeve Fouling Factor)
6. Lamp Age Factor: Reduction in available UV output at the end of the UV lamp life, as compared to a new UV lamp after 100 hours burn-in.
7. Lamp Life: Total guaranteed operational time that the UV lamp can deliver the UV output required to produce an effluent conforming to the effluent standards specified herein.
8. Normalized Lamp Velocity: Flow velocity across a lamp (in gpm per lamp), calculated by the total expected flow in a UV channel (in gpm) divided by the total number of lamps in only one (1) bank in the channel.
9. Sleeve Fouling Factor: The sleeve-fouling factor is a measure of the sleeve's loss of irradiance over time (expressed as a percentage of the irradiance from a new and clean quartz sleeve). Periodic automatic and manual cleaning of the system is performed to achieve the Sleeve Fouling Factor.
10. UV Intensity (UVI): The power per unit area passing through an area perpendicular to the direction of propagation. UV intensity is used to describe the magnitude of UV light in a UV reactor or in a bench-scale UV test.
11. UV Transmittance (UVT): A measure of the fraction of incident light transmitted through the water column. The UVT is the ratio of the light entering the effluent to that exiting the effluent. UVT is represented as a percentage. UVT is typically quantified by spectrophotometric measurement at a wavelength of 253.7 nm using a one-centimeter path length.
12. UV Module: The basic building block of a UV disinfection system. It is comprised of more than one UV lamp with common electrical feed.
13. UV Dosage:
    a. Delivered UV Dose: The dose that is assigned to the UV reactor under a given set of operating conditions that is based on Third-Party Reactor Validation Testing. The delivered UV dose is equivalent to that measured with the collimated-beam apparatus for the same degree of inactivation of the target microorganism. UV dose is typically reported in milli-joules per square centimeter (mJ/cm^2) or in milli-watt seconds per square centimeter ($mW\text{-}s/cm^2$).
    b. Design UV Dose: The UV dose delivered for a specific log inactivation of the target microorganism at the peak design flow at the design UVT. The design UV dose is used to size the UV Disinfection System.
14. UV Reactor: Single UV bank.
15. UV Testing, Reports, and References:
    a. Bioassay: A microbiological procedure used to determine the inactivation of a specific microorganism after exposure to UV light.
    b. Engineering Report: A bioassay testing report prepared and stamped by an independent, third party licensed civil engineer, registered in the State of California, United States. The Report is in accordance with Third Party Reactor Validation Testing and summarizes the results of the third party

bioassay testing, and documents the dose equation used to size and operate the proposed UV Disinfection System.

c. Hydraulic and Alarm Testing: As specified herein and per Third Party Reactor Validation Testing Guidelines, testing shall be completed to verify that alarm, head loss, and hydraulics specifications are met. To ensure this, tests shall be run at minimum, average, and peak flow over the range of channel operating conditions specified herein.

d. Initial Performance Test: A 30-day continuous test to demonstrate the installed UV Disinfection System meets the performance test requirements specified herein and produces an effluent in complete compliance with requirements as specified herein.

e. Third-Party Reactor Validation Testing: Testing completed on a pilot scale or full scale UV system in accordance with a test protocol per Third Party Reactor Validation Testing Guidelines that serve as a basis of testing for UV systems. Testing is conducted to develop reactor dose delivery for various operational conditions. A third party licensed civil engineer in the United States must perform the testing.

f. Field Commission Testing: In accordance with 2012 UV Guidelines, field commission testing must be completed on the installed full-scale UV system to gain site-specific acceptance from the California Department of Public Health (CDPH).

16. Project Manager/Product Manager: Vendor's personnel having a minimum of 10 years of experience in design and execution of wastewater UV systems to utilities.

1.04 PROJECT MANAGEMENT AND QUALITY ASSURANCE

A. The Vendor shall assign a qualified and experienced project manager or product manager for the duration of the project from initial selection through start-up. This project manager or product manager shall remain the same throughout the duration of the project. Any changes in project management will require approval from the OWNER and ENGINEER after they review the qualifications of the proposed candidates.

1. The project manager or product manager shall act as the main point of communication with OWNER and ENGINEER regarding technical aspects of the UV System , including design criteria and coordination, materials selection, equipment, and control systems.
2. The project manager shall coordinate between manufacturer and other parties during the construction bidding, shop drawing submission and review, RFIs, and scheduling deliveries, field inspections, startup, and performance testing during construction.

1.05 SYSTEM DESCRIPTION

A. Provide a complete UV Disinfection System that meets all the water quality requirements of the CCR Title 22, Division 4, Chapter 3 for unrestricted reuse water recycling, and the 2012 UV Guidelines disinfection design and this Section. In the event of a conflict between 2012 UV Guidelines, CCR-Title 22, and this Section, manufacturer must meet the more restrictive standard.

B. The UV Disinfection System shall be able to continuously provide a dose of 102 mJ/cm2 at all times at a design peak hour flow rate at the Minimum UV

Transmittance and at Attenuated Lamp Conditions, under the following circumstances:

1. While one UV channel is out of service and all banks of the remaining UV channels are in service.
2. While the automatic online cleaning system is in operation.
3. While the UV lamps, quartz sleeves, and/or ballasts are being replaced on one out of service UV bank in any channel.

C. Design Criteria:

1. Vendor shall provide UV disinfection equipment which meets the Performance Requirements, specified in this Section, based on the following conditions:
   a. Type: open-channel.
   b. Influent Water Quality:
      1) Description: tertiary cloth disk filter effluent.
      2) Design Flow Rate to the UV System:
         a) Minimum Continuous Flow Rate: 0.3 mgd.
         b) Maximum Month Flow Rate: 2.0 mgd.
         c) Peak Day Flow Rate: 2.70 mgd.
         d) Peak Hour Flow Rate (maximum): 2,800 gpm (4.04 mgd).
      3) Minimum Ultraviolet Transmittance (UVT) at 253.7 nm: 65 percent.
      4) 24-Hour Period Average: 2 NTU.
      5) Maximum Turbidity:Less than 10 NTU and not more than 5 NTU, 5 percent of the time.
      6) Maximum System Power Consumption: Defined in Form 1 (at the end of this Section).
      7) Water Temperature: 20.3 to 27.7 degrees Celsius.
   c. The UV Disinfection System shall meet the design criteria as specified herein and in Form 1:
      1) One redundant channel at Peak Hour Flow Rate.
      2) UV Bank: Lamp configuration: horizontal, parallel to flow.
      3) Minimum power draw per lamp: 250 watts.
      4) The UV Dose produced by the system shall not be less than the Design UV Dose at the end of the design time period with attenuated lamp conditions. Lamps required to deliver the design dose for the approximate maximum instantaneous flow shall be turned on. Power to those lamps shall be modulated as required to deliver the design dose as the flow fluctuates between the approximate maximum and minimum flow.
      5) Hydraulic Constraints:
         a) Vendor shall specify the maximum water surface elevation at which the UV system can operate (based on Third Party Reactor Validation Testing).
         b) Minimum water surface elevation at UV banks: Vendor shall specify the minimum water surface elevation that must be maintained at all times, in any channel that contains UV lamps that are turned “On.” The minimum water surface elevation shall be set such that the quartz sleeves of the UV banks are completely submerged.
         c) Weir Crest Elevation: As shown in Contract Drawings.
         d) Maximum Acceptable Normalized Lamp Velocity (gpm/lamp): To be specified by Vendor and shall not exceed maximum value proven effective during Third Party Validation Testing.

e) Minimum Acceptable Normalized Lamp Velocity: To be specified by Vendor and shall not exceed minimum value proven effective during Third Party Validation Testing.

6) Guaranteed Minimum Lamp Life: As stated in Form 1.

7) Lamp Age Factor: Maximum allowable Vendor value.
   a) Calgon $C^3$500D: 0.85.
   b) Trojan UV3000Plus: 0.90.
   c) Wedeco TAK 55: 0.88.

8) Sleeve Fouling Factor: Maximum allowable Vendor value.
   a) Calgon $C^3$500D: 0.90.
   b) Trojan UV3000Plus:0.95.
   c) Wedeco TAK 55: 0.90.

9) The UV sensors employed by Vendor must track the combined intensity loss due to lamp aging and sleeve fouling (attenuated lamp condition) or demonstrate to ENGINEER how the Vendor will comply with the 2012 UV Guidelines calculated dose intent.

D. Performance Requirements:

1. The UV Disinfection System shall produce an effluent conforming to the following:
   a. Total coliform less than 2.2 MPN/100 ml, based on a 7-day median concentration.
      1) Grab samples shall be taken in accordance with the Microbiology Sampling Techniques found in Standard Methods for the Examination of Water and Wastewater, 19th Ed.
   b. 5-log10 poliovirus reduction.
2. Provide a UV Disinfection System as indicated on the Drawings and as specified in this Section.
3. Physical location and hydraulics of the UV equipment are as indicated on the Drawings. Installed location of equipment may vary within 10 feet at no additional cost to the OWNER.
4. The maximum head loss across the UV disinfection system at peak flow conditions shall be identified by the Vendor. Vendor shall guarantee maximum head loss will not exceed the identified value by more than 0.25 feet.
5. The power factor shall be 99 percent or greater. Harmonic distortion shall be in accordance with IEEE 519-1992 Tables 10.1, 10.2, and 10.3 as measured at the input terminals to the Power Distribution Center.
6. The requirements stated in Form 1 are minimum requirements. If the UV Vendor determines more equipment is needed then the UV Vendor must provide the additional equipment to meet the performance requirement.

E. The Vendor shall review and supply equipment suitable for the ambient environmental conditions of Section 01610. The proposed UV channels shall be outdoors and subject to marine air. Refer to attached Drawings for specific constraints of the flow channels.

F. Facility Constraints: All components of the UV system must fit within the footprint of the UV Disinfection Facility as shown in the Drawings, including flow split between UV channels and proper approach and exit lengths, effluent weirs, electrical equipment, and reasonable operations and maintenance access.

1.06 SUBMITTALS

A. Product Data and Shop Drawings: Equipment Vendor shall submit, per Section 01330, the following:
   1. Product data, including, but not limited to, the following:
      a. Complete description in sufficient detail to permit an item-by-item comparison with the Specifications.
      b. Descriptive information including catalog cuts and Vendor's specifications for all components.
      c. Written field electrical termination requirements and instructions as required for the CONTRACTOR to install a complete and operational system.
      d. Sources for replacement lamps.
      e. Conditional Acceptance letter from California Department of Public Health.
      f. Third Party Reactor Validation Testing results and corresponding Engineering Report(s).
      g. Number of lamps per module.
      h. Number of modules per bank.
      i. Total number of UV lamps.
      j. Baffle plates conforming per Article 2.06.
   2. General Shop drawing submittal including, but not limited to:
      a. Details of the UV Bank, ballast enclosure, power distribution system with transformers as required, and control system.
      b. Dimensions and installation requirements.
      c. Information on the channel configuration, including but not limited to: widths, depths, lengths, and any other items necessary to confirm the proposed system will fit into the proposed UV channels.
   3. Electrical data and shop drawings per DIVISION 16:
      a. Electrical Shop Drawings including but not limited to:
         1) Front exterior and interior panel layout drawings for all electrical and control panels. Coordinate with DIVISION 17.
         2) Control schematics with wire numbers per DIVISION 17.
         3) Detailed interface and interconnection drawings that indicate all UV system and external component and equipment connections.
         4) Detailed electrical wiring diagrams as required for the CONTRACTOR to install a complete operational system. Electrical wiring diagrams shall include, but not be limited to:
            a) Source power feeder conductor quantities and sizes.
            b) Control wiring quantities and sizes.
            c) Signal cable quantities and sizes.
            d) Power (kW), power factor and apparent power (kVA) for each UV Bank.
            e) UV PLC power requirements for UPS sizing.
            f) Cut sheets for each electrical power and control device.
         5) Calculations to meet the heating and cooling requirements of Section 17050.
         6) Heating strips per Section 17710.
         7) Provide closed circuit air conditioning system as specified in Section 17710.
         8) Provide Corrosion inhibiting vapor capsules as specified in Section 17710.

4. Instrumentation and Controls data and shop drawings per DIVISION 17, including but not limited to:
    a. Loop drawings.
    b. Control philosophy narrative with integration of the 2012 UV Guidelines Validation Testing results, including the use of sensors to monitor and alarm the combined effect of lamp aging and sleeve fouling and/or the use of the sensors to continuously monitor UV dose based upon inputs of flow, sensor intensity, and potentially UV Transmittance (UVT).
    c. Provide system block diagram complete with all inter-equipment wiring and conduit requirements.
    d. Hardcopy and electronic copy on a CD-ROM of the UV PLC system program.
    e. Hardcopy and electronic copy on a CD-ROM of the HMI program.
    f. Systems must be supplied with PLCs and HMIs per Sections 17720 and 17721.
    g. Detailed memory map of data to be transferred from or to the Plant SCADA system.
5. List of spare parts to be provided by Vendor.

B. Operation and Maintenance Manuals:
1. UV equipment Vendor shall submit operation and maintenance manuals in accordance with Section 01782.
    a. In addition to the requirements listed in the above referenced Section, the Operation and Maintenance Manuals shall include:
        1) Name, address, and telephone number of nearest Vendor and spare parts warehouse.
        2) Special tools required for operation and maintenance.
        3) Reproducible prints of the Contract diagrams, schematics, and installation drawings for electrical and instrumentation work.
2. The ENGINEER will not approve an equipment unit before its manual has been accepted.
3. UV equipment Vendor's copy of complete manuals shall be available at the site of the work for use by field personnel and ENGINEER during Hydraulic and Alarm Testing, and Performance Testing of equipment.
4. Step by step instructions for operation and maintenance of all equipment provided by Vendor.

C. Quality Certification:
1. Qualifications of civil engineer for Third Party Reactor Validation Testing.
2. Factory Acceptance Testing: Provide complete results of Vendor's testing.
3. Provide Engineering Report as submitted to CDPH including:
    a. All raw data used to justify the conclusions of the 2012 UV Guidelines commission testing report.
    b. Test reactor configuration including tested parameters (e.g., flow rates, UV transmittance, number of reactors/lamps in operation, and type of water tested).
    c. Collimated beam results.
    d. Reactor validation results with regard to inactivation.
    e. Test results from head loss testing.
    f. Lamp age and fouling factor test results, if performed in accordance with 2012 UV Guidelines.

g. Recommended normal lamp velocity range (flow/lamp) to meet a delivered dose of 105 mJ/cm^2 for the recommended UV system.
h. Delivered UV Dose equation developed based on Vendor's Third-Party Reactor Validation Testing.

4. CDPH acceptance letter showing technology acceptance for the proposed system based on Engineering Report as described in this Section and in accordance with 2012 UV Guidelines.
5. Manufacturer's guarantee: Submit performance guarantee as specified under performance guarantee of this Section.
6. Hydraulic calculations demonstrating compliance with the hydraulic constraints specified herein.
7. Representative harmonic analysis calculations and reports for both voltage and current at the point of common coupling, as defined as the input terminals to the power distribution center. Certification that voltage and current harmonic distortion levels are within IEEE 519 Standard limits at the point of common coupling when powered from utility power supply in accordance with Article 2.03.
8. Vendor's UV equipment warranty including lamps, power supply, ballasts, quartz sleeves, wipers, and UV sensors, as specified herein.
9. Certified test results for power (kW), power factor, and apparent power (kVA) for the entire system.
10. Vendor's performance warranty as specified herein.
11. Documentation of the successful completion and results of the Underwriter's Laboratory (UL) or equivalent testing shall be provided.
12. Initial Performance Test protocol to fulfill requirements outlined herein.

D. Closeout Submittals:
1. Written certification of proper UV system installation as outlined in Article 3.02, Paragraph B herein.
2. Functional field testing protocol/report to fulfill requirements as specified in this Section.
3. Two copies of all UV PLC, operator interface, and other programs required for the maintenance of the UV system in native format on CD-ROM. Also, two hardcopies of annotated software.
4. Certificate of Proper Installation.

E. Other Qualification Requirement Submittals:
1. A statement listing any deviations or exceptions taken to these Specifications. Include specification reference and proposed alternative with reason stated for exception.

F. Warranty Submittals:
1. Performance and equipment guarantees.

1.07 QUALITY ASSURANCE

A. Qualification Requirements:
1. UV equipment Vendor shall have a minimum of six (6) installations in operation in North America with identical equipment proposed and have been regularly engaged in UV systems for at least ten (10) years.
2. The UV equipment Vendor shall have obtained written acceptance of the system capacity based on the 2003 UV Guidelines validation testing from the

CDPH for the UV Disinfection System supplied for this application. A UV reactor and lamp system that has not been given at least 'Conditional Acceptance for Validation by CDPH' prior to bid advertisement will not be accepted.

3. Sizing of equipment shall be completed in accordance with the 2012 UV Guidelines. Vendor shall have an independent third-party prepare an Engineering Report documenting the third-party validation testing.
4. The UV equipment Vendor shall demonstrate that the dose required in the performance specification can be met with the amount of equipment proposed. The UV equipment Vendor shall base sizing of UV system on a Third-Party Reactor Validation Testing calculation to meet the minimum UV design dose as specified herein. The bioassay calculation shall be based on protocol for bioassay testing or with a different method pre-approved by the ENGINEER. The UV equipment Vendor's data and results shall be reviewed by the ENGINEER. The ENGINEER can apply the required correction factor to the Vendor's bioassay results. The ENGINEER's review and opinion of the test protocol, pilot data, and pilot report conclusions shall be deemed final and shall be just cause for the rejection of the proposed equipment. In addition, bioassay calculations shall use one method for the calculation of gpm per lamp for all data, as defined herein as the "Normalized Lamp Velocity."
5. The delivered UV dose and thus, equipment performance, shall be determined based on the 2012 UV Guidelines, or another method approved by the ENGINEER. Deviation from this methodology will not be accepted. The Third-Party Reactor Validation Testing results must be supplied at the time of Proposal to be acceptable.
6. A statement by the UV equipment Vendor listing any deviations or exceptions taken to these Specifications shall be provided to the ENGINEER for the ENGINEER's review, opinion, and acceptance. The ENGINEER's final decision regarding the acceptance or denial of any deviations or exceptions shall be just cause for the rejection of the proposed equipment and require that the equipment Vendor supply the disinfection equipment as specified herein.

B. Provide equipment labeled and listed by Underwriters Laboratory (UL) or another nationally recognized testing laboratory, furnished by a single Vendor qualified and experienced in the production of similar equipment.

C. All stainless steel components and enclosure panels shall be cleaned, pickled and passivated as specified in Section 05500 to protect the stainless steel.

1.08 DELIVERY, STORAGE AND HANDLING

A. If required by the CONTRACTOR'S schedule, the Vendor shall provide equipment in multiple separate freight shipments.

B. Provide notification in writing to the OWNER and CONTRACTOR of approximate delivery date(s) 12 weeks before delivery. Notify same of actual delivery date at least 7 days before delivery. Provide description and approximate weight of shipping container and required equipment for unloading. Vendor shall coordinate delivery, unloading, and storage with CONTRACTOR.

C. Moisture sensitive products shall be stored in weather tight enclosures. Weather tight enclosures must be a cargo container suitable for transport either by train or

cargo ship. Vendor will designate those items that need to be store in a moisture controlled environment. Tarped crates are not acceptable. All damaged materials related to storage shall be replaced with new materials.

D. Vendor shall coordinate the delivery of equipment with CONTRACTOR. Vendor shall revise schedule for delivering equipment packages if requested by CONTRACTOR without additional cost to CONTRACTOR.

E. Storage:
   1. General: CONTRACTOR shall store, and handle in accordance with the Vendor's printed instructions.
   2. Packing and Shipping: Vendor shall deliver equipment to the project site in the original containers with seals unbroken and labeled with Vendor's identification and number.
   3. Delivery: Vendor shall deliver materials dry and undamaged to the CONTRACTOR. During the delivery process materials must be stored out of contact with the ground.
   4. Unpacking: The CONTRACTOR shall not destroy shipping containers. Shipping containers shall be given to the OWNER for storage of UV equipment.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate with restrictions specified in Section 01140.

1.10 VENDOR'S WARRANTY

A. The equipment Vendor shall warrant the OWNER against defects in materials and workmanship in accordance with the Instructions to Proposers and the following:
   1. General Warranty:
      a. The equipment furnished under this Section shall be free of defects in materials and workmanship, including damages that may be incurred during shipping, storage, and installation, for a period of 3 years, which shall commence from the date specified in Section 01740.
      b. All wiring in the channel exposed to UV light shall be warranted for 15 years by the Vendor. If the wiring fails before 15 years have elapsed, the Vendor shall be responsible for the replacement of the wires and the labor.
      c. Vendor shall guarantee that for components manufactured by the Vendor, replacement parts shall continue to be available to the OWNER for a minimum of 20 years from the date specified in Section 01740. s. Vendor shall guarantee that, if Vendor or Vendor's product line is sold, Vendor shall make provisions such that all guarantees, warrantees, and bonds will remain in effect and that replacement parts and operational support shall continue to be available to the OWNER for the time period specified above.
      d. No warrantees shall be pro-rated, and all warrantees shall include all costs associated with required site visits, inspections, equipment removal costs, and equipment installation costs.
      e. All warrantees and support shall be provided directly by the Vendor and not the local manufacturer's representative.

2. UV Lamp Warranty:
    a. The UV lamps shall be warranted by the Vendor against lamp failure as specified herein. Lamp failure occurs when the ratio of the available UV light output of the lamp to the UV light output of a new lamp after 100 hours of burn-in is less than the lamp age factor. The Vendor shall provide a warranty for the performance of the UV lamp for a minimum period of operating hours per lamp as stated in Form 1, which shall commence from the date specified in Section 01740.
    b. The Vendor shall replace any lamp that fails before the end of the operating hours per lamp as stated in Form 1 at no cost to the OWNER, with freight and insurance paid by Vendor, to the location of the Project site.
    c. This guarantee shall be limited by the guaranteed number of start/stop cycles. The guaranteed lamp start/stop cycle shall be 4 stop/start cycles per 24-hour period over the life of the lamp. The automation associated with the UV equipment shall be programmed to prevent more than 4 start/stop cycles per day. Additionally, the automation system must log the operational hours for each individual lamp.
    d. The guaranteed lamp life shall not be limited by time periods when the plant is not in operation and/or when the UV system is shut down.
    e. Vendor shall ensure all returned UV lamps (old/new) are recycled upon receipt of the returned lamps at the manufacturing headquarters for the life of the UV Disinfection System (20 years after successful completion of the date specified in Section 01740).
3. UV Ballast Warranty:
    a. Vendor shall guarantee all ballasts against failure for a minimum period of 5 years, which shall commence after the date specified in Section 01740.
    b. Vendor shall replace any ballast that fails before the end of the designated warranty period at no cost to the OWNER, with freight and insurance paid by Vendor, to the location of the Project site. Installation of the failed ballast can be performed by OWNER.
4. UV Quartz Sleeves Warranty:
    a. Vendor shall guarantee all quartz sleeves against failure for a minimum period of 5 years, which shall commence after the date specified in Section 01740. Sleeve failure is defined as permanent loss of 10 percent sleeve transmittance relative to new sleeve transmittance.
    b. Vendor shall replace any quartz sleeve that fails before the end of the designated warranty period at no cost to the OWNER, with freight and insurance paid by Vendor, to the location of the Project site.
5. UV Sensor Extended Warranty:
    a. Vendor shall guarantee all UV sensors against failure for a minimum period of 3 years, which shall commence on the date specified in Section 01740. Sensor is deemed to have failed when the sensor no longer measures UV intensity or sensor does not meet the specified accuracy in Sections 17515 and 17516.
    b. Vendor shall replace any UV sensor that fails before the end of the warranty period at no cost to the OWNER, with freight and insurance paid by Vendor, to the location of the Project site.
6. Performance Warranty:
    a. The equipment furnished under this Section, when operated within the conditions specified in the Contract Documents, will meet or exceed the

performance requirements specified herein for a period of 3 years from the date specified in Section 01740. This is the base bid requirement.

b. If the UV equipment fails to meet design and performance criteria, the UV equipment Vendor shall modify, change, or add equipment as necessary to meet performance criteria. Vendor shall be responsible for any additional costs to CONTRACTOR or OWNER due to changes (including but not limited to piping, mechanical, structural, or electrical changes) or additional equipment as necessary to meet performance requirements. This includes design, engineering, construction, as well as equipment.

c. The OWNER shall make available the UV Disinfection System electronic data records of historical performance for Vendor's review. The automation system shall log all relevant performance data and store it in the historical database.

d. If the system fails to meet specified performance criteria during the Initial Performance Test, or the warranty period following the date specified in Section 01740, and the Vendor is unable to modify the system through the addition of UV banks or other elements, then the Vendor shall be responsible for complete removal of nonconforming system and subsequent installation of UV disinfection products that are capable of meeting specified performance conditions. Payments for replacement or corrections not paid by Vendor in accordance with the Procurement Contract shall be paid from the Vendor's Performance Bond.

B. The equipment Vendor shall warrant the OWNER regarding power consumption as follows:

1. The Vendor shall furnish a warranty stating that the installed UV system shall not exceed the maximum power consumption as specified in Form 1.
2. If this maximum power usage is exceeded due to system modifications or by design, the Vendor agrees to pay OWNER a present worth cost (calculated based on a 20-year life and appropriate interest rate) equivalent to the difference between the actual usage and the warranted quantity. The cost of power shall be assumed at $0.10/kWhr.

C. End of Warranty Inspection:

1. Inspection:
   a. Vendor's representative shall perform a two-day (sixteen-hours total) inspection of Vendor's UV equipment, within 30 days prior to the 3-year anniversary date of the equipment warranty.
   b. Vendor shall ascertain or appraise the following:
      1) Status of equipment and installation after normal usage.
      2) Adherence to Vendor's recommended maintenance and operation of equipment.
      3) Quality of sleeve cleaning and recommended sleeve cleaning interval.
      4) All electrical connections.
      5) Calibration of duty UV sensors using reference UV sensors.
      6) Operation of alarms.
      7) UV transmittance monitors.
   c. Vendor shall make adjustments as necessary to restore equipment within original tolerances.
   d. Vendor shall submit a written letter report to the OWNER covering the inspection items and including recommendations where applicable.

1.11 MAINTENANCE

A. Spare Parts: The UV Disinfection System Vendor shall furnish, at a minimum, the following spare parts and safety equipment:
   1. UV Lamps: Ten percent additional.
   2. UV Ballasts (complete): Ten percent additional.
   3. Lamps Sleeves: Ten percent additional.
   4. Lamp Sealing Rings or Holder Seals: Ten percent additional.
   5. Wiper or Wiper Rings (if applicable): Ten percent additional.
   6. UV Sensors: Two (2).
   7. Integrated Bank Assembly: Three (3).
   8. Module Lifting Assembly/Frame/Sling: Provide for one (1) bank.
   9. Cleaning Solution (if applicable): One (1) full charge for 1 year after acceptance of Initial Performance Test.
   10. Printed circuit boards: Five percent additional.
   11. The spare parts listed above must be placed in a wooden container and labeled in a manner that is acceptable to the OWNER.
   12. Electrical and Instrumentation:
      a. PLC CPU: one (1).
      b. PLC card for each and everyone used: one (1).
      c. PLC power supply: one (1).
      d. HMI: one (1).
      e. PLC Backplane: one (1).
      f. Communication card for each and everyone used: one (1).

B. Special Tools: Provide 1 set of all special tools required for operation and maintenance, and complete assembly or disassembly of the UV disinfection system.

1.12 WORK BY OTHERS

A. The following items are provided by CONTRACTOR but shall be coordinated by the Vendor prior to Shop Drawing Submittals. These items will include:
   1. Structural:
      a. Concrete channels and strict tolerances for the UV reactors.
      b. Foundation/housekeeping pads and additional housing for supplied UV disinfection equipment.
      c. Protective coatings for concrete.
      d. Anchor bolts will be designed, provided and installed by CONTRACTOR; anchor bolt design by UV Vendor.
   2. Mechanical:
      a. Hoist equipment above the UV disinfection channels for installation and removal of the UV banks.
      b. Inlet modulating valves and magnetic flowmeters per channel.
      c. Installation materials for instrumentation and automatic valves including but not limited to air/sample line tubing, fittings, and mountings.
   3. Electrical:
      a. Electrical wiring interconnections (including wiring, conduit and other appurtenances required to provide power connections as needed) from the electrical power source to the UV disinfection equipment and and system control panels.
      b. Ethernet /IP communications connection to the OWNER’S Plant Control System.

4. Other:
    a. Receiving, unloading and safe storage of equipment at site or a storage facility until ready for installation.
    b. Raw materials and utilities during equipment testing.
    c. Laboratory services, operating and maintenance personnel during equipment checkout, startup and operations.
    d. Any on-site painting or touch-up painting of equipment supplied.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Basis of Bid:
    1. Calgon Carbon Corp. $C^3$500D.

B. Alternate:
    1. Trojan UV3000Plus.
    2. Wedeco TAK 55.

C. The drawings are based on the Model C^3 500D system by Calgon Carbon Corp. CONTRACTOR shall be responsible for the cost of any changes that may be required to accommodate alternate model and equipment by other manufacturers, including, but not limited to, structural, mechanical, instrumentation, and electrical work. CONTRACTOR shall also pay any additional engineering costs necessary for revisions of Contract Documents and extended review of equipment shop drawing resubmittal(s) required to accommodate alternate equipment.

2.02 GENERAL PRODUCT REQUIREMENTS

A. Description of Work:
    1. The work under this Section shall cover furnishing a complete and operational open-channel, gravity-flow, UV disinfection system. The system shall be complete with UV banks, power distribution, system control, baffle plates, weir, UV detection system, and automatic wiping system as shown on the Drawings and specified herein.
    2. The system shall utilize active control based on the Third-Party Reactor Validation Testing and using the following parameters:
        a. UV light intensity, as measured by a calibrated sensor technology meeting USEPA UVDGM standards.
        b. Water quality (UVT).
        c. Water flow.
        d. Power.
        e. Based on these parameters, the system will automatically vary the UV lamp power proportionally to continuously meet the dose requirement.
    3. The dose delivered by the UV system shall be linearly variable within a range of 50 to 100 percent of maximum power in both manual and automatic operating modes. If the variability differs between modes, the automatic mode of operation shall be the sole mode considered.
    4. The system shall be capable of continuous disinfection while automatically cleaning the UV lamp sleeves without reducing or shadowing the output of the lamps. For systems that require batch chemical cleaning, system redundancy can be used during the batch cleaning process to maintain the required dose.

5. The UV sensor technology employed by the Vendor must continuously track the combined intensity loss due to lamp aging and sleeve fouling and alarm when the intensity level drops to a set percentage of the intensity level of the system at full power with new lamps and clean sleeves. The target percentage is defined as the product of the lamp age factor and fouling factor (attenuated lamp condition).

B. Supplemental Design Criteria:
   1. Maximum Acceptable Normalized Lamp Velocity: To be specified by Vendor, but must not be above the maximum value tested as part of Third-Party Reactor Validation Testing for the target microorganism.
   2. Minimum Acceptable Normalized Lamp Velocity: To be specified by Vendor and meet Design Criteria as stated in Article 1.05 Paragraph C. Confirm anticipated design adjustments (if applicable) if minimum velocity falls below the minimum value tested as part of Third-Party Reactor Validation Testing for the target microorganism.
   3. Maximum combined height for the module, module lifting frame, and standard sling/chain arrangement is 6.0 feet.

C. General:
   1. Unless otherwise specified, all components in contact with the effluent and/or UV light shall be Type 316 stainless steel, Type 214 quartz glass, Viton® or Teflon®.
   2. All fasteners in contact with the effluent shall be Type 316 stainless steel.
   3. Unless otherwise specified, all metal components above the effluent shall be Type 316 stainless steel.
   4. All wiring exposed to UV light shall be Teflon-coated.
   5. System shall include automatic mechanical or mechanical/chemical cleaning system, system control panel and accessories as specified.

2.03 DESIGN, CONSTRUCTION, AND MATERIALS

A. Option A: For the Calgon $C^3$500D System:
   1. System Manufacture and Construction:
      a. System shall include automatic mechanical cleaning, master system control panel, power distribution centers for each bank and accessories as specified.
   2. Lamp Array Configuration:
      a. The lamp array configuration shall be the uniform array with all lamps parallel to each other and to the flow. The lamps shall be evenly spaced in horizontal and vertical rows with centerline spacing equal in both directions.
      b. The single array pattern shall be continuous and symmetrical throughout the reactor.
      c. The system shall be designed for complete immersion of the UV lamps including both electrodes and the full length of the lamp tube in the effluent. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent.
   3. UV Lamps:
      a. The lamps contained in the UV system must be the same low-pressure high-output amalgam lamps that were tested during 2012 UV Guidelines System Validation Testing. The UV lamp type shall be GA64T10L.

b. The lamp shall be rated for an average UV output of 205 W at 253.7 nm after 100-hour burn in. The average UV output of any proposed lamp cannot exceed 38 percent of the lamp input power.
c. Electrical connections at one (1) end.
d. Each connection shall have 4 pins.
e. Each low pressure, high output UV lamp shall produce UV light with at least 90 percent of the UV emission for a wavelength between 230 nm and 300 nm.
f. The lamp design shall be a low pressure high intensity amalgam lamps of the preheat start design.
g. The filament of the lamp shall be clamped design, significantly rugged to withstand shock and vibration.
h. The electrical connections of the UV lamps at one end shall be a four pin ceramic connector.
i. Minimum UV lamp arc length shall be 57 inches.
j. Lamps shall not produce any ozone.
k. The lamp bases shall be of a durable construction resistant to UV.
l. The lamp design shall prevent electrical arcing between electrical connections in moist conditions.

4. Lamp End Seal and Lamp Holder:
   a. The open end of the quartz sleeve shall be sealed by means of a Type 316 stainless steel nut that threads onto a coupling and compresses a sleeve O-ring.
   b. The sleeve coupling nut shall have a knurled surface to allow a positive hand grip for tightening. The nut shall not require any tools for removal.
   c. The quartz sleeve shall be held in place by means of an O-ring and compression washer.
   d. The UV lamp rack shall be designed to isolate the individual lamps and to prevent moisture from coming in contact with the electrical connections of other lamps in the event of a seal failure or a quartz sleeve fracture.
5. UV Lamp Sleeves:
   a. Type 214 clear fused quartz circular tubing as manufactured by General Electric or equal.
   b. The sleeve wall thickness shall be at least 1.50 mm (nominal).
   c. The quartz sleeve material shall be rated for 92-percent UV transmission and shall not be subject to solarization over its lifespan.
   d. The quartz sleeves shall be fabricated with one end closed so that only the open end requires sealing.
6. UV Module (UVM):
   a. Each UVM will consist of five (5) lamps with the electronic ballasts powering these lamps mounted in the Power Distribution Center (PDC) located adjacent to the UV lamp bank. The UV module frame is fabricated from Type 316/304 stainless steel. All components in contact with the effluent are Type 316 stainless steel.
   b. Each lamp shall be enclosed in its individual quartz sleeve.
   c. The UVM shall be connected to receptacles on the Power Distribution Center (PDC) by means of one or two multi-conductor cable(s) with modular repairable connector(s). The cable connector and all of its components shall be field repairable. The connector shall be of a "Snap-On" design having no threads that may bind or be subject to cross threading. The connector shall also allow for visual confirmation that the connection is locked in place. Pins shall be made from a copper alloy with

hard silver plating. The connector shall be coated with a corrosion resistant finish and all levers, bolts and screws shall be made of stainless steel. The connector shall meet IP65 (UL574) requirements for direct water spray when mated.

d. At the point of exit from the UVM, the multi-conductor cable(s) shall pass through a water resistant strain relief.
e. The UVM shall be designed so that when they are in place, in the UV banks with the grating removed, they shall support a live load of 300 lbs without damage. The tops of the racks shall present a surface on which workers can stand to access the racks in the UV bank.
f. The UVM shall incorporate a protective shield to prevent UV light from radiating above the lamp bank during normal operation.
g. The UVM shall be designed to comply with NEMA 4X (IP65) ratings.

7. UV Lamp Bank Support Rack:
   a. The rack shall be Type 304 stainless steel and suspended above the effluent in the channel by means of slotted angles allowing adjustment to the precise height of the channel and requiring no fastening of the individual UV lamp banks.
   b. The UV lamp bank rack shall be designed so that no UV light radiates above the channel when the UV lamp banks are energized and fully immersed in the effluent.
8. Automatic Cleaning System:
   a. Each UV bank shall be equipped with an automatic mechanical wiping system. The cleaning system shall maintain uniform wiping tension and cleaning over complete wiping length of the quartz sleeve and the UV sensors.
   b. The proposed cleaning system utilizes stainless steel scrapers to keep the quartz sleeves clean. The stainless steel wire is wound like a spring and is assembled with Teflon spacers and stand-offs to form a scraper assembly. The quartz sleeve must be removed from the lamp rack to replace the scraper assembly.
   c. When the cleaning system is not in use, the drive arm will be stationary and parked in the home positions, upstream end of the UV module.
   d. The scraper will be electrically actuated by an AC motor housed at the top of the UV module. Each UV module has its own cleaning motor.
   e. The wiper system shall have the capability of being operated in either manual or automatic mode. In automatic mode, the cleaning wipers shall be initiated and controlled by the operator interface.
   f. Cleaning cycle intervals be field adjustable within the range of once per minute to once per week.
9. UV Intensity Detection System:
   a. A submersible UV sensor, provided by Vendor, shall continuously sense the UV intensity produced in each bank and shall be as specified in Section 17515. Provide one UV sensor per bank as specified in this Section herein.
10. Low and High Water Level Sensors:
    a. Three water level sensors, provided by Vendor, shall be included for each channel and shall be as specified in Section 17206.
    b. During manual, automatic, and remote modes of system operation, the water level sensor shall ensure that the automatic cleaning system will not initiate if the water level in the channel drops below acceptable values.

11. Electrical:
    a. General:
        1) Each module shall be powered from the Power Distribution Center.
        2) Each ballast shall drive 1 high-intensity, low-pressure lamp.
        3) Power factor shall not be less than 99 percent lagging.
            a) A leading power factor shall not be acceptable.
            b) Provide power factor correction capacitors as necessary to meet the specified power factor.
        4) Forced-air cooling of control panels that contain electronic circuit boards shall not be acceptable.
        5) Provide air conditioning mounted directly on panels as required.
        6) Electrical supply for the water level sensor will be 230 VAC and powered by the PDC.
        7) UV Vendor to perform all terminations between lamps and ballasts.
        8) UV Vendor to supply all cabling and conduit between lamps and ballasts.
        9) All enclosures located indoors or outdoors shall be NEMA 4X Stainless Steel Type 316 unless otherwise specified. All panels shall be self supporting. Provide air conditioning panels as required.
        10) Harmonic distortion levels as measured at the 480V input terminals of the PDC supplied must be less than those allowed by IEEE 519-1992 Tables 10.1, 10.2, and 10.3. If these levels cannot be achieved at the installed site by the Contractor, the UV equipment Vendor shall furnish and install all necessary Accusine filters to comply with IEEE 519-1992 at no additional cost to the OWNER.
    b. Connectors:
        1) The UV module connectors shall be watertight with a molded backshell to meet the requirements of UL574 for direct water jet spray when mated.
        2) Each connector shall be automatically disconnected from power when uncoupled.
        3) The connector pins shall be copper alloy with gold plating.
        4) Each pin when mated shall seal with a “cork and bottle” seal.
        5) The ground pin shall be longer than the other pins, giving a “make first, break last” ground connection.
        6) The hood and base of the connector shall be powder coated aluminum alloy with all locking levers and bolts made of stainless steel.
12. Power Distribution Center (PDC):
    a. The electrical supply to each PDC shall be 480/277VAC, 3 Phase, 4 Wire plus ground, 60Hz. Where Vendor’s equipment requires other voltages, Vendor shall provide any transformers necessary for proper system operation.
    b. Maximum power consumption per UV Channel shall be no greater than 39.2 kW.
    c. Data concentration shall be through integrated circuit boards located inside the PDC.
    d. Fusing and ground detection circuits shall be located inside the PDC.
    e. Enclosure material shall be Type 316 stainless steel.
    f. All internal components shall be sealed from the environment.
    g. All PDCs shall be self-supporting and shall be constructed of Type 316 stainless steel.

h. Each PDC shall include its own main breaker. This will allow maintenance personnel to perform any service work per local safety regulations.
i. The PDC shall be equipped with the necessary components to allow each bank of lamps to be controlled in either the Remote (Automatic) or Local (Manual) mode. Each PDC shall have a Control Card and Operator Station used to control and monitor the bank of lamps.
j. Each PDC shall operate as an independent unit. In UV systems that include multiple banks, the operation of each PDC shall not be affected by the operation of other PDCs.
k. Provide heating and cooling for the unit to meet the heating and cooling requirements of Section 17050:
    1) Heating strips per Section 17710.
    2) Provide closed circuit air conditioning system as specified in Section 17710.
    3) Provide Corrosion inhibiting vapor capsules as specified in Section 17710.

13. System Control Center (UV PLC):
    a. The UV control system shall include a master UV PLC for the entire system. The master UV PLC shall be contained in a cabinet located adjacent to the channels, as indicated on the drawings. The UV PLC shall be provided and programmed as specified in Section 17101-31, the Drawings, and this Section.
    b. Electrical supply to the master UV PLC will be 120 volts, 1 phase, 30 amps (plus ground). Where Vendor's equipment requires other voltages, Vendor shall provide any transformers necessary for proper system operation.
    c. Vendor shall provide an uninterruptible power supply (UPS) to support the UV PLC per Section 17712.
    d. UV System control and monitoring shall be provided through display screen and message keypad to allow complete operator interface. Hardwired panel devices and meters shall not be permitted.
    e. Keypad shall have a sealed membrane overlay covering all function keys and numerical keys.
    f. The UV PLC control panel shall be provided with HMI as specified in Section 17720. Operator interface shall be menu-driven with automatic fault message windows appearing upon alarm conditions.
    g. Bank status shall be capable of being placed either in Manual, Off, or Auto mode.
    h. Banks shall be cycled in a lead/lag rotation through automatic control at the UV PLC for equal wear, and timed off to minimize bank cycling.
    i. Elapsed time of each bank shall be recorded and displayed on the display screen when prompted.
    j. Panel shall be UL approved, rated NEMA 4X 316 stainless steel. Panels shall be free standing.
    k. Provide heating and cooling for the panel to meet the heating and cooling requirements of Section 17050:
        1) Heating strips per Section 17710.
        2) Provide closed circuit air conditioning system as specified in Section 17710.
        3) Provide Corrosion inhibiting vapor capsules as specified in Section 17710.
    l. Digital I/O modules shall be provided to indicate all alarms and status signals as required per the Drawings and Section 17720.

14. Chemical Cleaning Tank
    a. The UV system Vendor shall furnish a 304L stainless steel liner with drain stub and cover for installation by the Contractor. The module cleaning station should accommodate 1 bank immersed in citric or phosphoric acid (5 to10 percent concentration with pH between 2.0 and 3.0).
    b. The location and elevation of the chemical cleaning tank located adjacent to the channels, as indicated on the Drawings.
    c. The chemical cleaning tank shall be provided with a drain connection, as indicated on the Drawings.

B. Option B: Trojan UV3000PLUS UV System:
1. System Vendor and Construction:
    a. The UV disinfection system shall be manufactured by Trojan UV Technologies.
    b. System shall include automatic mechanical/chemical cleaning, master system control panel, power distribution centers for each bank and accessories as specified.
2. Lamp Array Configuration:
    a. The lamp array configuration shall be the uniform array with all lamps parallel to each other and to the flow. The lamps shall be evenly spaced in horizontal and vertical rows with centerline spacing equal in both directions.
    b. The single array pattern shall be continuous and symmetrical throughout the reactor.
    c. The system shall be designed for complete immersion of the UV lamps including both electrodes and the full length of the lamp tube in the effluent. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent.
3. UV Lamps:
    a. The lamps contained in the UV system must be the same low-pressure high-output amalgam lamps manufactured by Heraeus Nobelight identified by Trojan Part #794447 that were tested during system validation testing.
    b. Low-pressure amalgam design: The coiled filamentary cathodes to be heated by the arc current. The lamp will be preheated to promote longevity.
    c. The filament shall be of the clamped design, significantly rugged to withstand shock and vibration.
    d. Electrical connections at one (1) end.
    e. Each connection shall have 4 pins.
    f. Minimum UV output 70 watts at 253.7 nm after 100-hour burn in, measured in an integrating sphere.
    g. Rated to produce zero levels of ozone.
    h. Lamp bases shall be of a red ceramic construction with a glazed finish resistant to UV and ozone. The base shall be stepped internally and bridged externally to provide additional electrical isolation between the electrodes.
    i. The barrier shall be dielectrically tested for 2,500 Volts.
    j. 1.47 m minimum arc length.
    k. 28 mm nominal outside diameter.
    l. Four Teflon® O-rings equally spaced to center the lamp within the quartz sleeve.

4. Lamp End Seal and Lamp Holder:
    a. The open end of the lamp sleeve shall be sealed by means of a Ryton sleeve nut that threads onto a sleeve cup and compresses the sleeve O-ring.
    b. All electrical connections shall be watertight.
    c. The sleeve nut shall have a knurled surface to allow a positive handgrip for tightening. The sleeve nut shall not require any tools for removal.
    d. The lamp shall be held in place by means of a molded lamp holder, which shall incorporate 2 seals. The lamp holder shall seal against the inside of the quartz sleeve to act as a second seal in series with the external O-ring seal.
    e. The second seal on the lamp holder shall isolate and seal the lamp from the module frame and all other lamps in the module.
    f. In the event of a quartz sleeve fracture, the 2 seals of the lamp holder shall prevent moisture from entering the lamp module frame and the electrical connections to the other lamps in the module.
    g. The lamp holder shall also incorporate a UV resistant PVC molded stop that shall prevent the lamp sleeve from touching the steel sleeve cup.
5. UV Lamp Sleeves:
    a. Type 214 clear fused quartz circular tubing as manufactured by General Electric or equal.
    b. Rated for UV transmission of 89 percent and shall not be subject to solarization over the length of their life.
    c. The nominal wall thickness shall be 1.5 mm.
    d. Lamp sleeves will be domed at one (1) end.
6. UV Module (UVM):
    a. Each UV module shall consist of six (6) lamps with an electrode ballast enclosure mounted on a type 316 stainless steel frame.
    b. Each lamp shall be enclosed in its individual quartz sleeve; one end of which shall be closed and the other end sealed by a lamp end seal and compressed O-ring.
    c. The closed end of the quartz sleeve shall be held in place by means of a retaining O-ring. The quartz sleeve shall not come in contact with any steel in the frame.
    d. The ends of the lamp sleeve shall not protrude beyond the stainless steel frame of the UVM.
    e. Lamp wires shall terminate in the electronic ballast enclosure located at the top of the UVM.
    f. The electronic ballast enclosure shall contain the electronic ballasts and addressable lamp status monitoring systems.
    g. All wires connecting the lamps to the ballasts shall be enclosed inside the frame of the UVM and not exposed to the effluent.
    h. Each UVM shall be connected to a receptacle on the Power Distribution Center by means of a multiconductor cable with a moulded connector.
    i. At the point of exit from the UVM frame, the multiconductor cable shall pass through a waterproof strain relief.
    j. The UVMs shall be designed such that operating personnel at the plant can change the lamps and quartz sleeves without any special tools.
    k. UVM enclosure shall have a NEMA 6P rating.
7. UV Lamp Module Support Rack:
    a. The rack shall be 304 stainless steel and suspended above the effluent in the channel by means of slotted angles allowing adjustment to the precise

height of the channel and requiring no fastening of the individual UV lamp modules.

b. The UV lamp module rack shall be designed so that no UV light shall radiate above the channel when the UV lamp modules are energized and fully immersed in the effluent.

8. Automatic Cleaning System:
   a. Cleaning system will have mechanical and chemical cleaning capabilities, complete with an automatically initiated and controlled cleaning cycle.
   b. The cleaning system, including both mechanical and chemical components, will be fully operational without requiring either lamps or modules be placed out of service.
   c. Cleaning cycle intervals to be field adjustable within the range of once every 3 hours to once every 500 hours. Remote Manual and Remote Auto cleaning control to be available through the operator interface.
   d. The system will be provided with the required cleaning reagents and solutions necessary for initial equipment testing and for equipment start-up.
9. UV Intensity Detection System:
   a. A submersible UV sensor, provided by Vendor, as specified in Section 17515. Provide one UV sensor per bank as specified in this Section herein.
10. Low, Optimum, and High Water Level Sensors:
   a. Three water level sensors, provided by Vendor, shall be included for each channel and shall be as specified in Section 17206.
   b. During manual, automatic and remote modes of system operation, the water level sensor shall ensure that the automatic cleaning system extinguishes automatically if the water level in the channel drops below an acceptable value.
11. Electrical:
   a. General:
      1) Each module shall be powered from the Power Distribution Center.
      2) Each ballast shall drive 2 high-intensity, low-pressure lamps.
      3) Power factor shall not be less than 99 percent lagging.
         a) A leading power factor shall not be acceptable.
         b) Provide power factor correction capacitors as necessary to meet the specified power factor.
      4) Forced-air cooling of control panels that contain electronic circuit boards shall not be acceptable.
      5) Provide air conditioning mounted directly on panels as required.
      6) Electrical supply for the water level switch will be provided by the PDC and be 120VAC.
      7) UV Vendor to perform all terminations between lamps and ballasts.
      8) UV Vendor to supply all cabling and conduit between lamps and ballasts.
      9) All enclosures located indoors or outdoors above the channels shall be NEMA 4X Stainless Steel Type 316 unless otherwise specified. All panels shall be self supporting. Provide air conditioning panels as required.
      10) Harmonic distortion levels as measured at the 480V input terminals of the PDC supplied must be less than those allowed by IEEE 519-1992 Tables 10.1, 10.2, and 10.3. If these levels cannot be achieved at the installed site by the Contractor, the UV equipment SUPPLIER

shall furnish and install all necessary Accusine filters to comply with IEEE 519-1992 at no additional cost to the OWNER.

b. Connectors:
   1) The UV module connectors shall be watertight with a moulded backshell to meet the requirements of UL574 for direct water jet spray when mated.
   2) Each connector shall have no more than 277 Volts across any pin to ground.
   3) Each connector shall be automatically disconnected from power when uncoupled.
   4) The connector pins shall be brass with silver plating.
   5) Each pin when mated shall seal with a “cork and bottle” seal.
   6) The ground pin shall be longer than the other pins, giving a “make first, break last” ground connection.
   7) The body of the nut and receptacle shall be stainless steel.

12. System Control Center (UV PLC):
   a. The UV control system shall include one master UV PLC for control and monitoring of the entire UV system. The UV PLC shall be contained in cabinet located adjacent to the channels, as indicated on the drawings. The UV PLC and shall be provided and programmed as specified in Section 17101-31, the Drawings, and this Section.
   b. Electrical supply to the master UV PLC will be 120 volts, 1 phase, 30 amps (plus ground) Where Vendor’s equipment requires other voltages, Vendor shall provide any transformers necessary for proper system operation.
   c. Provide heating and cooling for the panel to meet the heating and cooling requirements of Section 17720:
      1) Heating strips per Section 17710.
      2) Provide closed circuit air conditioning system as specified in Section 17710.
      3) Provide Corrosion inhibiting vapor capsules as specified in Section 17710.
   d. Vendor shall provide an uninterruptible power supply (UPS) to support the UV PLC per Section 17712.
   e. UV System control and monitoring shall be provided through display screen and message keypad to allow complete operator interface. Hardwired panel devices and meters shall not be permitted.
   f. Keypad shall have a sealed membrane overlay covering all function keys and numerical keys.
   g. The Master UV PLC control panel shall be provided with HMI as specified in Section 17721. Operator interface shall be menu-driven with automatic fault message windows appearing upon alarm conditions.
   h. Bank status shall be capable of being placed either in Manual, Off, or Auto mode.
   i. Banks shall be cycled in a lead/lag rotation through automatic control at the UV PLC for equal wear, and timed off to minimize bank cycling.
   j. Elapsed time of each bank shall be recorded and displayed on the display screen when prompted.
   k. Panel(s) shall be UL approved, rated NEMA 4X. Panels shall be free standing.
   l. Digital I/O modules shall be provided to indicate all alarms and status signals as required per the Drawings and Section 17720.

m. Provide heating and cooling for the panel to meet the heating and cooling requirements of Section 17050.
n. The UV PLC shall be provided with all networking equipment required to properly receive and communicate information to and from the Plant PLC system.

13. Power Distribution Center (PDC):
    a. Electrical supply to each of Power Distribution Center (s) shall be 277/480 Volts, 3-phase, 4-wire (plus ground) connection. Where Vendor's equipment requires other voltages, Vendor shall provide any transformers necessary for proper system operation.
    b. Maximum power consumption per UV Channel shall be no greater than 31.5 kW.
    c. Data concentration shall be through integrated circuit boards located inside the PDC.
    d. Fusing and ground detection circuits shall be located inside the PDC.
    e. Enclosure material shall be Type 316 stainless steel.
    f. All internal components shall be sealed from the environment.
    g. All PDC's shall be self-supporting.
    h. Panel(s) shall be UL approved, rated NEMA 4X.
    i. Provide heating and cooling for the unit to meet the heating and cooling requirements of Section 17050:
        1) Heating strips per Section 17710.
        2) Provide closed circuit air conditioning system as specified in Section 17710.
        3) Provide Corrosion inhibiting vapor capsules as specified in Section 17710.
14. Hydraulic Systems Center (HYD):
    a. Electrical supply to the Hydraulic Systems Center will be 480 Volts, 3-phase, 3 wire (plus ground).
    b. Two HYD will be supplied to house all components required to operate the automatic cleaning system.
    c. The HYD will contain a hydraulic pump complete with integral 4-way valve and fluid reservoir housed inside the HYD.
    d. All tubing and piping shall be Type 316 stainless steel.
15. Chemical Cleaning Tank
    a. The UV system Vendor shall furnish a 304L stainless steel liner with drain stub and cover for installation by the Contractor. The module cleaning station should accommodate half of the modules in a single bank immersed in citric or phosphoric acid (5 to 10 percent concentration with pH between 2.0 and 3.0).
    b. The location and elevation of the chemical cleaning tank located adjacent to the channels, as indicated on the Drawings.
    c. The chemical cleaning tank shall be provided with a drain connection, as indicated on the Drawings.

C. Option C: For the Wedeco TAK55 System:
1. System Manufacture and Construction:
    a. System shall include automatic mechanical cleaning, master system control panel, power distribution centers for each bank and accessories as specified.

2. Lamp Array Configuration:
    a. The lamp array configuration shall be the uniform array with all lamps parallel to each other and to the flow. The lamps shall be evenly spaced in horizontal and vertical rows with centerline spacing equal in both directions.
    b. The single array pattern shall be continuous and symmetrical throughout the reactor.
    c. The system shall be designed for complete immersion of the UV lamps including both electrodes and the full length of the lamp tube in the effluent. Both lamp electrodes shall operate at the same temperature and be cooled by the effluent.
3. UV Lamps:
    a. The lamps contained in the UV system must be the same low-pressure high-output amalgam lamps that were tested during 2012 UV Guidelines system validation testing. The UV lamp type shall be Ecoray.
    b. The lamp shall be rated for an average UV output of 150 W at 253.7 nm after 100-hour burn in. The average UV output of any proposed lamp cannot exceed 38 percent of the lamp input power.
    c. Electrical connections at one (1) end.
    d. Each connection shall have 4 pins.
    e. Each low pressure, high output UV lamp shall produce UV light with at least 90 percent of the UV emission for a wavelength between 230 nm and 300 nm.
    f. The lamp design shall be a low pressure high intensity amalgam lamps of the preheat start design.
    g. The filament of the lamp shall be clamped design, significantly rugged to withstand shock and vibration.
    h. The electrical connections of the UV lamps at one end shall be a four pin ceramic connector.
    i. Minimum UV lamp arc length shall be 56.3 inches.
    j. Lamps shall not produce any ozone.
    k. The lamp bases shall be of a durable construction resistant to UV.
    l. The lamp design shall prevent electrical arcing between electrical connections in moist conditions.
4. Lamp End Seal and Lamp Holder:
    a. The open end of the quartz sleeve shall be sealed by means of a Type 316 stainless steel nut that threads onto a coupling and compresses a sleeve O-ring.
    b. The sleeve coupling nut shall have a knurled surface to allow a positive hand grip for tightening. The nut shall not require any tools for removal.
    c. The quartz sleeve shall be held in place by means of an O-ring and compression washer.
    d. The UV lamp rack shall be designed to isolate the individual lamps and to prevent moisture from coming in contact with the electrical connections of other lamps in the event of a seal failure or a quartz sleeve fracture.
5. UV Lamp Sleeves:
    a. Type 214 clear fused quartz circular tubing as manufactured by General Electric or equal.
    b. The sleeve wall thickness shall be at least 1.50 mm (nominal).
    c. The quartz sleeve material shall be rated for 92-percent UV transmission and shall not be subject to solarization over its lifespan.
    d. The quartz sleeves shall be fabricated with one end closed so that only the open end requires sealing.

6. UV Module (UVM):
    a. Each UV module shall consist of dual (sided-by-side) row configuration of UV lamp assemblies , with pars of lamp assemblies in the vertical direction. Each module will consist of eight (8) total lamps with the electronic ballasts powering these lamps mounted in the Power Distribution Center (PDC) located adjacent to the UV lamp bank. The UV module frame is fabricated from Type 316/304 stainless steel. All components in contact with the effluent are Type 316 stainless steel.
    b. Each lamp shall be enclosed in its individual quartz sleeve.
    c. The UVM shall be connected to receptacles on the Power Distribution Center (PDC) by means of one or two multi-conductor cable(s) with modular repairable connector(s). The cable connector and all of its components shall be field repairable. The connector shall be of a "Snap-On" design having no threads that may bind or be subject to cross threading. The connector shall also allow for visual confirmation that the connection is locked in place. Pins shall be made from a copper alloy with hard silver plating. The connector shall be coated with a corrosion resistant finish and all levers, bolts and screws shall be made of stainless steel. The connector shall meet IP65 (UL574) requirements for direct water spray when mated.
    d. At the point of exit from the UVM, the multi-conductor cable(s) shall pass through a water resistant strain relief.
    e. The UVM shall be designed so that when they are in place, in the UV banks with the grating removed, they shall support a live load of 300 lbs without damage. The tops of the racks shall present a surface on which workers can stand to access the racks in the UV bank.
    f. The UVM shall incorporate a protective shield to prevent UV light from radiating above the lamp bank during normal operation.
    g. If housing ballasts, the UVM shall be designed to comply with NEMA 4X (IP65) ratings. If not housing ballasts, the UVM shall be 316 SS.
7. Automatic Cleaning System:
    a. Each UV bank shall be equipped with an automatic mechanical wiping system. The cleaning system shall maintain uniform wiping tension and cleaning over complete wiping length of the quartz sleeve and the UV sensors.
    b. The proposed cleaning system utilizes Viton® and Teflon® wiper rings.
    c. When the cleaning system is not in use, the drive arm will be stationary and parked in the home positions, upstream end of the UV module.
    d. The system will be pneumatically actuated by a self-contained unit provided by the UV Vendor.
    e. The wiper system shall have the capability of being operated in either manual or automatic mode. In automatic mode, the cleaning wipers shall be initiated and controlled by the operator interface.
    f. Cleaning cycle intervals be field adjustable within the range of once per minute to once per week.
8. UV Intensity Detection System:
    a. A submersible UV sensor, provided by Vendor, shall continuously sense the UV intensity produced in each bank and shall be as specified in Section 17515. Provide one UV sensor per bank as specified in this Section herein.

9. Low, Optimum and High Water Level Sensors:
    a. Three water level sensors, provided by Vendor, shall be included for each channel and shall be as specified in Section 17206.
    b. During manual, automatic, and remote modes of system operation, the water level sensor shall ensure that the automatic cleaning system extinguishes automatically if the water level in the channel rises above or drops below acceptable values.
10. Electrical:
    a. General:
        1) Each module shall be powered from the Power Distribution Enclosure.
        2) Each ballast shall drive 1 high-intensity, low-pressure lamps.
        3) Power factor shall not be less than 99 percent lagging.
            a) A leading power factor shall not be acceptable.
            b) Provide power factor correction capacitors as necessary to meet the specified power factor.
        4) Forced-air cooling of control panels that contain electronic circuit boards shall not be acceptable.
        5) Provide air conditioning mounted directly on panels as required.
        6) Electrical supply for the water level sensor will be 230 VAC and powered by the PDC.
        7) UV Vendor to perform all terminations between lamps and ballasts.
        8) UV Vendor to supply all cabling and conduit between lamps and ballasts.
        9) All enclosures located indoors or outdoors shall be NEMA 4X Stainless Steel Type 316 unless otherwise specified. All panels shall be self supporting. Provide air conditioning panels as required.
        10) Harmonic distortion levels as measured at the 480V input terminals of the PDC supplied must be less than those allowed by IEEE 519-1992 Tables 10.1, 10.2, and 10.3. If these levels cannot be achieved at the installed site by the Contractor, the UV equipment Vendor shall furnish and install all necessary Accusine filters to comply with IEEE 519-1992 at no additional cost to the OWNER.
    b. Connectors:
        1) The UV module connectors shall be watertight with a molded backshell to meet the requirements of UL574 for direct water jet spray when mated.
        2) Each connector shall be automatically disconnected from power when uncoupled.
        3) The connector pins shall be copper alloy with gold plating.
        4) Each pin when mated shall seal with a “cork and bottle” seal.
        5) The ground pin shall be longer than the other pins, giving a “make first, break last” ground connection.
        6) The hood and base of the connector shall be powder coated aluminum alloy with all locking levers and bolts made of stainless steel.
11. Power Distribution Enclosures (PDE):
    a. Electrical supply required for each Power Distribution Enclosure shall be 480 Volts, 3-phase, 60 Hz, 4-wire (plus ground) connection.
    b. The PDE shall provide a single point of isolation for a complete UV channel.

c. The PDE shall provide the individual power supplies, with appropriate circuit protection levels, required for the operation of a single channel, including each Electronic Ballast Enclosure and any auxiliary electrical equipment associated with the channel.
d. Maximum power consumption per UV Channel shall be no greater than 38.4 kW.

12. Electronic Ballast Enclosure (EBE):
    a. The EBE shall house all the control gear and electronic ballasts, etc., associated with a single bank of UV lamps. Enclosure shall meet the requirement of Division 17.
    b. The EBE shall have a door-interlocked isolator, which shall be the single point of isolation for the full bank of lamps, enabling simple isolation for safe working on the lamps, etc. The door-interlocked isolator shall provide the OWNER the ability to lock the system off with padlock.
    c. Each EBE shall be equipped with a temperature control device, which will shut off this part of the UV system in case of surpassing the critical limit of 50 degrees C (122 degrees F). Normal operating temperature of the enclosure shall be maintained at a design temperature of 90 degrees. A mechanical cooling system shall be provided.
    d. Each EBE shall be equipped with a cabinet heater to prevent the formation of moisture due to humidity.
13. Junction Box (JB):
    a. The JB shall be a Type 316 stainless steel unit which spans the channel and provides all service connections for the associated bank of lamps, sensor, position and safety switches, wiper system operation, etc., via quick disconnect plug and socket arrangements.
    b. The JB shall provide individual termination points for all field cabling and air lines entering the unit.
    c. Access to the field terminations inside the JB shall be via a bolted door with weatherproof seal.
    d. The construction of the JB shall provide mechanical protection for all cabling and air lines entering the JB.
14. System Control Center (UV PLC):
    a. The UV control system shall include a master UV PLC for the entire system. The master UV PLC shall be contained in a cabinet located adjacent to the channels, as indicated on the drawings. The UV PLC shall be provided and programmed as specified in Section 17101-31, the Drawings, and this Section.
    b. Electrical supply to the master UV PLC will be 120 volts, 1 phase, 30 amps (plus ground). Where Vendor's equipment requires other voltages, Vendor shall provide any transformers necessary for proper system operation.
    c. Provide heating and cooling for the panel to meet the heating and cooling requirements of Section 17050:
        1) Heating strips per Section 17710.
        2) Provide closed circuit air conditioning system as specified in Section 17710.
        3) Provide Corrosion inhibiting vapor capsules as specified in Section 17710.
    d. Vendor shall provide an uninterruptible power supply (UPS) to support the UV PLC per Section 17712.

e. UV System control and monitoring shall be provided through display screen and message keypad to allow complete operator interface. Hardwired panel devices and meters shall not be permitted.
f. Keypad shall have a sealed membrane overlay covering all function keys and numerical keys.
g. The UV PLC control panel shall be provided with HMI as specified in Section 17720. Operator interface shall be menu-driven with automatic fault message windows appearing upon alarm conditions.
h. Bank status shall be capable of being placed either in Manual, Off, or Auto mode.
i. Banks shall be cycled in a lead/lag rotation through automatic control at the UV PLC for equal wear, and timed off to minimize bank cycling.
j. Elapsed time of each bank shall be recorded and displayed on the display screen when prompted.
k. Panel(s) shall be UL approved, rated NEMA 4X. Panels shall be free standing.
l. Provide heating and cooling for the panel to meet the heating and cooling requirements of Section 17720.
m. Digital I/O modules shall be provided to indicate all alarms and status signals as required per the Drawings and Section 17720.

15. Chemical Cleaning Tank
    a. The UV system Vendor shall furnish a 304L stainless steel liner with drain stub and cover for installation by the Contractor. The module cleaning station should accommodate half of the modules in a single bank immersed in citric or phosphoric acid (5 to 10 percent concentration with pH between 2.0 and 3.0).
    b. The location and elevation of the chemical cleaning tank located adjacent to the channels, as indicated on the Drawings.
    c. The chemical cleaning tank shall be provided with a drain connection, as indicated on the Drawings.

2.04 ACCESSORIES

A. Face Shields:
   1. Quantity: Three.
   2. Design: Block UV light wavelengths between 200 and 400 nm.

2.05 WEIR LEVEL CONTROL

A. Vendor shall provide Effluent Finger Weirs at the end of each channel for effluent level control within the UV channels.

B. Design:
   1. The effluent finger weirs shall be designed to:
      a. Maintain the minimum water surface elevation specified in Form 1.
      b. The UV Disinfection System meets the hydraulic constraints specified herein in, under all flow conditions.
      c. The effluent finger weirs shall be located at the end of the UV channels as indicated on the Drawings.
      d. Weir configuration and dimensions to be determined by Vendor. Minimum weir length per channel to be determined by Vendor.

e. Design each channel weir to handle up to 110-percent of the peak hour flow per channel as defined herein. Bottom elevation shall be as indicated on the Drawings.
f. Weirs shall be anchored to the floor and both walls. Number and spacing of anchors shall be determined by Vendor. Anchorage system shall utilize Type 316 stainless steel all thread rods.
g. Weirs shall be provided with stiffeners suitable to prevent weir disfiguration when subjected to hydrodynamic loads and potential seismic loads.
h. Weirs shall be field adjustable to a tolerance of ± 1/4 inches.
i. Weirs shall be designed to prevent flow harmonics.

C. Materials:
1. Type 316 stainless steel.
2. Anchor bolts and other fasteners: 316 stainless steel.
3. Components shall be cleaned, pickled and passivated as specified in Section 05500 at the factory and for any field welds.

2.06 INLET BAFFLES

A. Provide an inlet baffle on upstream end of UV channel at location as indicated on the Drawings and as designed by the UV Vendor.

B. Design:
1. Designed to promote plug flow to the UV bank.
2. Located at upstream end of UV channel.
3. Designed to be removable.
4. Allowable head loss: 0.33 - 0.50 feet.

C. Materials:
1. Plates: 316 stainless steel.
2. Guides: 316 stainless steel.
3. Anchor Bolts and Other Fasteners: 316 stainless steel.
4. Components shall be cleaned, pickled and passivated as specified in Section 05500 at the factory and for any field welds.

2.07 INSTRUMENTATION AND CONTROLS

A. General:
1. Network communication between the UV system and the existing Plant SCADA system shall be provided via an Ethernet /IP connection.
2. All instrumentation used in the UV disinfection system control or monitoring shall be individually fused or circuit breaker protected to minimize the effects of any single point of failure.
3. The CONTRACTOR shall install all instrumentation per Vendor’s instructions.
4. The Vendor shall design, provide hardware and software, install, and program its control system in accordance with DIVISION 17 sections, including but not limited to sections listed under the referenced Equipment Sections.

B. Control System:
1. General:
a. Programming: The Vendor shall provide all control equipment and computer programming as required for a complete and functional UV

control system that performs all functions described herein and as indicated on the Project P&IDs, with the exception of programming required for the plant SCADA system:

1) The Vendor shall be responsible for preparing, writing, and testing all PLC programming logic associated with the UV control system and shall provide a system block diagram complete with all inter-equipment wiring and conduit requirements.
2) Provide status, alarm, and process variable data to the plant SCADA system. Control signals shall also be accepted from the plant SCADA system. Coordinate all tagging and memory mapping with the CONTRACTOR and follow the ENGINEER's direction.
3) Programming for the UV control system shall include not only equipment associated with and included in the UV Disinfection System, but also other equipment in the area that is connected to the UV control system, including but not limited to:
    a) Inlet valves at the inlet of each channel (one per channel).
    b) Ultrasonic level sensors in each channel.
        (1) Level sensors shall provide a discrete contact for either high or low alarms as follows:
            (a) One ultrasonic shall be located at the influent end of the channel to provide a high-level alarm (1 per channel).
            (b) An ultrasonic shall be located below each PDC to provide a low-level alarm (2 per channel).
    c) All other devices as shown on the Project P&IDs.
4) Programming for the plant SCADA system shall be done by others.
5) Vendor shall coordinate with the CONTRACTOR and the SCADA system programmer while developing the software design.
6) Vendor shall include an allowance for an additional 80 hours (each) for PLC, HMI, and SCADA coordination programming. Execution of hours will be determined by ENGINEER and OWNER as needed.

b. Components: Vendor shall provide a PLC-based UV control system with operator interface and interconnects for monitoring of the UV control system through the Plant PLC system. The UV control system shall include 1 UV PLC to monitor and control all equipment associated with the UV Vendor's System. The UV PLC shall operate as an interface between the UV control system and the Plant PLC system. The UV PLC shall communicate to the Plant PLC system through peer-to-peer Ethernet/IP communications. The UV PLC shall be suitable for installation in an outdoor environment as specified in DIVISION 17 and include all required hardware/software and programming. Comply with DIVISION 17 specifications for I/O module types, PLC programming, HMI, etc.:

1) The UV PLC shall include an HMI, panel-view type display with a touch screen, mounted at eye level. The HMI shall allow for complete UV system control and monitoring through the touch screen and display.
2) The UV PLC shall be provided with start and stop (with lockout), and Local-Off-Remote control of the entire UV system.
3) A separate Local-Off-Remote switch shall be provided on each Power Distribution Center (PDC).
4) At a minimum, the UV control system shall have the following inputs:
    a) Remote START/STOP via Plant PLC system Ethernet.

b) UVT (Ultraviolet Transmittance) input (from Vendor supplied UVT monitor).
c) High and low water level input (from Vendor-supplied water level instruments).
d) Flow input (from CONTRACTOR-supplied flow measurement instruments).
e) UVI (Ultraviolet Intensity) Isolated analog 4 to 20mA input (from Vendor supplied UV Intensity instruments).

5) The UV control system shall operate the automatic cleaning mechanism. The interval between cleaning cycles shall be programmable though the HMI.

c. Degree of protection of control bank, field instruments, and field enclosures shall be as specified in Related Sections of DIVISION 17.

d. All electrical and instrumentation/controls shall be in accordance with Related Sections of DIVISIONs 16 and 17 of the Specifications and meet the requirements of the Project P&IDs. Control and Instrumentation including documentation and wire identification labels shall conform to related Sections of DIVISION 16.

e. Human Machine Interface (HMI):

1) The HMI shall provide access to all status and control functions for operations personnel. With password access to limit change options dependant on authority (3 levels). It shall also provide access to diagnostic information, e.g., I/O status, and all PID and control functions for the commissioning engineer to allow changes to be made with appropriate password without the need for a programming terminal.

2) These points are in addition to the specified spare requirements in Section 11287.

2. Additional I/O Requirements as specified below:

a. Vendor shall provide I/O points for equipment and instrumentation provided by others.

b. These points shall be transmitted over the Plant PLC system Ethernet/IP communication protocol to the plant SCADA system.

c. Data sheets for additional equipment are provided in DIVISION 17.

d. These points are in addition to the specified spare requirements in Section 17220.

3. UV disinfection system monitoring and control system shall be as defined in this Section, Section 11287, and DIVISION 17.

4. UV System Control Philosophy:

a. Final control philosophies are subject to approval by the ENGINEER and OWNER.

b. The UV PLC shall control the UV disinfection system of all channels. Monitored parameters including UV transmittance, flow, and UV intensity shall be used to operate each channel individually to deliver the setpoint dose. UV transmittance shall be monitored at the influent pipe of the UV disinfection process. Flow shall be monitored at each channel. UV intensity shall be monitored for each UV bank.

c. All control philosophies shall use the dose equation in accordance with the results of the 2012 UV Guidelines Reactor Validation Testing of the proposed UV Disinfection System, to continuously calculate the delivered dose of the system and automatically vary the lamp power and control the

system as required to minimize energy use and deliver the target dose at all times. The dose equation and control philosophy shall be as follows:

1) Dose as a function of flow, UVT, and UV intensity sensor value, directly in agreement with Third-Party Reactor Validation Testing results. Under this control method, the UV intensity sensors continuously monitor the combined impact of lamp aging and sleeve fouling, and alarm when the delivered UV dose is less than the setpoint UV dose.
2) Equalize instantaneous flow between each operating channel within +2.0% as a function of the percent-open of the respective inlet valve per channel during normal operation provided that at no time shall the flow through a channel exceed 1,400 gpm. The operator may allow a given channel to continue to operate at a lower flow than the other operating channel(s). Alarm when the delivered UV dose is less than the setpoint UV dose.

C. Control Philosophy:
1. References:
   a. 31N01 – UV Disinfection Channel No. 1.
   b. 31N02 – UV Disinfection Channel No. 2.
   c. 31N03 – UV Disinfection Channel No. 3.
   d. Abstract: Packaged control system provided by Vendor complete with equipment and appurtenances in accordance with 2012 UV Guidelines. Automated control functions are performed with the PLC provided by the UV system supplier.
2. Hardwired control:
   a. None.
3. Hardwired interlocks:
   a. None.
4. PLC control:
   a. General:
      1) The UV control system shall monitor and control all equipment as specified herein to ensure that the target UV dose of the UV process is delivered in each channel for the given flow, UVT, lamp life, and fouling conditions.
      2) The target UV dose shall be an operator-adjustable setpoint. The allowable target UV dose shall range from 100.0 to 120.0 mJ/cm^2.
      3) The UV PLC shall execute the following for the entire UV system:
         a) Monitor the flow in the channel and UV intensity at each bank.
         b) Calculate the UV dose delivered in the channel as specified in Appendix A.
         c) Control all UV equipment in the channel to deliver the target UV dose in the channel.
         d) Control the online, automatic cleaning system.
         e) Control the inlet valve of each channel.
         f) Monitor UVT.
         g) Calculate and trend flow through the overall system.
         h) Totalize the influent flow measured in each channel.
         i) Signal PDCs to start-up and shutdown as required. The UV PLC shall alternate the call sequence of the UV channels. The channels shall be sequenced on a “first on, last off” basis. If a

channel fails to meet the target dose, the call sequence shall automatically proceed to the next available channel.

(1) The control scheme shall allow the OWNER to limit the cycling of the channels to the days and times identified through setpoints entered through the plant SCADA system or HMI.

j) When 1 channel is to be taken off-line, the UV PLC shall first determine whether the total influent flow can be treated in the remaining channels prior to taking a channel off-line.

k) The UV PLC shall open and close the inlet valves, and shall start up standby UV banks and channels as required.

4) Each channel shall be equipped with a magnetic flowmeter that measures the flow in the channel. This information shall be sent to Plant PLC and directly to the UV PLC. The UV PLC shall use the measured flow to control the UV lamps within each operating channel to deliver the target dose within each channel. An alarm shall be triggered if the flow differential between the channels exceeds a setpoint value (1 to 10 percent). The default setpoint shall be 5 percent.

5) Ultrasonic level sensors shall be provided to detect high and low water levels in the channel. The high level shall be located upstream of the first UV bank and the low level shall be located below each channel PDC. The high level alarm shall be sent directly to the UV PLC. The low level alarm shall be sent directly to its associated PDC and then communicated to the UV PLC.

6) Finger weirs located downstream of the UV banks shall passively control the water level in each channel. The crest of the finger weirs shall be at the same elevation as the top of the top quartz sleeve, which is protecting the top lamp of each UV bank.

b. Automatic control: With the Hand-Off-Auto selector switch in “Auto” position, the UV system shall be controlled by the UV PLC to deliver the target UV dose:

1) General:

a) Based on the influent flow entering each channel, the UV PLC shall select the number of banks to be in service (minimum 2 banks per channel) and the required power setting in each operating bank. The UV PLC shall be able to select the minimum and maximum flow through a channel in automatic mode or in manual mode. The selection of the service channels must be based upon the utilization of all channels on the rotation basis.

b) The UV PLC shall monitor each UV lamp by its input power current and minimize the total input power current required to deliver the target dose in the channel.

c) Whenever possible, channels not in service shall be stored wet.

2) Start-up procedure of a channel: The UV PLC shall initiate and execute the following start-up procedure:

a) Refer to Section 17101-31 for interface with Plant PLC.

b) UV PLC shall request the Plant Water UV Channel Fill valve opens for the channel that is being put into service to the fully open position.

c) Once the water level in the channel is higher than the low water level, the UV PLC shall turn On all duty banks in the channel to 100-percent power and allow the lamps to warm up for the Vendor warm-up period. During the warm-up period, the UV

PLC shall initiate a lamp wiping cycle by the online, automatic cleaning system.

(1) If the channel water level does not exceed the low water level after an operator-adjustable period, a low-priority alarm shall be initiated.

(2) Once the channel water level

d) After lamp warm-up is complete, the UV PLC will communicate a “UV Channel 1 Running,” “UV Channel 2 Running”, and/or “UV Channel 3 Running” to the Plant PLC and open the associated inlet valve(s).

e) The UV PLC shall optimize the input power to the UV to deliver the target UV dose.

3) Shutdown procedure of a channel: When a channel is required to be taken out of service, the UV PLC shall initiate and execute the following shutdown procedure:

a) The UV PLC shall calculate the new flow that will occur in each available channel when the channel that is being taken off-line is completely out of service AND isolated from the influent flow:

(1) If there are insufficient banks in the remaining operating channels to treat the total flow, the INSUFFICIENT BANKS alarm shall occur in the UV PLC and the Plant PLC system. The inlet valve of the channel being shut down shall remain open until the UV PLC determines there are a sufficient number of banks available in the remaining channels to treat the total flow.

(2) If there are a sufficient number of banks in the remaining channels to treat the total flow, the shutdown procedure shall continue as follows:

(a) The UV PLC shall calculate the additional flow that will occur in each channel when the channel that is being taken off-line is completely out of service and isolated from the influent flow.

(b) The UV PLC shall determine the number of banks and the power input to the lamps required to provide the setpoint dose for the current flow and additional flow.

(c) The UV PLC shall turn UV banks ON and increase the power input as required to deliver the setpoint dose for the current flow and additional flow.

(d) After determining the remaining channel(s) is delivering the setpoint dose required for the current flow and additional flow, the inlet valve of the channel being taken off-line shall close (adjustable with 1 percent increments and 5 minutes of delay).

(e) Upon verification that the inlet valve has been closed, the UV PLC shall turn the UV lamps OFF in the channel being taken out of service.

(f) The UV PLC shall initiate an automatic wiping cycle on the banks that have been taken off-line.

b) The UV PLC shall close the inlet valve for the channel taken out of service.

c. Manual control: With the Hand-Off-Auto selector switch in “Hand” position, the UV system shall be controlled by the HMI at the UV PLC.

5. Software interlocks:
   a. With the Hand-Off-Auto switch in either Auto position or Hand position (prompt as permissives), the UV safety devices shall prevent any potential damages to the system.
   b. The UV inlet valve shall remain closed unless the both UV bank READY signals are received by the UV PLC for the corresponding channel.
   c. Upon HIGH Priority Alarm:
      1) With the Hand-Off-Remote switch in either position, the UV PLC shall initiate the shutdown procedure specified herein under the following conditions:
         a) If High Priority alarm is related to electrical, mechanical, and/or instrumentation hazard and a standby channel is available, then the UV PLC shall initiate the startup procedure for a standby channel and immediately shutdown the alarming channel and clear the associated “Channel # Running” signal to the Plant PLC.
         b) If High Priority alarm is related to electrical, mechanical, and/or instrumentation hazard and a standby channel is not available, then the UV PLC shall shutdown the alarming channel(s) and clear the associated “Channel # Running” signal(s) to the Plant PLC.
         c) If High Priority alarm is not related to electrical, mechanical, and/or instrumentation hazard, the UV PLC shall turn On all duty banks in the channel to 100-percent power.
         d) If High Priority alarm is related to channel delivered dose (LOW-LOW OPERATIONAL UV dose Alarm) for longer than an operator adjustable period (0-10 minutes), the UV PLC shall initiate the startup procedure for a standby channel and shut down the associated UV banks affected. Default period is 5 minutes. Delivered dosage shall never be below 100 mJ/cm2 when producing recycled water.
         e) If High Priority alarm is related to inlet water quality (High-High Filter Effluent Turbidity Alarm) as described in Section 17101-31, the UV PLC shall immediately close all inlet valves and lamps shall remain in operation until either:
            (1) The High-High Filter Effluent Turbidity Alarm is cleared by the Plant PLC and UV PLC resumes normal operation.
            (2) The RUN permissive signal is cleared by the Plant PLC.
         f) If High Priority alarm, LOW-LOW UVT, occurs during start-up of a new channel or during normal channel operation, and if after 15 minutes the UVT level remains below the Low-Low-UVT alarm setpoint, then the UV PLC shall turn on all banks (or banks/modules) to 100-percent power and allow the lamps to warm up for the required SCADA-adjustable value. During the warm-up period, the UV PLC shall initiate a lamp wiping cycle by the online, automatic cleaning system. The UV system shall continue operating.
         g) Refer to Article 2.07, Paragraph C.9 for list of high-priority alarms.
   d. Upon Low Priority Alarm:
      1) The UV PLC shall continue normal operation, monitoring, and controlling the equipment as needed to deliver the target dose.

e. Power failure:
   1) Power failure as indicated by power failure relay PLC inputs.
   2) All UV Inlet Valves shall fail-to-close.
f. Power failure recovery:
   1) Following a power failure, the plant UV PLC shall initiate the start-up procedure of each UV channel that was previously online and an additional channel, as described in Article 2.07, Paragraph C.10.
g. Channel maintenance mode:
   1) When initiated at the Plant PLC or at the UV PLC, the UV PLC shall execute the shutdown procedure as described in Article 2.07, Paragraph C.4.b.3:
      a) If there are an insufficient number of banks in the remaining channels to treat the total flow AND the channel maintenance is not mandatory to continue successful operation of the UV Disinfection System, the shutdown procedure shall not continue. The total logged hours of banks associated with the channel that require cleaning shall determine if the channel maintenance is required.
      b) If there are an insufficient number of banks in the remaining channels to treat the total flow AND the channel maintenance is mandatory to continue successful operation of the UV Disinfection System, the shutdown procedure shall continue.
   2) While in maintenance mode, the UV control system shall disregard all alarms associated with that channel and treat the channel as off-line with respect to monitoring and reporting values.
h. Water level switch:
   1) During manual, automatic, and remote modes of system operation, the water level switch shall ensure that the lamps in the channel extinguish automatically if the water level in the channel drops below an acceptable value. The acceptable water level is specific to each UV system and shall be specified by UV Vendor.
   2) During manual, automatic, and remote modes of system operation, the water level switch shall ensure that the wiping system extinguishes automatically if the water level in the channel drops below an acceptable value.

6. HMI control:
   a. With the Hand-Off-Auto switch in “Hand” position, the UV system shall be operated through the local UV PLC HMI:
      1) The operator shall have the ability to manually adjust the intensity of the UV system as well as turn banks On and Off.
      2) The operator shall have the ability to initiate a wiper cleaning cycle.
      3) The UV PLC shall continue to monitor and display the status of the UV lamps and calculated dose in Hand mode.
      4) Monitor and notify operator of all alarms triggered to prevent any potential damages to the system.
7. SCADA control:
   a. In Auto mode, operator control and monitoring functions available at UV HMI screen shall be handled at the Plant SCADA system and transmitted to the UV PLC via Ethernet/IP.
   b. In Manual mode, all operator control shall be inputted at the HMI on the UV PLC. All screen indicators and alarms shall continue to be updated at the plant SCADA screen.

8. Indicators and alarms:
    a. Provide HMI alarms and monitoring required as specified herein and on the Project P&IDs, and transmit all monitored information and alarms to the plant SCADA system via Ethernet/IP. Ethernet communications shall be provided as shown on the SCADA block diagram.
    b. All analog alarm values (setpoints) shall be operator adjustable via the HMI and via the plant SCADA system.
    c. Screen indicators and alarms:
        1) Inlet Butterfly Valve: Open and Closed Indications.
        2) Inlet Butterfly Valve: Remote Mode Status Indication.
        3) Inlet Butterfly Valve Percentage Open Indications.
        4) Flow Rate (each channel and totalized).
        5) Turbidity Indication (signal to be provided from Plant PLC).
        6) Bank On/Off Status.
        7) Lamp On/Off Status.
        8) Bank Manual-Automatic Status.
        9) Bank Warming-up/Operating Status.
        10) Bank UV Intensity Indication.
        11) Bank Power Level Indication.
        12) Bank LOW Intensity Alarm.
        13) Bank FAIL Alarm.
        14) Bank Elapsed Time.
        15) Lamp FAIL Alarm.
        16) Channel Elapsed Time.
        17) Channel Running
        18) LOW Level Alarm in UV Channel (each PDC in the channel).
        19) HIGH Level Alarm in UV Channel (each channel).
        20) Number of Banks ON (each channel).
        21) Individual Lamp Run Time.
        22) Cumulative System On/Off Cycles
        23) Cumulative System Power Consumption
        24) Ballast Run Time.
        25) Number of Starts per Bank.
        26) UV Transmittance Alarm.
        27) UV Dose Indication.
        28) LOW UV Dose Alarm.
        29) Not Enough Banks Available Alarm.
        30) Wiper System FAIL Alarm.
        31) Power FAIL Alarm.
        32) Ground Fault Interruption Alarm.
        33) Communication Failure Alarms.
9. High Priority Alarms:
    a. Inlet Butterfly Valve – Fail to Open/Close.
    b. Module FAIL (entire module fails).
    c. Bank FAIL (entire Bank fails).
    d. High-High Turbidity Alarm (signal to be provided from Plant PLC).
    e. LOW-LOW Intensity (intensity probe reading drops below an operator adjustable setpoint accessible at the HMI or from the SCADA).
    f. LOW-LOW UVT (UVT drops below an operator adjustable setpoint accessible at the HMI or from the SCADA).
    g. LOW-LOW OPERATIONAL UV dose (delivered UV dose drops below an operator adjustable setpoint accessible at the LOI or from the SCADA).

h. HIGH water level.
i. LOW water level
j. Adjacent lamp FAIL (2 or more adjacent lamps fail), include location of lamps by bank and position.
k. Multiple lamp FAIL (more than 5 percent of lamps fail per bank), include location of lamps by bank and position.
l. Power Fail. Alarm generated from external dry contact provided from each UV power distribution center.
m. Communication Fail, UV PLC to SCADA.

10. Low Priority Alarms:
    a. High Turbidity Alarm (signal to be provided from Plant PLC).
    b. Not Enough Banks Available FAIL.
    c. LOW UV intensity (intensity probe reading drops below an operator adjustable setpoint accessible at the LOI or from the SCADA).
    d. LOW UVT (UV transmittance drops below an operator adjustable setpoint accessible at the HMI of from the SCADA).
    e. LOW Operational UV dose (delivered UV dose drops below an operator adjustable setpoint accessible at the HMI or from the SCADA).
    f. Wiper System Fail.
    g. Individual lamp FAIL (include location of lamp by bank and position).

D. On-Line UV Transmittance (UVT) Monitor:
1. Provided by Vendor as specified in Section 17516.
2. Vendor shall supply all components necessary for mounting the UVT monitor as specified.

E. UV Intensity Monitoring System:
1. Provided by Vendor.
2. UV Intensity monitoring system shall meet requirements of Section 17515.

F. Water Level Sensor:
1. Provided by Vendor:
    a. Siemens pointek ULS200 Series point level probe or equal.
    b. Vendor shall provide all accessories required for the assembly including but not limited to:
        1) Mounting bracket.
        2) Flexible conduit.
        3) Mounting hardware.
        4) Wire.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation of the UV equipment shall be by the CONTRACTOR in accordance with the Contract Documents, and Vendor's engineering drawings and instructions. Vendor shall supervise the installation of the UV equipment.

3.02 MANUFACTURERS SERVICES

A. Manufacturer shall provide services as specified in this Section and related sections:
   1. Warranties.
   2. Factory acceptance testing.
   3. Equipment supplier's certificate of installation for each process unit and overall UV System.
   4. Field checkout and testing for all process units.
   5. Instrument Calibration.
   6. System Test Phase.
   7. Operational Test Phase.
   8. Hydraulic, Alarm, and Functional Testing.
   9. 10 day Startup Test Period and Performance Acceptance Test (PAT).
   10. Maximum Power Consumption Verification.
   11. Operator and maintenance training.

3.03 FACTORY ACCEPTANCE TESTING

A. Perform factory testing of UV system to demonstrate its successful operation and control for continuous production of disinfected tertiary recycled water. The OWNER shall, at their discretion, be able to participate in/witness testing activities.

B. Factory acceptance testing specified herein shall be in addition to that required for control system testing specified in Section 17050.

3.04 MANUFACTURER'S CERTIFICATE OF INSTALLATION

A. Manufacturer shall check that all equipment is installed properly and functions as specified in Section 01660. Equipment checks shall include, but not be limited to:
   1. Proper installation and alignment of UV support structure (defined as the concrete channels containing the UV banks or pipe runs).
   2. Water tightness of all submerged equipment.
   3. Proper placement of UV lamp banks to assure specified water levels relative to the lamps.
   4. Electrical wiring and connections.
   5. Proper operation of instrumentation, alarms, and operating indicators associated with the UV equipment.
   6. Proper placement and operation of ballast/driver and other equipment in the control panels.
   7. Adequate air conditioning and heating of control panels.
   8. Proper operation of lamp bank shutoff switches and ground fault circuit interrupters.

3.05 TESTING, TRAINING, AND UV SYSTEM START-UP SERVICES

A. Manufacturer shall provide testing, training, and startup services for each UV system process unit.

B. Testing, training and facility startup requirements shall be as specified in Sections 01660 and 17050, and as set forth herein.

C. Manufacturer shall provide a minimum the following for testing, training, and start-up services as follows:
   1. One trip for installation certification, checkout, initial commissioning of the system, and training of OWNER's personnel.
   2. One trip for Operational Testing Phase.
   3. One trip during the Commissioning Period, PAT, and follow-up training of OWNER's personnel.

3.06 OPERATIONAL TESTING

A. Following complete installation of all UV System components and controls and manufacturer's Certificate of Installation, manufacturer shall participate with CONTRACTOR, OWNER, and ENGINEER to conduct Operational Tests as specified in Section 01660.

B. The manufacturer and the CONTRACTOR shall provide the Operational Testing reports within 10 working days of completion of the test.

3.07 HYDRAULIC, ALARM, AND FUNCTIONAL TESTING

A. After completion of Operational Tests, manufacturer shall participate with CONTRACTOR, OWNER, and ENGINEER in conducting a Hydraulic, Alarm, and Functional Performance Test of each process unit as specified in Section 01660 and as set forth herein.

B. Hydraulic, Alarm, and Functional Performance Test shall be performed to determine whether or not the equipment meets the hydraulic, alarm, and performance conditions specified prior to conducting the Performance Acceptance Test.
   1. Hydraulic tests shall include demonstrate.
   2. Specified hydraulic requirements are met over the operational flow range of the system.
   3. Head loss through the UV System complies with manufacturer's stated head loss values.
   4. Alarm and functional testing shall include simulation of flow and water quality change, lamp and bank failures, sensor performance alarms and the proper maintenance of the minimum UV dose over a range of flow and water quality conditions, in accordance with the specified requirements.

3.08 COMMISSIONING AND PERFORMANCE ACCEPTANCE TEST

A. After completion of the Hydraulic, Alarm, and Functional Testing, manufacturer shall participate with CONTRACTOR, OWNER, and ENGINEER to conduct a ten (10) consecutive day Performance Acceptance Test (PAT) following the Commissioning Period as specified in Sections 01660, 17050, and as set forth herein.

B. Conditional acceptance of the UV system will not be granted (production of recycled water) until a minimum of three months following completion of Commissioning testing.

C. During the Commissioning Period, vendor shall collect and summarize data to demonstrate that the UV System meets specified PAT requirements in Sections 01660, 17050, and as follows for UV disinfection performance:
   1. Net Production Capacity: System meets average daily flow and peak flow rate requirements as defined in this Specification.

2. Minimum Design Dose: System can deliver the minimum design UV dose as defined in this specification.
3. UV Disinfected Effluent Water Quality: UV Disinfection system produces an effluent in complete compliance with requirements as specified in this specification.
4. Cleaning: The online, automatic cleaning system cleans the lamps as thoroughly and frequently as is required for the system to deliver the minimum design dose at all times. The cleaning system maintains the Sleeve Fouling Factor.
5. Chemical Cleaning (if applicable): If the on-line, automatic cleaning system does not provide chemical cleaning, one UV bank shall be chemically cleaned at the end of the PAT period. This cleaning shall restore the UV sleeves to its state of cleanliness at the onset of the PAT test. This shall be quantified by comparing the UV intensity measured at this bank at the onset of the PAT testing and after the chemical cleaning.
6. No major changes in equipment or apparatus will be permitted during this test period. However, minor adjustments of equipment that would normally be expected during regular operation of the equipment in plant use may be made.

D. Manufacturer's Data Collection:
1. Direct readings from the instruments shall be used in the calculations to determine conformance with the guaranteed performance requirements.
2. Readings shall be obtained from digital trends from the UV System PLCs and by manually recording the values directly from instruments.
3. Readings shall be recorded to the level of accuracy of the instrument before any calculations.
4. Collect manual instrument readings at 4-hour intervals during the PAT.
5. There shall be no adjustment to readings or calculations due to random or systematic instrumentation error or accuracy limitations.
6. The manufacturer shall document all modifications, changes, or additions made during the PAT and amend the operations and maintenance manuals and record drawings to reflect the modifications.
7. All modifications required as a result of PAT failure must be completed within 10 days of the start of the original testing period.
8. If retesting is required, the manufacturer shall recalibrate instruments associated with the retest if they have not been calibrated within the previous 30 days and submit that information to the ENGINEER prior to retesting.

E. Successful completion of the Commissioning Period and PAT shall be as defined in Sections 01660, 17050, and as set forth herein.
1. The UV System shall operate continuously over the entire test period without a major failure and demonstration performance requirements specified are met.
2. Downtime resulting from OWNER's operation will not be counted against the criteria of "continuous days of operation."

F. Failure to complete the Commissioning Period and PAT or to meet PAR performance requirements will require Commissioning Test Period and PAT to be repeated.
1. If any process unit or component thereof fails to meet performance requirements, manufacturer shall modify, change, or add equipment as necessary to meet performance requirements.

2. Additional testing, labor, materials, equipment, etc., associated with correcting deficiencies in the UV system, including the repeated performance test, shall be borne by the manufacturer. Each repetition of the test shall be for a continuous period.
3. If after three attempts manufacturer cannot successfully complete the Commissioning Period and PAT, OWNER shall have the right to reject the UV System and request manufacturer replace the UV System in accordance with the specified Performance Warranty provisions.

G. During the PAT, the OWNER shall have the option of collecting samples for independent analyses to confirm measurements and analyses conducted by the manufacturer. The ENGINEER and the OWNER shall have the option of witnessing all testing performed by the manufacturer.

3.09 MAXIMUM POWER CONSUMPTION VERIFICATION

A. Verification of warranted power consumption shall be documented by testing performed by the manufacturer with the oversight of the OWNER and ENGINEER. Power consumption testing shall be conducted separate and independent from the Startup Test Period and PAT described above, but may be conducted concurrently.

B. Electrical acceptance test shall consist of consecutive 8-hour measurement of kW usage and power factor on the UV bank(s) or reactor by manufacturer as witnessed by OWNER and/or ENGINEER.

C. Test Protocol:
1. UV modules or reactors shall be operated with all lamps in operation at 100 percent power.
2. During the test, the power consumption, power factor and harmonic values at maximum power shall be measured and continuously recorded using a watt-hour meter and power factor meter. The meters each shall provide accuracy of ±0.25 percent, shall operate at frequencies between 47 to 63 Hz, and shall be furnished with a statement from the meter manufacturer attesting to its accuracy.
3. Meters shall be connected to the line side of the Power Distribution Center at a location acceptable to the OWNER and ENGINEER.
4. In the event that manufacturer disputes results of the electrical acceptance testing manufacturer shall bear the entire cost of retesting by a third party mutually acceptable to OWNER and manufacturer.

D. If maximum power consumption exceeds the values provided in Form 1 (at the end of this Specification), manufacturer shall make any and all modifications necessary to adjust the system to meet the requirements, without cost to the OWNER to meet the specified requirements of the Power Consumption Guarantee.

E. If the power factor is less than that specified herein, the manufacturer shall provide all modifications necessary to modify the system to meet the requirements without any additional cost to the OWNER.

F. If the harmonic values exceed those as stated in IEEE 519-1992, the manufacturer shall provide all modifications necessary to modify the system to meet the requirements without any additional cost to the OWNER.

3.10 TRAINING OF OWNER'S PERSONNEL

A. Manufacturer shall provide training, startup and operation services as specified in Section 01660 and as provided herein.

B. Classroom Training: Allow for 40 hours on-site during the Testing Phase to address the complete UV system including mechanical, electrical, controls, instrumentation and overall operations. Repeat training during Commissioning Phase per Section 01660.

C. Hands-on Field Training: Allow for 24 hours on-site training prior during the Testing Phase. Repeat training during Commissioning Phase per Section 01660.

D. The manufacturer’s representative shall be a qualified individual who has previously provided onsite services for the installation, testing, and startup of the manufacturer’s identical UV System at a minimum of three recycled water plants of similar size.

3.11 WARRANTY PERIOD SERVICES

A. Manufacturer's representative shall provide offsite and onsite services to respond to OWNER’s operation and maintenance requests.

B. Manufacturer shall provide OWNER with contact information for three or more names of individuals qualified to support operation and maintenance. At least one of the listed individuals shall be available at all times including nights, weekends, and holidays in the event of an emergency. Contact information shall include:
   1. Email address.
   2. Toll free telephone number.
   3. Cell phone number that is accessible 24 hours per day, seven days per week.

C. Manufacturer shall return to the site to observe UV System performance, calibrate instruments, adjust UV System components to optimize performance, and consult with OWNER during the 3-year construction warranty period. Services shall include one trip with two (2) days on site per trip.

D. Manufacturer shall return to the site at the 3-year construction warranty period inspection and at the second and third years of operation to review UV System performance, operations, and maintenance.

Form - 1 Minimum UV Equipment and Sizing Criteria			
Manufacturer	Calgon C^3 500	Trojan UV3000+	Wedeco TAK55
Minimum System Configuration			
Number of duty/standby channels	2/1	2/1	2/1
Number of duty/standby banks per channel	3/0	3/0	3/0
Number of UV modules per bank	4	7	5
Number of UV lamps per bank	20	42	40
Total number of modules	36	63	45
Total number of lamps	180	378	360
Lamp Aging Factor (EOLL)	0.85	0.90	0.88
Sleeve Fouling Factor (FF)	0.90	0.95	0.90
Maximum Power Consumption, including all power to the UV system, KW[1]	117.6	108	115.2
Concrete Channel Characteristics[2]			
Width, ± allowable deviance, inches	24.0, -0.00/+0.25	28.0, -0.25/+0.25	43.0, -0.1875/+0.1875
Side Water Depth immediately downstream of inlet Baffle, ± allowable deviance, inches	31.0, -0.10/+0.50	24.6, -0.25/+0.25	17.50, -0.25/+0.25
Total Channel Depth, feet	5.0 ft	5.0 ft	3.8 ft
Head Loss per Bank at Peak Flow, inches	0.25	0.15	0.20
Lamp Characteristics			
Lamp Type	GA64T10L	Heraeus	Ecoray
Guaranteed Lamp Life, hours	12,000	9000	14,000
Power Turndown Range, %	100-60	100-60	100-50

Form - 1 Minimum UV Equipment and Sizing Criteria			
Ballast Characteristics			
Type of Ballast	Electronic	Electronic	Electronic
Guaranteed Ballast Life, years	5	5	5

Notes:

(1) Total system power with all banks (including the banks in the redundant channel) operating at 100 percent power.

(2) Channel dimensions and tolerances are provided for approximate reference only. Contractor must confirm and coordinate all information provided herein in addition to tolerances for bottom of channel and perpendicular to channel walls (e.g. ±1/8") with selected UV vendor.

END OF SECTION

SECTION 11294B

HEAVY-DUTY FABRICATED STAINLESS STEEL SLIDE GATES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Heavy-duty fabricated stainless steel slide gates.

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 01660 - Testing, Training, and Commissioning.
   c. Section 09960 - High-Performance Coatings.
   d. Section 13446 - Manual Actuators.
   e. Section 13447 - Electric Motorized Actuators.
   f. Section 15050 - Common Work Results for Mechanical Equipment.
   g. Section 15958 - Mechanical Equipment Testing.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
1. Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. American Water Works Association (AWWA):
1. AWWA C 561 - Fabricated Stainless Steel Slide Gates.

C. American Welding Society (AWS):
1. D1.6 - Structural Welding Code-Stainless Steel.

D. ASTM International (ASTM):
1. A 240 – Standard Specification for Stainless Steel Plate, Sheet and Strip.
2. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
3. B 584 - Standard Specifications for Copper Alloy Sand Castings for General Application.
4. D 1248 - Standard Specification for Polyurethane Plastics Extrusion Materials for Wire and Cable.
5. D 2000 - Standard Classification for Rubber Products in Automotive Applications.
6. D4020 - Standard Specification for Ultra-High Molecular-Weight Polyethylene Molding and Extrusion Materials.

1.03 DEFINITIONS

A. Slenderness ratio (l/r): The largest ratio obtained by dividing the unsupported length of the stem by the radius of gyration of the stem cross section.

B. Design head: Depth from surface of water to centerline of gate. Use value specified in the gate schedule.

C. Seating head: Pressure applied to gate slide from weight of water column above gate centerline that forces gate slide into seat.

D. Unseating head: Pressure applied to gate slide from weight of water column above gate centerline that forces gate slide away from seat.

E. Substantially similar:
   1. Similar in size, design head, and service.
   2. Utilizes the proposed design for critical components including guides and seals.

1.04 DESIGN REQUIREMENTS

A. Except as modified or supplemented herein, all gates and operators shall conform to the requirements of AWWA C 561, latest edition.

B. Gate components:
   1. Frames:
      a. Design for the design head scheduled with a minimum safety factor of 5 with regard to ultimate tensile, compressive, and shear strength.
      b. Self-contained gates: Where operational loads are taken by the frame, not by the concrete at the base of the pedestal, design to be self-supporting so that no further reinforcing or support is required.
   2. Stem: Select stem diameter, stem guide quantity and stem guide spacing based on following criteria:
      a. Slenderness ratio (l/r): Shall not exceed 200.
      b. Tensile strength: Suitable to withstand the force generated by the operator with the application of a 200-pound force applied to the crank or handwheel or a 250 foot-pound torque applied to the wrench nut.
      c. Compressive strength:
         1) Suitable to withstand buckling due to the force generated by the operator with the application of an 80-pound force applied to the crank or handwheel or a 100 foot-pound torque applied to the wrench nut.
         2) Determine buckling load using Euler Column formula in accordance with AWWA C 561, where C = 2.
      d. Design force for power actuators:
         1) Hydraulic cylinder operators: 1.25 times the output thrust at maximum hydraulic fluid operating pressure.
         2) Electric motor operators: 1.25 times the output thrust in the stalled-motor condition.
      e. Gates having widths in excess of 48 inches and widths that are greater than 2 times the height: Provide with 2 lifting mechanisms connected by a tandem shaft.

3. Thrust nut: Suitable to withstand thrust developed by operator with the application of a 40-pound force on the crank or handwheel with safety factor of 5. Base design on ultimate strength of material used.
4. Yokes for self-contained gates:
   a. Design yoke using design loading criteria for stem with safety factor of 5 based on the ultimate strength of the material used.
   b. Maximum deflection at design load: Not to exceed 1/360th of the span or 1/4-inch, whichever is less.
5. Slide:
   a. Deflection shall be less than or equal to 1/1000 of the span of the gate or 1/16 inch, whichever is less, when under the design head.
   b. Design for the maximum design head specified with a minimum safety factor of 5 with regard to ultimate tensile, compressive, and shear strength.

1.05 PERFORMANCE REQUIREMENTS

A. Leakage shall comply with allowable limits set forth in AWWA C561.

1.06 SUBMITTALS

A. Submit information as specified in Section 01330 and Section 15050. In addition, submit information specified herein.

B. Layout and installation drawings for each gate size and type.

C. Complete bill of materials.

D. Gate operators: As specified in Sections 13446 and 13447.
   1. Provide certification from both the motorized operator manufacturer and the gate manufacturer confirming that the proposed gate stem configuration has been coordinated with motorized operator selection.
      a. Confirm that the proposed gate stem configuration provides the most efficient combination of stem diameter, pitch, and lead.
      b. Confirm the design will keep the operating temperature at the stem nut to a minimum during operation.
      c. Confirm the design will meet the specified motorized operator operating speed requirements.
   2. For coordination purposes, gate manufacturer shall supply calculations verifying the suitability of the selected motorized operator for the application. For each gate include:
      a. Open/close speed per Section 13447.
      b. The maximum torque required for operation of the gate (including breakaway from seat) with a safety factor of 1.4.
      c. The torque supplied by the motorized operator scheduled in Section 13447 for the operating speed specified in Section 13447.
      d. The thrust output capacity of the motorized operator with the furnished motor.

E. Wall thimbles design.

F. Manufacturer's installation instructions.

G. Design calculations:
   1. Submit calculations and design data substantiating conformance with the Drawings and Specifications.
   2. Gate opening and closing thrust forces that will be transmitted to the support structure with operator at extreme positions and load.
   3. Torque required to open and close the gate, including maximum torque at any point along gate travel. Indicate thrust valve and stem factor.
   4. Breakaway torque from seat. Indicate thrust valve and stem factor.
   5. Submit calculations that substantiate the slide design is in conformance with the minimum safety factors specified in the latest revision of AWWA C561. In particular, confirm this at the slide centerline and along the length of the slide, on each side, where it engages the guides.
   6. Submit calculations that substantiate the guide design is in conformance with the minimum safety factors specified in the latest revision of AWWA C561. In particular confirm that all components, including but not limited to, the guide frame and guide frame attachment bolts are designed within the specified safety factors.

H. Detailed performance test procedures for factory and field-testing.

I. Operation and maintenance manual.

1.07 QUALITY ASSURANCE

A. Factory markings:
   1. Mark gates according to the scheduled equipment tag numbers when such numbers are used.
   2. Where thimbles, frames, and other components are not interchangeable, the components shall be match marked.

B. Manufacturer qualifications:
   1. Experience in production of substantially similar equipment with substantially similar sealing mechanism during the 10 years prior to issuance of this contract, and able to submit evidence of satisfactory operation in at least 50 different installations using substantially similar sealing mechanism in the United States.
      a. Multiple gates at a plant shall be considered as one installation toward meeting the experience requirements.
   2. Manufacturer's shop welds, welding procedures, and welders: Qualified and certified in accordance with the requirements of AWS D1.6.
   3. Assembled gates: Shop inspected, adjusted, and tested before shipping.

C. Fulfillment of the specified experience requirements shall be a condition of acceptance.

1.08 WARRANTY

A. As specified in Section 01740 unless noted otherwise.

B. Warrant equipment free of defects in material and workmanship for 2 year from the date specified in Section 01740. Cover parts and labor.

C. Manufacturer’s warranty shall be issued in the OWNER’s name.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following or equal.
   1. H. Fontaine, Series 20 or 25.
   2. Whipps, Series 900.

B. Operator anchor bolts and wall thimbles: Provided by manufacturer of slide gates.

2.02 MATERIALS

A. Stainless steel: ASTM A240 or ASTM A 276, Type 316.
   1. Components or structural shapes that are welded: ASTM A240 or ASTM A 276, Type 316L.
   2. All wetted and unwetted parts including all fasteners and hardware, except as specified herein, shall be 316 stainless steel.

B. Ultra high molecular weight polyethylene: ASTM D 1248 and D 4020.

C. Neoprene: ASTM D 2000, Grade 2 BC 510.

D. Manganese bronze: ASTM B 584, UNS Number C86500.

E. Silicon bronze: ASTM B 584 UNS Number C87300.

2.03 COMPONENTS

A. Slide:
   1. Type 316L stainless steel.
   2. Rectangular or square.
   3. Fabricated with a flat plate reinforced with formed plates or structural members.
   4. All structural components shall have a minimum material thickness of 1/4 inch.

B. Frame:
   1. Construct gate frame of Type 316L stainless steel structural members or formed plate welded to form a rigid 1-piece frame.
   2. Mounting: As scheduled on the Drawings.
   3. Self-adjustable ultra high molecular weight polyethylene seals. Seal systems that utilize adjustable seals are not acceptable.
   4. Flush bottom type unless otherwise scheduled on the Drawings or in the gate schedule.
   5. Allow replacement of top, side, and bottom seals without removing the gate frame from concrete or wall thimble.
   6. Provide seal between gate frame and thimble (where applicable) that will meet leakage performance requirements.

C. All structural components shall have a minimum material thickness of 1/4 inch. Yoke for self-contained gates:
   1. Type 316L stainless steel.

2. Extend guides and frame so that bottom of yoke is at least 2 inches above top of slide at full open position and as required to set the yoke at an elevation convenient for manual operation.
3. Bolt or weld to frame.
4. Provide mounting plate on top of yoke to mount operator.
5. Design yoke to allow removal of gate slide.
6. Gates with enclosures:
    a. Provide extension spool piece of Type 316 stainless steel to support the motor operator outside the enclosure.

D. Guides:
1. Type 316L stainless steel with ultra high molecular weight polyethylene seal in contact with slide.
2. Minimum engagement of slide with seals: 1 inch on each side.
3. Length: To completely support the slide fully in the open position.
4. Anchor bolts shall not pass through the guides and seals.

E. Seals:
1. Designed to achieve the specified leakage requirements.
2. Sealing and sliding surfaces shall provide a low coefficient of friction with the surface of the slide.
3. Field replaceable without removing gate from concrete or wall thimble.
4. Anchor bolts shall not pass through the guides and seals.
5. J-bulb seals are not acceptable.
6. Minimum seating surface width: 3/4 inch in contact with slide.
7. Bottom seal:
    a. Resilient neoprene or EPDM.
    b. Attached to the bottom of the slide or embedded in gate frame invert.
8. Side and top seals:
    a. Seal design:
        1) UHMWPE self-adjusting type seals: Utilize a continuous silicon or nitrile compression cord to ensure contact between the seals and the slide.
        2) Side seals:
            a) Attach to frame using one of the following approaches.
                (1) Held in place between the front and back angles of the guide with Type 316 stainless steel bolts passing through the guide and seal along the length of the guide.
                (2) Held in place between front and back of a formed, one piece, rigid channel guide. Attach seals to frame using Type 316 stainless steel bolts.
            b) Design and installation shall provide access to and removal of the bolt to allow removal of the side seal without removing the gate from the concrete.
        3) Top Seal: UHMWPE self-adjusting type seal with a single or double-compression cord.

F. Stem:
1. Type 316 stainless steel.
2. Machine cut or rolled threads of the full depth Acme type, polished as necessary to a 16-microinch finish or better.

3. Stem couplings:
    a. Silicon bronze.
    b. Threaded and keyed to stem or threaded and bolted to stem.
4. Stem guides:
    a. Type 316 stainless steel.
    b. Split collar.
    c. Adjustable in 2 directions.
    d. Ultra high molecular weight polyethylene bushing.
5. Provide manganese bronze stop collar on stem above manual operator.
6. Drill and connect stem to slide structural sections with a minimum of two Type 316 stainless steel bolts.
7. Minimum Stem Diameter: 1-1/2 inch.
8. Coordinate the selection of the gate stem configuration with the gate operator and operating speed.
    a. The selected gate stem configuration shall provide the most efficient combination of stem diameter/pitch/lead and keep the operating temperature at the stem nut to a minimum during operation.
    b. For motorized applications, if the proposed gate stem configuration would result in any deviation from the operating rise rate specified in Section 13447, submit proposed deviation for approval by the ENGINEER.

G. Stem Covers
1. Fabricated from ultraviolet light resistant, clear butyrate or lexan plastic pipe. Stem covers shall be capped on the upper end and either threaded into the top of the gate operators or held in place by stainless steel fasteners or bolt-down aluminum brackets.
2. For weir gates:
    a. Staff gauges shall be adhesive-backed mylar, suitable for outdoor service. Staff gauges shall be calibrated in hundredths of feet and shall read out directly the weir crest elevation. The staff gauge range shall be 1.5 feet minimum and elevations -0.75, -0.50, -0.25, 0.0, 0.25, 0.50, 0.75, shall be indicated on each staff gauge. Staff gauges shall be supplemented with a stem-mounted pointer or indicator which shall permit direct observation of the weir gate crest elevation.

H. Operating nut:
1. Locate at operator level.
2. Material: Manganese bronze.

I. Gate operators: As specified in Sections 13446 and 13447.

J. Coordination with motorized operator supplier:
1. Sizes and model numbers of motorized operators for gates are estimated in Section 13447. Gate manufacturer's responsibility shall extend to confirming these sizes and model numbers for each gate based on:
    a. Design seating and unseating head.
    b. Open/close speed specified in Section 13447.
    c. Torque safety factor of 1.4, minimum, applied to the maximum torque requirement, including breakaway from seat.
2. Verify, in writing, that the motorized operators are adequately sized.

3. If the motorized operators are not properly sized for each furnished gate, notify the ENGINEER immediately.
4. In the event that a different size or model is required for any gate, gate manufacturer shall advise CONTRACTOR of the proper selection and CONTRACTOR shall provide, at no additional cost, the proper operator.
5. The gate supplier shall machine the stem nuts, provide proper mounting adaptation, and adaptation hardware to ensure adequate interface between the motorized operators and the slide gates.

K. Pedestals and wall brackets: Type 316L stainless steel.

L. Bolts, nuts, and fittings: Type 316 stainless steel.

M. Anchor bolts:
1. Type 316 stainless steel with a minimum diameter of 1/2 inch.

2.04 WALL THIMBLES

A. Provide wall thimbles when scheduled or indicated on the Drawings.

B. F-section of a depth equal to the thickness of the structure wall upon which the gate is mounted.
1. Modify F-sections where required for F-section and pipe bell ring connections in a wall.
   a. Provide flange-by-mechanical joint or flange by push on joint wall thimble where ductile iron piping connects to the wall thimble. Ensure that joint wall thimble has sufficient embedment to resist pipe thrust.
   b. Provide flange-by-bell ring wall thimble insert where reinforced concrete piping connects to the wall thimble.
   c. Mechanical joint wall thimbles that attach to ductile iron pipe can be constructed of ductile iron or stainless steel.

C. Fabricated Type 316L stainless steel of sufficient section to resist permanent distortion; minimum 3/8 inch thick plate.

D. Width of mounting flange of wall thimble: 1/2 inch wider than mounting flange of gate.

E. Fully machine front flange of thimble to a plane. Drill and tap to match the drilling on the flange back gate seat.

F. Clearly mark top center of each thimble for installation.

G. Provide Type 316 stainless steel studs for attaching the gate frame.

H. Seal joint between thimble and gate watertight, in accordance with AWWA C 561.

I. To permit entrapped air to escape as the thimble is being cast in concrete, drill holes in each entrapment zone formed by ribs, flanges, and water stops.

J. Provide annular weep ring to control seepage and resist thrust, where needed to anchor the pipe thrust restraint system.
   1. Continuously weld weep ring to outside of the wall thimble. Stitch welding and sealing in between the welds is also acceptable.
   2. Weep ring shall be minimum 1/4 inch thick and minimum 2 inches deep.

2.05 GATE ENCLOSURES

A. Completely enclose each self contained gate as scheduled to contain odors. Extend enclosure over floor opening.

B. Supplied by the gate manufacturer.

C. Features: As shown on the Drawings and as follows.
   1. Removable without removing gate operator. Fabricated in 2 pieces with a joint in the same plane as the gate frame.
   2. Access openings: As required for maintenance.
   3. Seal opening at top of enclosure where operator mounting extension spool piece passes through the enclosure.

D. Material of construction: FRP or stainless steel plate. Stainless steel plate shall have a minimum thickness of 16 gauge.

2.06 FINISHES

A. Stainless steel:
   1. Shot blast gates and wall thimbles after fabrication in accordance with ASTM A380 to remove weld burn, slag, and splatter and to polish scratches.
   2. Clean the entire surface to produce an even color and sheen.

B. Operators, stands, and other accessory equipment: Surface preparation, factory prime, field prime, and finish coats as specified in Section 09960.

2.07 FABRICATION

A. Shop assembly:
   1. Gates shall be factory assembled, adjusted, and tested.
   2. Mount accessories and appurtenances on gates at the factory that are being provided by gate manufacturer.
      a. Motor actuators shall be shop tested by the original manufacturer prior to shipment.

2.08 SOURCE QUALITY CONTROL

A. Factory testing:
   1. All gates shall be factory assembled and tested before shipment.
   2. Test equipment as specified in Section 15958.
   3. Operational testing:
      a. Test functionality of all controls and limit switches.
   4. Leakage test:
      a. Verify compliance with allowable leakage limits as specified.
      b. Conduct water test in accordance with AWWA C 561. Feeler gauge test is not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as indicated on the Drawings and in strict conformance with the manufacturer's installation instructions, shop drawings, and recommendations.

B. Mount thimbles and gates plumb in both vertical planes and level in horizontal plane.

C. Coat seating surfaces between frame and wall thimble with a waterproof plastic compound or provide EPDM gasket prior to tightening frame studs.

D. Fit each seal to the point where it will not be possible to insert a 0.004 inch feeler gauge between the gate slide and the gate frame at any point.
   1. Securely fasten seals into position after adjustment.

E. Adjust limit switches in electric operators in accordance with manufacturer's instructions.

F. Face mounted gates:
   1. Where wall thimbles are not provided, mount gate to wall with anchor bolts and provide a 1-inch non-shrink grout pad in accordance with manufacturer’s recommendations.

G. Embedded gates:
   1. Provide blockouts in sidewalls and channel bottom for installation of gates.
   2. After gate placement, adjustment, and alignment in accordance with manufacturer’s recommendations, grout frame with non-shrink grout.

B. Oxidation Ditch Weir Gates
   1. Calibrate each weir gate to ensure consistent, uniform and identifiable elevations along the length of the weir crest, throughout the full range of travel of the weir gate. The calibration procedure shall consist of the following:
      a. With the weir plate of the gate set to its lowest elevation, check the distance between the center line of each stem-to-weir plate connection and the top of the pedestal operator. Verify that the lengths are within 0.005 foot of each; if they are not, consult the manufacturer's representative for adjustment advice.
      b. Check the elevation of the weir crest at three equally spaced locations along its length with the weir at its lowest elevation, at its midpoint elevation, and its uppermost elevation. If the weir elevation remains within 0.01 foot across its length for each set point, the performance testing can begin. If the weir elevation exceeds this limit, correct and adjust the gate before initiating the performance testing.

3.02 FIELD QUALITY CONTROL

A. Testing:
   1. Leakage tests: Conduct in accordance with AWWA C 561. Comply with specified allowable leakage limits
   2. After gate installation and checking, run gates through at least 2 full cycles from the closed position to full open position and back to the closed position.
   3. Verify functionality of all switches and controls.
   4. Provide certificate of proper installation. Comply with Section 01660.

B. Oxidation Ditch Weir gate acceptance testing.
   1. In addition to the testing above conduct the following tests on each weir gate under the supervision of the manufacturer's representative.
      a. Set the weir gate to its lowest position. Check and record the elevations of the weir crest at three equally spaced locations along its length. If the actual elevations are within 0.01 foot of the setpoint, proceed with the test. If not, adjust the gate until the tolerance is achieved, then proceed.
      b. Move the weir in 0.10-foot increments up to and including the highest set point elevation. Determine and record the weir crest elevations at each of three equally spaced locations along the length of the weir crest. Lower the weir in 0.10-foot increments, down to and including the lowest position of the weir, determining and recording elevations as previously outlined.
      c. Repeat Step 2.
      d. If the weir gate meets the criteria established in Article 3.02 Paragraph B, the weir gate is acceptable and testing may be terminated. If the gate does not meet the criteria outlined, the CONTRACTOR shall adjust the gate and repeat the test.
      e. If after two repeat test cycles (Steps 2 and 3) the weir gate still fails to meet acceptance criteria, the CONTRACTOR shall, upon advice of the manufacturer's representative, modify the gate, at no expense to the OWNER, as required to achieve acceptable performance.

C. Manufacturer’s field services:
   1. CONTRACTOR shall furnish services of a qualified manufacturer’s representative experienced in installation and operation of the gates.
   2. CONTRACTOR shall coordinate field service work with the manufacturer’s representative, OWNER, and ENGINEER prior to initiating field service work.
   3. Manufacturer’s representative shall perform the services described below and specified in Section 01660.
      a. Installation assistance and inspection:
         1) Advise/observe the CONTRACTOR on the installation of the gates.
         2) Check and verify that installation of the gates is in accordance with the Drawings and manufacturer’s installation instructions.
      a. Field testing.
      b. Certification of proper installation.
      c. Training of OWNER’s personnel in accordance with Section 01660.

3.03 SCHEDULE

A. The Slide Gate Schedule is not a take-off list. CONTRACTOR shall provide additional gates per specifications and as indicated on the Drawings.

SLIDE GATE SCHEDULE

Equipment Tag Number	Service/Location	Reference Drawing	Opening Size, Inches (WxH)	Design Head, Seating and Unseating, Feet	Type of Frame	Type of Closure	Gate Mounting	Wall Thimble	Type of Wall Thimble	Operating Head, Feet	Operator	Remarks
03-GAT-111A 03-GAT-112A	Secondary Clarifier Drain Manhole	03C07	12 x 12	20	NSC	STD	RM	No	NA	20	FS/CO/RS	8
03-GAT-110	Secondary Clarifier Drain Manhole	03C07	6 x 6	20	NSC	STD	RM	No	NA	20	FS/CO/RS	8
03-GAT-321 03-GAT-324	REW Pond No. 1 Inlet Gate REW Pond No. 2 Inlet Gate	3M01	24 x 24	24	NSC	FB	FM	No	NA	12	FS/MO/RS	3,4,6
03-GAT-323 03-GAT-325	REW Pond No. 1 Outlet Gate REW Pond No. 2 Outlet Gate	3M01	24 x 24	24	NSC	DO	FM	No	NA	12	FS/MO/RS	3,4,6
03-GAT-322	REW Pond No. 1 Inlet Gate from Pond No. 3	3M01	24 x 24	24	NSC	FB	FM	No	NA	12	FS/CO/RS	2,3,4,6
10-GAT-041 10-GAT-051	Screen Inlet Gate Nos. 1 and 2	10M01	24 x 66	6	SC	FB	EMB	No	NA	4	BS/MO/RS	1,3,5,7
10-GAT-042 10-GAT-052	Screen Outlet Gate Nos. 1 and 2	10M01	24 x 66	6	SC	FB	EMB	No	NA	4	BS/MO/RS	1,3,5
20-GAT-081 20-GAT-082 20-GAT-085 20-GAT-086	Oxidation Ditch No. 1 Influent Gate No. 1 Oxidation Ditch No. 1 Influent Gate No. 2 Oxidation Ditch No. 2 Influent Gate No. 1 Oxidation Ditch No. 2 Influent Gate No. 2	20M02	36 X 30	3	SC	DO	FM	No	NA	3	CO/BS/RS	1,4,6
20-GAT-083 20-GAT-084 20-GAT-087 20-GAT-088	Oxidation Ditch No. 1 RAS Gate No. 1 Oxidation Ditch No. 1 RAS Gate No. 2 Oxidation Ditch No. 2 RAS Gate No. 1 Oxidation Ditch No. 2 RAS Gate No. 2	20M02	36 X 30	3	SC	DO	FM	No	NA	3	CO/BS/RS	1,4,6

SLIDE GATE SCHEDULE

Equipment Tag Number	Service/Location	Reference Drawing	Opening Size, Inches (WxH)	Design Head, Seating and Unseating, Feet	Type of Frame	Type of Closure	Gate Mounting	Wall Thimble	Type of Wall Thimble	Operating Head, Feet	Operator	Remarks
20-GAT-096 20-GAT-106	Oxidation Ditch No. 1 Inlet Gate Oxidation Ditch No. 2 Inlet Gate	20M02	18 X 18	13	NSC	FB	FM	No	NA	13	CO/FS/RS	1,4,6
20-GAT-094 20-GAT-104	Oxidation Ditch No. 1 Weir Gate Oxidation Ditch No. 2 Weir Gate	20M02	120 x 12	1	SC	DO	FM	No	NA	1	MO/BS/RS	4,5
20-GAT-107 20-GAT-108	Secondary Clarifier No. 1 Influent Gate Secondary Clarifier No. 2 Influent Gate	20M02	18 X 18	13	NSC	FB	FM	No	NA	13	CO/FS/RS	4,6
21-GAT-111 21-GAT-112	Secondary Clarifier No. 1 Effluent Gate Secondary Clarifier No. 2 Effluent Gate	21M01	18 X 18	13	NSC	FB	FM	No	NA	13	CO/FS/RS	4,6
23-GAT-134 23-GAT-135	Secondary Clarifier No. 1 Scum Gate Secondary Clarifier No. 2 Scum Gate	23M01	6X6	10	NSC	FB	FM	No	NA	10	CO/BS/RS	4,6
28-GAT-188A 28-GAT-188B	Filter Influent Pump Station Wet Well No. 1 Gate Filter Influent Pump Station Wet Well No. 2 Gate	28M01	36x36	16	NSC	FB	FM	No	NA	16	CO/BS/RS	4,6
50-GAT-413 50-GAT-415	Sludge Storage Tank No. 1 Weir Gate No. 1 Sludge Storage Tank No. 2 Weir Gate No. 1	50M01	36 x 66	10	NSC	DO	FM	No	NA	8	BS/MO/RS	3,4,6
50-GAT-414 50-GAT-416	Sludge Storage Tank No. 1 Weir Gate No. 2 Sludge Storage Tank No. 2 Weir Gate No. 2	50M01	36 x 54	15	NSC	DO	FM	No	NA	13	BS/MO/RS	3,4,6
50-GAT-419	Sludge Storage Tank Equalization Gate	50M01	48 x 48	15	NSC	STD	FN	No	NA	13	BS/CO/RS	3,4,6

SLIDE GATE SCHEDULE

Equipment Tag Number	Service/Location	Reference Drawing	Opening Size, Inches (WxH)	Design Head, Seating and Unseating, Feet	Type of Frame	Type of Closure	Gate Mounting	Wall Thimble	Type of Wall Thimble	Operating Head, Feet	Operator	Remarks

Notes:
1. Type of Frame:
   SC = Self-Contained
   NSC = Non Self-Contained
2. Type of Closure:
   FB = Flush Bottom
   DO = Downward Opening
   STD = Standard
3. Gate Mounting:
   EMB = Embedded
   FM = Face mounted
   FM x CWX = Face mounted with Extra-Wide Flange to cover existing cast iron thimble
   FM x EMB = Face mounted with one side-mounted flange
   RM = Round Manhole
4. Type of Thimble:
   F = F Thimble
   F x SP = F Thimble with Spigot
   F x FLG = F Thimble with Flange
   F x B = F Thimble with Bell
   NA = Not Applicable with Mechanical Joint

Notes (continued):
5. Operator:
   HW = Handwheel
   CO = Crank Operator with 2-inch AWWA Nut
   IFS = Interconnected Floor Stands
   MS = Modulating Service
   FS = Floor Stand
   BS = Bench Stand
   MO = Motorized Operator
   RS = Rising Stem
   NRS = Non-Rising Stem

Remarks:
1) Provide FRP or SST Gate Enclosure per the Specifications.
2) Provide provisions for future motorized actuator.
3) 3-inch Schedule 80 PVC pipe sleeve around gate stem.
4) Yoke or top of bench stand elevation shall be 3 feet above operation floor.
5) Top seals are not required.
6) Top seals are required.

Remarks (continued):
7) Locate stem on backside (i.e., downstream) of slide.
8) Mounted inside a curved wall.

END OF SECTION

SECTION 11298B

STOP PLATES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Stop plates and frames.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01600 - Product Requirements.
      b. Section 01740 - Warranties and Bonds.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. American Water Works Association (AWWA):
   1. AWWA C 561- Fabricated Stainless Steel Slide Gates.

C. ASTM International (ASTM):
   1. A 240 - Standard Specification for Stainless Steel Plate, Sheet and Strip.
   2. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
   3. B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   4. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   5. F 594 - Standard Specification for Stainless Steel Nuts.
   6. D 2000 - Standard Classification for Rubber Products in Automotive Applications.
   7. D 4020 - Standard Specification for Ultra-High Molecular-Weight Polyethylene Molding and Extrusion Materials.

1.03 SUBMITTALS

A. Product data.

B. Shop drawings.

1.04 PERFORMANCE REQUIREMENTS

A. Leakage shall comply with allowable limits set forth in AWWA C561.

B. Leakage shall not exceed 0.1 gpm/ft of wetted seal perimeter in seating head and unseating head conditions.

1.05 QUALITY ASSURANCE

A. The manufacturer shall have experience in the production of substantially similar equipment, and shall show evidence of satisfactory operation in at least 50 wastewater plant installations.
   1. Fulfillment of the specified experience requirements shall be a condition of acceptance.

B. The manufacturer's shop welds, welding procedures and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX.

C. Certification for welders is the AWS D1.6.

D. The manufacturer shall be ISO 9001:2000 certified or use similar quality control processes.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products as specified in Section 01600.

1.07 WARRANTY

A. As specified in Section 01740.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Fontaine, Series 92 Model 920FE.
   2. Whipps Inc., Series 521.

2.02 MATERIALS

A. Stop plate: Aluminum per ASTM B-209, Alloy 5083-H32 or 6061-T6.

B. Frame: Type 316L stainless steel per ASTM A-240.

C. Guides and Seals:
   1. Guide bar: Ultra high molecular weight polyethylene (UHMWPE) per ASTM D-4020.
   2. Side and bottom seals: EPDM per ASTM D-2000.
   3. Gasket: EPDM per ASTM D-2000.

D. Fasteners: Type 316 stainless steel per ASTM F593 and F594 or ASTM A276.

2.03 FABRICATION

A. Plates:
   1. Reinforced with angles welded to the plate.
   2. Designed for a deflection of less than 1/720 of the span.
   3. Equipped with a hand-lifting lug.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

3.02 EXAMINATION

A. Verify that conditions are satisfactory for installation of products as specified in Section 01600.

3.03 FIELD TESTS

A. Following the completion of each installation, the stop plates shall be operated through at least two complete open/close cycles.

B. Check leakage and verify compliance with leakage requirements.

C. If leakage requirements are exceeded, the manufacturer shall make necessary modifications to the stop plates at no additional cost and the testing shall be repeated until satisfactory results are obtained.

3.04 SCHEDULES

Stop Plate Schedule

Equipment Type	Equipment Number	Reference Drawing	Width of Opening	Height of Each Stop Plate	Quantity	Design Pressure, Seating, Feet	Design Pressure, Unseating, Feet
Stop Plate	10-MK-01	10M01	2' – 0"	5' – 5.5"	1	5' – 5.5"	5' – 5.5"
Stop Plate	10-MK-02	10M01	2' – 0"	5' – 5.5"	1	5' – 5.5"	5' – 5.5"
Embedded Stop Plate Frame	N/A	10M01	2' – 0"	5' – 5.5"	4	5' – 5.5"	5' – 5.5"

END OF SECTION

SECTION 11312B

HORIZONTAL, CENTRIFUGAL, NON-CLOG OR MIXED FLOW, DRY PIT PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Horizontal dry pit, non-clog (Francis-Vane) or mixed flow, flexibly coupled, centrifugal pumps with drivers, and features as specified.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01600 - Product Requirements**.**
      c. Section 01610 - Project Design Criteria.
      d. Section 01660 - Testing, Training, and Commissioning.
      e. Section 09960 - High-Performance Coatings.
      f. Section 15050 - Common Work Results for Mechanical Equipment.
      g. Section 15958 - Mechanical Equipment Testing.
      h. Section 16050 - Common Work for Electrical.
      i. Section 16222 - Low Voltage Motors up to 500 Horsepower.

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

C. ASTM International (ASTM):
   1. A 48 - Standard Specification for Gray Iron Castings.
   2. A 108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished.
   3. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
   4. A 283 - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

5. A 743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
6. B 148 - Standard Specification for Aluminum-Bronze Sand Castings.
7. B 505 - Standard Specification for Copper Alloy Continuous Castings.
8. B 763 - Standard Specification for Copper Alloy Sand Castings for Valve Applications.
9. E 10 - Standard Test Method for Brinell Hardness of Metallic Materials.

D. Hydraulic Institute (HI):
1. 1.1-1.2 - Centrifugal Pumps for Nomenclature and Definitions.
2. 1.3 - Rotodynamic (Centrifugal) Pumps for Design and Application.
3. 1.6 - Centrifugal Pump Tests.
4. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application and Sound Measurement, and Decontamination.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 1.6, and 9.1-9.5 and as modified in this Section.

B. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.

1.04 SYSTEM DESCRIPTION

A. Components: Horizontal non-clog (Francis-Vane) or mixed flow pumps, drivers, motors, seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as required for a complete and operational system.

B. Design requirements:
1. Pump performance characteristics: As specified in the Pump Schedule, Pump Performance Characteristics:
   a. As specified in the Pump Schedule.
   b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
2. Motor characteristics: As specified in the Pump Schedule.

1.05 SUBMITTALS

A. Submit as specified in Section 15050.

B. Torsional analysis: Submit as specified in Section 15050 when scheduled.

C. Furnish motor submittals as specified in Section 16222.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Provide pumps specified in this Section from same manufacturer.

C. Require pump manufacturer to furnish and coordinate pump, driver, drive, and pump components as scheduled and to provide written installation and checkout requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050.

1.11 MAINTENANCE

A. Special tools: For each type or size of pump specified, provide 1 set of all special tools required for complete assembly or disassembly of the pump system components.

B. Spare parts: Deliver the following as specified in Section 01600:
   1. Pump thrust bearing set.
   2. Pump radial bearing set.
   3. Motor bearing set of each type.
   4. Pump impeller, trimmed to match installed impeller.
   5. Mechanical seal set.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pumps: One of the following or equal:
   1. Fairbanks Morse (Pentair Water).
   2. Flowserve Worthington.
   3. ITT-Flygt Pump.

2.02 MATERIALS

A. General: Materials in the Pump Schedule shall be the type and grade as specified below.

B. Cast iron: ASTM A 48, Class 30 minimum.

C. Nickel cast iron: ASTM A 48, minimum Class 30, cast iron with 3 percent nickel.

D. Iron-chromium alloy: ASTM A 743, Grade CA40.

E. Bronze or leaded tin bronze: ASTM B 505, Alloy C92700.

F. Aluminum bronze: ASTM B 148 or B 763, Alloy C95200.

G. Stainless steel: ASTM A 276, type as scheduled.

H. Neoprene: Polychloroprene rubber.

I. Structural steel: ASTM A 283, Grade D.

J. Steel: ASTM A 108, Grade as scheduled.

2.03 GENERAL PUMP CONSTRUCTION

A. Type: Heavy-duty, horizontal, non-clog (Francis-Vane) or mixed flow (as specified) centrifugal type pumps.

B. Other requirements:
   1. Vibration: As specified in Section 15958.

2.04 PUMP CASINGS

A. Type: 1 piece volute type with integral suction and discharge nozzles.

B. Material: As scheduled.

C. Construction: Of sufficient strength, weight, and thickness to provide accurate alignment, prevent excessive deflection.

D. Rotating assembly: Removable without disturbing suction or discharge connections.

E. Design Working Pressure: Minimum 1.10 times maximum shutoff total dynamic head with maximum installable impeller diameter at maximum operating speed plus maximum suction static head.

F. Discharge: Tangential to casing or centered on casing when space permits acceptable rearrangement of piping.

G. Suction and discharge piping connections: Flanged meeting ASME B16.1, Class 125, or ASME B16.5, Class 150, or higher pressure class as required to meet Design Working Pressure.

H. Handholes: Provide to permit inspection and cleaning of pump interior. Provide bolted cover with inner contour that matches contour of casings; minimum 5-inch diameter when pump size permits this size handhole.

I. Vent and taps:
   1. Provide castings with both 3/4-inch threaded high point and low point drain taps.
   2. Provide 1/2 inch threaded tap with valve and pressure gauge on the suction and discharge flanges.

J. Hydrostatic test: 5-minute hydrostatic test at minimum 1.5 times Design Working Pressure.

2.05 IMPELLERS

A. Type: As scheduled.

B. Material: As scheduled.

C. Maximum number of vanes: As scheduled.

D. Design with smooth water passages to prevent clogging by stringy or fibrous materials. Passages shall be capable of passing solids with sphere size as scheduled.

E. Method of securing to shafts: Keyed and secured by bronze nut locked in place, but readily removable without use of special tools.

F. Adjustment of axial clearance: Through jacking screws and lock nuts placed between frame and outboard bearing housing or by shims held in place by frame housing.

G. Rotation: Clockwise looking from driver, unless otherwise indicated on the Drawings.

H. Balance: As specified in Section 15050 and vibration criteria as specified in Section 15958.

2.06 WEAR RINGS

A. Materials:
   1. Impeller wear ring: As scheduled with a Brinell Hardness Number of 350 to 380 or at least 50 Brinell Hardness Number less than the casing or suction head wear ring Brinell Hardness Number when tested in accordance with ASTM E 10.
   2. Casing or suction head wear ring: As scheduled with a minimum Brinell Hardness Number of 450 when tested in accordance with ASTM E 10.

B. Features:
   1. Able to allow compensation for minimum 1/8 inch wear.
   2. Provided with wearing surfaces normal to axis of rotation (perpendicular to shaft axis).
   3. Removable.
   4. Fastened with recessed screws to prevent relative rotation.

2.07 PUMP SHAFTS

A. Material: As scheduled, turned, ground, and polished.

B. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.

C. Resonant frequency: As specified in Sections 15050 and 15958.

D. Deflection: Maximum 0.002 inches under operating conditions.

E. Impeller attachment: Taper fitted or straight at impeller with key and bolt for securing impeller.

F. Shaft sleeve:
   1. Material: As scheduled with minimum Brinell Hardness of 450 when tested in accordance with ASTM E 10.
   2. Renewable, key locked in stuffing box, gland area, and bearings.
   3. Able to protect shaft from pumped liquid and wear.

2.08 STUFFING BOXES

A. Size: As specified in Section 15050.

B. Materials: Same as pump casing.

C. Provide separate stuffing box housing (not integral to the rear liner or wear plate) suitable for shaft seal type scheduled.

D. Shaft seal type: As scheduled and as specified in Section 15050.

2.09 BEARINGS AND BEARING FRAME

A. Bearing type: Anti-friction meeting ABMA standards; self-aligning spherical roller type radial bearings; angular contact ball type, or tapered roller for thrust bearings.

B. Bearing lubrication:
   1. When grease lubrication scheduled, provide:
      a. External grease fittings with grease relief pipe.
      b. Lip type grease seals and labyrinth type grease deflectors at both ends of bearing housings, able to prevent entrance of contaminants.
   2. When oil lubrication scheduled, provide:
      a. Pressure lubricating system or separate oil reservoir type system.
      b. Oil filler pipe.
      c. External level indicator gauge.
   3. Size sufficiently to safely absorb heat energy normally generated in bearing under maximum ambient temperature of 60 degrees Celsius.

C. Bearing life: Minimum L_{10} life of 100,000 hours at rated design point or 24,000 hours in accordance with ABMA 9 or 11 at bearing design load imposed by pump shutoff with maximum sized impeller at rated speed, whichever provides longest bearing life in intended service.

D. Pump bearing frames:
   1. Material: As scheduled.
   2. Provide a 1-piece rigid construction with bearing housing at outboard (pump) end, and end cover or housing at inboard (driver) end.

E. Inboard bearing frame drain hole: Tapped, 3/4 inch NPT, located as low as possible to drain leakage when adjacent to packing or seal.

2.10 COUPLINGS

A. Types: As scheduled and as specified in Section 15050.

B. Flexible coupling life: Infinite at up to 0.3-degree misalignment angle total or per disk for disk type at maximum operating loads.

C. Design coupling to withstand a minimum of 1.5 times the maximum operating torque and other imposed loads.

D. Components for driver connected through intermediate shafting: When scheduled, provide drive shafting, couplings, intermediate bearing supports, U-joints, and separate motor/driver support arranged in accordance with general arrangement indicated on the Drawings.

E. Motor/driver and pump couplings for single intermediate shafts: Flexible disc or other type required to meet torsional vibration requirements.

2.11 SUPPORTS, PEDESTALS, AND BASEPLATES

A. Materials: Same as pump casing or ASTM A 283 steel, hot-dip galvanized after fabrication and coated as specified in Section 09960.

B. Pump, driver, and intermediate bearing support strength: Able to withstand minimum 1.5 times maximum imposed operating loads or imposed seismic loads, whichever is greater.

C. Configuration: Allow easy access to stuffing boxes, bearing frames, and couplings.

D. Support pump and motor pedestals on a common structural steel baseplate.

2.12 EQUIPMENT GUARDS

A. Provide equipment safety guards as specified in Section 15050.

2.13 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.

b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors: As specified in Section 16222 and as specified in this Section.
1. RPM: As scheduled:
2. Enclosure: As scheduled.
3. Electrical characteristics: As scheduled.
4. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222.
5. Motor accessories: As specified in Section 16222 and as specified in this Section.
6. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive.

C. Other drivers: As scheduled and as specified in sections listed in the Schedule.

D. Non-reverse ratchets, type: When scheduled, able to prevent reverse rotation of pump and driver.

2.14 FINISHES

A. Prepare surfaces and apply protective finishes as specified in Section 09960.

2.15 SOURCE QUALITY CONTROL

A. Witnessing: Source or factory testing shall be witnessed by the ENGINEER or OWNER when scheduled; provide advanced notice of source testing as specified in Sections 01660 and 15958.

B. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

C. Vibration test: Test level as scheduled; test as specified in Section 15958.

D. Noise test: Test level as scheduled; test as specified in Section 15958.

E. Motor factory tests: Test as specified in the variable frequency drive section.

F. Hydrostatic pressure tests: As specified for components in this Section.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Section 15050.

3.02 FIELD QUALITY CONTROL

A. Witnessing: All field-testing shall be witnessed by the ENGINEER; provide advanced notice of field-testing as specified in Sections 01660 and 15958.

B. Inspection and checkout: As specified in Sections 15050 and 15958.

C. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

D. Vibration test: Test level as scheduled; test as specified in Section 15958.

E. Noise test: Test level as scheduled; test as specified in Section 15958.

F. Operational testing: As specified in Section 01660.

3.03 MANUFACTURER'S FIELD SERVICES

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this section and in Sections 15050 and 15958.

B. Training: As specified in Section 01660.

3.04 PUMP SCHEDULE

Tag Numbers	**50-PMP-121, 50-PMP-122, 50-PMP-123**
General Characteristics:	
Service	RAS Pumps
Quantity	3
First Named Manufacturer’s Model Number	5422
Maximum Noise, dBA at 3 feet	85
Torsional Analysis	Not Required
Minimum Pumped Fluid degrees Fahrenheit	50
Normal Pumped Fluid degrees Fahrenheit	70
Maximum Pumped Fluid degrees Fahrenheit	85
Pump Characteristics:	
Impeller Type	Non-clog
Impeller, Maximum Number Vanes	Per Manufacturer
Pass Minimum Sphere Size, Inch	3
Impeller Bearing Lubrication	Grease
Shaft Seal Type	Split Face Single Mechanical
Stuffing Box Type	

Tag Numbers	50-PMP-121, 50-PMP-122, 50-PMP-123
Coupling Type	Flexible Coupling
Speed Control	Variable Frequency Drive
Maximum Pump rpm	1,170
Minimum Pump rpm	700
Rated Design Point (at Maximum Revolutions per Minute):	
Flow, gpm	550
Head, Feet	16.0
Minimum Efficiency, Percent	65
Required Condition 2 (at Maximum Revolutions per Minute):	
Flow, gpm	420
Head Range, Feet	19
Minimum Efficiency, Percent	65
Required Condition 3 (at Maximum Revolutions per Minute):	
Flow, gpm	160
Head Range, Feet	25
Minimum Efficiency, Percent	45
Required Condition 4 (at Maximum Revolutions per Minute):	
Flow, gpm	685
Head Range, Feet	10
Minimum Efficiency, Percent	50
Other Conditions:	
Shut Off Head, Feet	31
Maximum NPSHr at Every Specified Flow, Feet	5.1
Minimum NPSHa at Every Specified Flow, Feet	22
Minimum Suction Static Head, Feet	11
Maximum Suction Static Head, Feet	11
Pump Materials:	
Impeller Casing	Cast Iron
Impeller	Cast Iron
Impeller Wear Ring	420 Stainless
Casing or Suction Head Wear Ring	420 Stainless Steel
Shaft	Steel, Gr 1045

Tag Numbers	50-PMP-121, 50-PMP-122, 50-PMP-123
Shaft Sleeve	Iron-Chromium Alloy
Pump Bearing Frame	Cast Iron
Driver Characteristics:	
Driver Type	Motor
Drive Arrangement	Horizontal, Coupled
Minimum Driver Horsepower	7.5
Maximum Driver rpm	1,200
Motor Characteristics (when motor is driver type):	
Inverter Duty Rated	Yes
Motor Voltage/Phases/Hertz	460/3/60
Enclosure Type	Note 1
Source Quality Control Testing:	
Test Witnessing	Not Witnessed
Performance Test Level	3
Vibration Test Level	3
Noise Test Level	3
Field Quality Control Testing:	
Performance Test Level	1
Vibration Test Level	1
Noise Test Level	1
Notes: (1) As required to meet the area classification as defined in Section 16050.	

END OF SECTION

SECTION 11312D

VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Pump systems including vertical turbine pumps with radial, mixed flow, or axial (propeller) type impellers and drivers as scheduled.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01610 - Project Design Criteria.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 09960 - High-Performance Coatings.
      e. Section 15050 - Common Work Results for Mechanical Equipment.
      f. Section 15958 - Mechanical Equipment Testing.
      g. Section 16222 - Low Voltage Motors up to 500 Horsepower.

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.

C. American Water Works Association (AWWA):
   1. C205 - Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 In. (100 mm) and Larger-Shop Applied.

D. ASTM International (ASTM):
   1. A 48 - Standard Specification for Gray Iron Castings.
   2. A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. A 108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished.
   4. A 276 - Standard Specification for Stainless Steel Bars and Shapes.

5. A 278 - Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F (350°C).
6. A 283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
7. A 516 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate-and Lower-Temperature Service.
8. A 582 - Standard Specification for Free-Machining Stainless Steel Bars.
9. A 743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
10. B 148 - Standard Specification for Aluminum Bronze Sand Castings.
11. B 505 - Standard Specification for Copper Alloy Continuous Castings.
12. B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
13. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
14. F 594 - Standard Specification for Stainless Steel Nuts.

E. Hydraulic Institute (HI):
1. 2.1-2.2 - Vertical Pumps for Nomenclature and Definitions.
2. 2.3 - Vertical Pumps for Design and Application.
3. 2.4 - Vertical Pumps for Installation Operation and Maintenance.
4. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, and Sound Measurement and Decontamination.
5. 14.6 - Rotodynamic Pumps For Hydraulic Performance Acceptance Tests.

F. International Standards Organization (ISO):
1. ISO 9001 Certified.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 2.1-2.2, 2.3, 9.1-9.5, and 14.6 and as modified in the Specifications. The pump head and efficiency are evaluated at the outlet of the discharge head and include the net losses in the pump column and discharge.

B. Flow, head, efficiency, and motor horsepower specified in this Section are minimums unless stated otherwise.

C. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric.

D. Tolerances: This Section and related sections contain tolerances that may be more stringent than Hydraulic Institute Standard tolerances. Where tolerances are not mentioned, Hydraulic Institute Standards 2.1-2.2, 2.3, 2.4, and 9.1-9.5 shall apply.

1.04 SYSTEM DESCRIPTION

A. Components: Pump, driver, motors, and drive arrangements as specified or as scheduled with shafts, columns, barrels, intermediate bearings, seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as required for a complete and operational system.

B. Design requirements:
   1. Pump performance characteristics:
      a. As specified in the Pump Schedule.
      b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
      c. Pump curve shall be continuously rising throughout the design conditions listed in the pump schedule.
   2. Motor characteristics: As specified in the Pump Schedule.

1.05 SUBMITTALS

A. Submit as specified in Section 15050.

B. Torsional analysis: Submit as specified in Section 15050 when scheduled.

1.06 QUALITY ASSURANCE

A. General: As specified in Section 15050.

B. Provide pumps specified in this Section from same manufacturer. Require pump manufacturer to furnish and coordinate pump, driver, drive, and pump components including barrel/can as scheduled and to provide written installation and checkout requirements.

C. Pump manufacturer must be ISO 9001 certified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions as specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050.

1.11 MAINTENANCE

A. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

B. Spare parts: Deliver the following spare parts to OWNER; pack and label for storage
   1. Line shaft rubber bearings: 1 set for each type pump.
   2. Impeller and bowl wear rings: 1 set for each type of pump.
   3. Mechanical seal: 1 complete seal of each type.
   4. Motor/gear thrust bearing set: 1 for each type of pump.
   5. Motor radial bearing set: 1 for each size of motor (if specified).

6. Pump impeller/bowl assembly: 1 of each type supplied.
7. Line shaft: 1 length of each size and type.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
1. Ruhrpumpen; model as scheduled.
2. Peerless Pump; similar to scheduled model.
3. Flowserve; model as scheduled.

2.02 MATERIALS

A. General: Materials in the Pump Schedule shall be the type and grade as specified in this Section.

B. Cast iron: ASTM A 48, Class 30 minimum.

C. Nickel cast iron: ASTM A 48, minimum Class 30, cast iron with 3 percent nickel.

D. Gray iron casting: ASTM A 278, Class 30.

E. Iron-chromium alloy: ASTM A 743, Grade CA40; ASTM A 276, Type 420 Stainless Steel may be substituted; Brinell Hardness Number of 350 to 380.

F. Leaded tin bronze: ASTM B 505, Alloy C92700.

G. Bronze or high lead tin bronze: ASTM B 584, Alloy 93800.

H. Leaded red brass: ASTM B 584, Alloy C83600, leaded red brass.

I. 416 stainless: ASTM A 582, Type 416 Stainless Steel.

J. Neoprene: Polychloroprene rubber.

K. Steel: ASTM A 283, Grade D or ASTM A 516 Gr. 70.

L. Steel pipe: ASTM A 53, Grade B.

M. Aluminum bronze: ASTM B 148.

2.03 GENERAL PUMP CONSTRUCTION

A. Type: Industrial, heavy duty, vertical turbine, centrifugal type pumps meeting performance requirements and features as scheduled and as specified.

B. Discharge flange: ASME B16.1 or B16.5 drilled; rated for 1.2 times the pump shutoff head at 150 degrees Fahrenheit.

C. Discharge nozzles: Provide 1/2-inch NPT taps for pressure gauges; install nipple and gauge with block valve.

D. Bearings:
   1. Design driver/motor bearings to support the line shaft assembly and rated for ABMA L_{10} life of 40,000 hours at Design Rated Point flow and head in accordance with ABMA 9 or ABMA 11.
   2. Design motor to withstand continuous duty full load thrust and momentary upthrust that may occur during pump on/off or other operations.

E. Fasteners: Provide Type 316 stainless steel fasteners in accordance with ASTM F 593 or ASTM F 594.

2.04 PUMP SUCTION ASSEMBLY

A. Pump suction assembly: Provide suction bell. Provide anti-vortex baffles and strainer when scheduled.

B. Design suction bells and provide strainers and anti-vortex baffles to minimize solids plugging and vortexing. Screens to have a flow area at least 4 times the suction pipe area.

C. Materials:
   1. Pump suction bell: As scheduled.
   2. Anti-vortex baffles: Same material as scheduled for pump suction bell.
   3. Pump suction bell bearing: As scheduled.
   4. Pump suction strainer: When strainer scheduled, provide Type 316 stainless steel.

2.05 PUMP IMPELLER BOWL ASSEMBLIES

A. Pump impeller assembly:
   1. Type: As scheduled.
   2. Maximum number of vanes: As scheduled.
   3. Number of stages: As scheduled.
   4. Required balance: As specified in Section 15050 to meet vibration criteria as specified in Section 15958.
   5. Method of securing impellers to shafts: Keyed and secured by a bronze nut locked in place or locked by other methods acceptable to the ENGINEER. Provide any special tools required for removal and installation of pump impellers.
   6. Provisions for adjustment of axial clearance: Make such adjustment through use of motor adjusting nut or adjustable coupling.
   7. Impeller thrust: When appropriate for the specified impeller type, provide hydraulically balanced impeller to minimize down thrust.

B. Intermediate and discharge impeller cases:
   1. Material: As scheduled.
   2. Attached with bolting.

C. Pump impeller bowl bearings: Provide bearing for each impeller; material as scheduled.

D. Diffusion vanes: Provide vanes cast into bowl.

E. Suction bowl bearings:
   1. Provide bronze sleeved bearings with self-contained lubrication system filled with graphite type non-soluble grease when grease lubrication scheduled; provide bearing with sand cap.

F. Design with smooth water passages to reduce clogging by stringy or fibrous materials on impellers or shafting.

G. Design replaceable wear rings for both the bowl and impeller on each impeller bowl.

H. Design capable of passing solids with a sphere size as scheduled or larger.

2.06 LINE SHAFTS

A. Provide line shaft type and lubrication type as scheduled and as specified in this Section.

B. Open line shaft, product lubricated:
   1. Shaft and couplings:
      a. Provide keyed shaft type mechanical couplings with key or set screw locking of shaft couplings.
      b. Shaft threaded connections are not allowed.
   2. Bearings and bearing retainers: Provide bearings and retainers spaced as scheduled, but not to exceed 10 feet; provide at least 1 bearing for each line shaft length; provide grease fitting for top bearing extended to outside any guards when grease lubrication specified.
   3. Materials:
      a. Shaft and couplings: As scheduled; where hard faced steel shaft is specified, hard face at sleeve bearings to 550 Brinell minimum.
      b. Bearings and bearing retainers: As scheduled; when not scheduled, Neoprene rubber bearings with ASTM B 584, Alloy C93800, leaded tin bronze retainers.

C. Enclosed line shaft, oil lubricated:
   1. Shaft and couplings: Provide flanged shaft couplings with key or set screw locking of shaft couplings.
   2. Shaft bearings and spiders: Provide bearings and retainers as scheduled, but not to exceed 10 feet; provide oil reservoir volume for 3 days continuous use.
   3. Enclosing tube: Pipe, thickness as scheduled.
   4. Materials: As scheduled; when not scheduled provide:
      a. Shaft and couplings: ASTM A 108, Grade 1045 steel with ASTM A 276, Type 316 hardened stainless steel journal or sleeve at each bearing.
      b. Shaft bearings and spiders: ASTM B 584, Alloy C83600 leaded red brass bearings; Neoprene rubber spider on enclosing tube.
      c. Enclosing tube: Steel pipe, ASTM A 53, Grade B unless scheduled otherwise.

D. Design strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.

E. Resonant frequency: As specified in Sections 15050 and 15958.

F. Sleeves: Provide shafting with Type 316 stainless steel sleeve or hardened sleeves where shafts pass through bearings or stuffing boxes as scheduled; Brinell 550 or higher for hardened shaft; when the specified mechanical seals cannot be installed on a hardened shaft, hardened shafts are not required in the area of the mechanical seal.

G. Design pump line shafting in interchangeable lengths as scheduled, but not to exceed 10 feet; shaft lengths to match scheduled pump column lengths.

H. Coupling strength: Design driver to pump line shaft coupling of sufficient length and strength to maintain line shaft alignment.

I. Adjustment:
   1. Design a means to adjust shaft position to adjust impeller position.
   2. For motor driven units with solid shaft motors, design driver to pump line shaft coupling to allow adjustment of the impeller position.
   3. For motor driven units with hollow shafts, an adjusting nut may be provided at the top of the motor shaft.

J. Spacer coupling: When mechanical seals are scheduled, provide an adjustable spacer coupling to allow removal of the seal without driver removal.

2.07 PUMP COLUMN PIPE

A. Pump column pipe: Thickness and material as scheduled.

B. Head connection: Design with flanged and bolted connection to discharge head and flanged and bolted connection to impeller assembly to permit removal of impeller bowl assembly without disturbing the column or discharge connections.

C. Design Working Pressure: Design to withstand a design working pressure not less than 1.20 times the maximum shutoff total dynamic head with the maximum diameter impeller at the maximum operating speed plus the maximum suction static head.

D. Pressure test: Design to withstand a 5 minute hydrostatic test pressure not less than 1.5 times the design working pressure; perform test at source.

E. Lengths and connections: Design with maximum 10 foot length, or less if scheduled, interchangeable column sections with flanged or threaded with registered fit screwed connections as scheduled.

F. Diameter: Design column inside diameter for no more than 4 feet of fluid friction loss per 100 feet of column length.

2.08 PUMP BARREL/CAN

A. Pump barrel/can: Pipe thickness and material as scheduled and shall be provided by manufacturer; inlet as indicated on the Drawings.

B. Mounting flange: Sufficient strength and thickness to withstand 1.5 times the imposed loads under any operating condition.

C. Can lining: When scheduled, provide cement mortar lining in accordance with AWWA C205.

D. Can diameter: Provide can diameter so that free flow cross-sectional area in the can after lining or coating is at least 10 percent more than the can inlet nozzle flow area.

2.09 PUMP DISCHARGE HEAD ASSEMBLY

A. Design the discharge head for above or base discharge as scheduled.

B. Design the discharge vertical to horizontal flow transition as a smooth pipe elbow or from a minimum of 3 pipe pieces mitered to form the elbow.

C. Design discharge head to mate with the driver as scheduled.

D. Head and base plate construction: Sufficient strength, weight, and thickness to provide accurate alignment, prevent excessive deflection and support the drive motor.

E. Stuffing box and seal:
   1. Design the discharge head with a stuffing box to accommodate packing or mechanical seals as scheduled.
   2. Packing: When packing scheduled, provide stuffing box arranged for packing (sized for bronze lantern ring and 6 packing rings minimum); provide hollow shaft motor with top adjusting nut.
   3. Mechanical seal: When scheduled, provide stuffing box suitable for the specified seal and provide solid shaft motor with spacer coupling.
   4. Additional seal or packing requirements: As specified in Section 15050.
   5. Drain: Provide drain, minimum 3/4 inch size, for pump stuffing box leakage, together with drain line to the pump can or wet well or to nearest equipment drain as indicated on the Drawings.

F. Discharge vent: Provide 3/4 inch NPT threaded high point vent on discharge; install pipe nipple with threaded gate valves in vent.

G. Materials: As scheduled; when not scheduled, provide:
   1. Pump discharge head/driver stand: Steel, ASTM A 283, Grade B and/or ASTM A 53, Grade B; or Cast iron, ASTM A 48, Class 30 minimum.
   2. Pump discharge head sleeve bearing: ASTM B 584, Alloy C93800, high lead tin bronze.
   3. Stuffing box and seal: Container and gland, Cast iron, ASTM A 48, Class 30 minimum; Neoprene top shaft seal.

2.10 EQUIPMENT GUARDS

A. Provide equipment safety guards as specified in Section 15050.

2.11 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
      c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors: Provide motors as specified in Section 16222 and as specified in this Section:
   1. RPM: As scheduled:
   2. Enclosure: As scheduled.
   3. Electrical characteristics: As scheduled.
   4. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222.
   5. Motor accessories: As specified in Section 16222 and in this Section.
   6. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive.

C. Other drivers: As scheduled and as specified in Sections listed in the Schedule.

D. Non-reverse ratchets: When scheduled, provide driver with nonreverse ratchets or pin mechanism to prevent reverse rotation of the pump and driver in the event of discharge valve failure.

2.12 SUPPORTS

A. Strength: Design pump discharge head and driver (motor or engine) supports to withstand a minimum of 1.5 times the maximum imposed operating loads or the imposed seismic loads, whichever is greater.

B. Resonant frequency: Design supports in conjunction with the pump, shafting, drivers, bearings, and other components to avoid natural resonant frequencies, either torsional, radial, or axial as specified in Section 15958.

C. Coordinate pump and drive system supports with the foundation designs as indicated on the Drawings.

2.13 FINISHES

A. Prepare surfaces and apply protective coatings as specified in Section 09960.

2.14 SOURCE QUALITY CONTROL

A. Witnessing: Source or factory testing shall be witnessed by the ENGINEER or OWNER when scheduled; provide advanced notice of source testing as specified in Section 15958.

B. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

C. Vibration test: Test level as scheduled; test as specified in Section 15958.

D. Noise test: Test level as scheduled; test as specified in Section 15958.

E. Motor factory tests: Test as specified in Section 16222.

F. Hydrostatic pressure tests: As specified for components in this Section.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Section 15050.

3.02 FIELD QUALITY CONTROL

A. Witnessing: All field-testing shall be witnessed by the ENGINEER; provide advanced notice of field-testing as specified in Section 15958.

B. Inspection and checkout: As specified in Sections 15050 and 15958.

C. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

D. Vibration test: Test level as scheduled; test as specified in Section 15958.

E. Noise test: Test level as scheduled; test as specified in Section 15958.

F. Operational testing: As specified in Section 01660.

3.03 MANUFACTURER'S FIELD SERVICES

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and in Sections 15050 and 15958.

B. Training: As specified in Section 01660.

3.04 PUMP SCHEDULE

Tag Numbers	**40-PMP-301, 40-PMP-302, 40-PMP-303, 40-PMP-304**
General Characteristics:	
Service	Plant Effluent
Quantity	4
First Named Manufacturer's Model Number	12B-90

Tag Numbers	40-PMP-301, 40-PMP-302, 40-PMP-303, 40-PMP-304
Maximum Noise, dBA at 3 feet	85
Torsional Analysis	Required
Minimum Pumped Fluid Degrees Fahrenheit	50
Normal Pumped Fluid Degrees Fahrenheit	70
Maximum Pumped Fluid Degrees Fahrenheit	85
Pump Characteristics:	
Number of Stages	5
Impeller Type	Enclosed
Pump Impeller Bowl Bearing Lubrication	Grease
Suction Bowl Bearing Lubrication	Grease
Suction Strainer	Required
Anti-Vortex Baffle	Required
Line Shaft Type	Open
Minimum Line Shaft Bearing Spacing, Feet	10
Line Shaft Lubrication	Product
Discharge Shaft Seal Type	Single Mechanical
Column Connection Type	Flanged
Maximum Column Section Lengths, Feet	10
Pump Barrel or Can	Required
Discharge Arrangement	Above
Coupling Type	Spacer
Speed Control	Fixed
Maximum Pump rpm	1,800
Rated Design Point (at Maximum Revolutions per Minute):	
Flow, gpm	850
Head, Feet	277
Minimum Efficiency, Percent	82
Required Condition 2 (at Maximum Revolutions per Minute):	
Flow, gpm	605
Head Range, Feet	335-340
Minimum Efficiency, Percent	77

Tag Numbers	40-PMP-301, 40-PMP-302, 40-PMP-303, 40-PMP-304
Required Condition 3 (at Maximum Revolutions per Minute):	
Flow, gpm	755
Head Range, Feet	305-315
Minimum Efficiency, Percent	82
Required Condition 4 (at Maximum Revolutions per Minute):	
Flow, gpm	900
Head Range, Feet	260-270
Minimum Efficiency, Percent	82
Required Condition 5 (at Maximum Revolutions per Minute):	
Flow, gpm	1,050
Head Range, Feet	205-215
Minimum Efficiency, Percent	75
Other Conditions:	
Shut Off Head, Feet	390
Maximum NPSHr at every Specified Flow, Feet	12
Minimum NPSHa at every Specified Flow, Feet	20
Minimum Suction Static Head, Feet	41
Maximum Suction Static Head, Feet	50
Pump Materials:	
Suction Bell	Cast Iron
Suction Bell Bearing	High Lead Tin Bronze
Impeller Cases	Bronze
Impeller	Bronze
Impeller Bearing	Bronze
Impeller Shaft Key	Steel
Line Shaft and Coupling	Type 416 Stainless Steel
Line Shaft Bearings	Neoprene
Shaft Enclosing Tube	Schedule 40 Steel Pipe
Shaft Sleeve	Hardened
Can Material and Thickness, Inch or Schedule	Steel Pipe, 0.5
Can Lining	Epoxy
Discharge Head/Driver Stand	Steel

Tag Numbers	40-PMP-301, 40-PMP-302, 40-PMP-303, 40-PMP-304
Discharge Head Bearing	Bronze
Discharge Stuffing Box	Cast Iron
Driver Characteristics:	
Driver Type	Motor
Drive Arrangement	Vertical, Coupled
Non-Reverse Ratchets	Required
Minimum Driver Horsepower	100
Maximum Driver rpm	1,800
Motor Characteristics (when motor is driver type):	
Inverter Duty Rated	Yes
Motor Voltage/Phases/Hertz	460/3/60
Enclosure Type	TEFC
Source Quality Control Testing:	
Test Witnessing	Not Witnessed
Performance Test Level	2
Vibration Test Level	1
Noise Test Level	1
Field Quality Control Testing:	
Performance Test Level	2
Vibration Test Level	1
Noise Test Level	1

END OF SECTION

SECTION 11312I

PROGRESSING CAVITY PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Rotary, positive displacement, Moineau principal, single-screw, progressing-cavity-type pumps with drivers and specified components for the following areas.

Tag Number	Service	Location
50-PMP-423, 50- PMP-427	Thickened Waste Activated Sludge	Sludge Storage Tanks

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01140 - Work Restrictions.
   b. Section 01600 - Product Requirements.
   c. Section 01612 - Seismic Design Criteria.
   d. Section 01660 - Testing, Training, and Commissioning.
   e. Section 09960 - Coatings.
   f. Section 15050 - Basic Mechanical Materials and Methods.
   g. Section 15052 - Basic Piping Materials and Methods.
   h. Section 15958 - Mechanical Equipment Testing.
   i. Section 16222 - Motors.
   j. Section 16262 - Variable Frequency Drives Below 100 Horsepower.
   k. Section 17100 - Control Strategies.

C. Inclusion of a specific manufacturer's name in the specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the Specifications.

D. CONTRACTOR shall indicate specific manufacturer and type of shaft/rotor connection to be provided in Bid Sheets. Substitution of connection types other than those specified herein for each manufacturer shall not be allowed.

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Gear Manufacturers Association (AGMA):
   1. AGMA 2001-B88 - Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
   2. AGMA 6001-B89 - Design and Selection of Components for Enclosed Gear Drives.
   3. AGMA 6010-E88 - Spur, Helical, Herringbone, and Bevel Enclosed Drives.

C. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
   2. B16.5 - Pipe Flanges and Flanged Fittings.

D. American Society for Testing and Materials (ASTM):
   1. A 48 - Standard Specification for Gray Iron Castings.
   2. A 108 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
   3. A 276 - Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes.
   4. A 283 - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   5. A 576 - Standard Specification for Steel Bars, Carbon, Hot Wrought, Special Quality.
   6. A 681 - Standard Specification for Tool Steels Alloy.
   7. A 743 - Standard Specification for Castings, Iron-Chromium, Iron-Nickel, Corrosion Resistant, for General Application.
   8. E 10 - Test Method for Brinell Hardness of Metallic Materials.

E. American National Standards Institute/Hydraulic Institute (ANSI/HI):
   1. 3.1 - Rotary Pumps - Nomenclature, Definitions, Application, and Operation.
   2. 3.6 - Rotary Pump Tests.
   3. 9.1 - Pumps - General Guidelines for Types, Definitions, Application, and Sound Measurement.

1.03 DEFINITIONS

A. Pump Head (Total Dynamic Head, TDH), Flow Capacity, Pump Efficiency, Net Positive Suction Head available (NPSHa), and Net Positive Suction Head Required (NPSHr): As defined in ANSI/HI 3.1-3.5, 3.6, and 9.1-9.5 and as modified in the Specifications.

B. Suction Head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.

1.04 SYSTEM DESCRIPTION

A. Pump Type and Components: Rotary, positive displacement, Moineau principle, single-screw, progressing-cavity-type pumps with components. System includes pump, motor or other driver, run-dry protection drive arrangements, seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves,

gauges, taps, lifting eyes, stands, and other items as required for a complete and operational system.

B. Design Requirements:
   1. Pump Performance Characteristics:
      a. As specified in the Pump Schedule.
      b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
   2. Motor Characteristics: As specified in the Pump Schedule and per Section 16222.

1.05 SUBMITTALS

A. Shop Drawings: Submit as specified in Section 15050 and include the following:
   1. Make, model, and weight of each equipment assembly.
   2. Complete catalog information, descriptive literature, specifications, and materials of construction.
   3. Detailed structural and mechanical drawings showing the equipment dimensions, size, and installation.
   4. Process data and design calculations including performance curves, operating points, head, NPSH, and flow curves.
   5. Factory protective coatings.
   6. Anchor bolt calculations and mounting details for each equipment assembly as required by Sections 01612 and 15050.
   7. Motor and electrical information as specified in Section 16222, including, but not limited to, full load current and locked rotor current.
   8. Details of storage and off loading requirements.
   9. Sample warranty.

B. Quality Control Submittals:
   1. Factory functional test report.
   2. Field performance test report.
   3. Certificate of Installation.
   4. Manufacturer's installation manuals.
   5. Equipment testing information as required by Section 15958.

C. Torsional Analysis: Submit as specified in Section 15050 when scheduled below.

D. Certificates as required by Sections 15050 and 15958.

E. Operation and Maintenance Manual as required by Section 15050.

F. Warranties.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Provide pumps in this section from same manufacturer.

C. Require pump manufacturer to furnish pump and to coordinate pump, driver, drive, and pump components as specified and scheduled and to provide written installation and checkout requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with Sections 01600 and 15050.

1.08 PROJECT CONDITIONS

A. Environmental Requirements: As specified in Section 15050.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions as specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050 unless noted otherwise.

B. Warrant equipment free of defects in material and workmanship for two years from the date specified in Section 15050. Warranty shall cover parts and labor.
   1. Warrant the drive mechanism, which transmits torque from the drive shaft to the rotor for 5 years. This guarantee shall cover the standard warranty listed above, plus any wear on the drive mechanism. The responsible manufacturer shall replace the drive mechanism deemed by the manufacturer to be defective or worn without cost to the OWNER.

C. Manufacturer's warranty shall be issued in the OWNER's name.

1.11 MAINTENANCE

A. As specified in Section 15050.

B. Special Tools: Deliver one set for each furnished pump type and size needed to assemble and disassemble pump system.

C. Spare Parts: Deliver the following as specified in Section 01600:
   1. Pump Thrust Bearing Set.
   2. Pump Radial Bearing Set.
   3. Stators: One every type.
   4. Shaft Coupling or U-joint: Two every size and type.
   5. Motor Bearing Set(s): One every type.
   6. Pump Rotor: One every type.
   7. Mechanical Seal: One every size and type.
   8. Drive Belts: Complete set for every size provided.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pumps: One of the following, or equal:
   1. Moyno Industrial Products Division of Robbins & Meyers, Inc.: Model Series 2000.
   2. NETZSCH, Inc.: Model Series NM.

2.02 MATERIALS

A. General: Materials in the Pump Schedule shall be the type and grade as specified in this Section.

B. Cast Iron: ASTM A 48, Class 30 minimum.

C. Buna-N: Synthetic rubber with a minimum Durometer hardness of 68 per ASTM D 2240 test methods.

D. Tool Steel: ASTM A 681, with 0.020-inch minimum chrome plating thickness oversized and finish to Rockwell hardness of not less than C58.

E. Stainless Steel: ASTM A 276 or AISI 316L.

F. Structural Steel: ASTM A 283, Grade D, or ASTM A36.

2.03 PUMP CASINGS

A. Construction: Material as scheduled of sufficient strength, weight, and thickness to provide accurate alignment and prevent excessive deflection.

B. Housing Cover Plates: Two on suction housing, one on each side for access to rotor and shaft ends without otherwise dismantling the pump.

C. Design Working Pressure: Not less than the maximum of 1.25 times the Rated Design Point head or 1.1 times the maximum discharge pressure at the maximum revolutions per minute in vendor-published information for the specified model.

D. Hydrostatic Test: 5-minute hydrostatic test; minimum 1.5 times Design Working Pressure.

E. Suction and Discharge Piping Connections: Flanged meeting ANSI/ASME B 16.1, Class 125, or ANSI/ASME B 16.5, Class 150; provide higher pressure class as required to meet Design Working Pressure. Configuration of pipe connections as indicated on the Drawings.

F. Vent and Taps: Provide casings with both 3/4-inch National Pipe Thread (NPT) high-point vent and low-point drain taps.

2.04 STATOR AND ROTOR

A. Stages: As scheduled.

B. Materials: As scheduled.

C. Stator Removal: Removable for maintenance replacement.

D. Rotation: As determined by manufacturer.

E. Balance: As specified in Section 15050 to meet the vibration criteria as specified in Section 15958.

2.05 DRY RUN PROTECTION

A. Provide stator run dry protection for all supplied pumps.
   1. Run dry protection shall be provided for the pump stator through the measurement of temperature at the stator/rotor interface. The temperature run dry protection shall shut down the pump upon high temperature before stator damage occurs.
   2. As part of the run dry protection package, provide thermistor, thermowell drilled and tapped into pump stator, explosion proof connection head, and NEMA 1 controller to monitor temperature of the stator.
      a. Connection head for polymer pumps shall be PVC. For all other pumps, connection head shall be aluminum.
      b. Controller shall have dual display simultaneously indicating stator temperature and alarm setpoint.
      c. Controller shall include fault output for remote monitoring.
      d. Controller shall be mounted within a dedicated NEMA 4X enclosure.
         1) NEMA 4X enclosure shall be provided by manufacturer and to be installed where indicated on the Drawings.
   3. Provide relay to allow annunciation of a high stator temperature (fail) alarm if the temperature reaches an adjustable preset temperature. Setpoint for alarm condition shall be set in the field per manufacturer’s recommendations.
   4. Electrical characteristic: 120 volts, single phase, 60 Hertz.

2.06 DRIVE SHAFTS

A. Type:
   1. Moyno Industrial Products Division of Robbins & Meyers, Inc., Model Series 2000: Hollow shaft.
   2. NETZSCH, Inc., Model Series NM: Solid shaft.

B. Moyno Industrial Products Division of Robbins & Meyers, Inc., Model Series 2000:
   1. Shaft-Rotor Connections:
      a. Hollow shaft shall be rigidly connected to the rotor through a connecting rod and grease lubricated, gear type U-joint. Pin joints are not acceptable.
      b. Shaft turned and polished.
   2. Material: Tool Steel.
   3. Joint shall be guaranteed for a minimum of 10,000 hours of operation.
   4. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads, and of ample strength and stiffness to operate without distortion or vibration which may reduce pump life at normal speeds as shown in the manufacturer's literature.
   5. Resonant Frequency: As specified in Sections 15050 and 15958.
   6. Shaft Connecting Rod: Design to limit operating angle to within 1-degree angular deflection.

C. NETZSCH, Inc., Model Series NM:
   1. Shaft-Rotor Connections:
      a. Solid shaft shall be rigidly connected to the rotor through a connecting rod and grease lubricated, gear type U-joint. Pin joints are not acceptable.
      b. Shaft turned and polished.
   2. Material: Tool Steel.

3. Joint shall be guaranteed for a minimum of 10,000 hours of operation.
4. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads, and of ample strength and stiffness to operate without distortion or vibration which may reduce pump life at normal speeds as shown in the manufacturer's literature.
5. Resonant Frequency: As specified in Sections 15050 and 15958.
6. Shaft Connecting Rod: Design to limit operating angle to within 1-degree angular deflection.

D. Pin shaft joints or flexible shafts will not be accepted.

2.07 BEARINGS AND BEARING FRAME

A. Materials:
1. Pump Bearing Frame: As scheduled.

B. Bearing Type: Mount shaft in two sets of antifriction tapered roller bearings or radial ball bearings meeting ABMA standards and adequate to withstand radial or axial thrust forces and complying with following:
1. Inboard Set: Single.
2. Outboard Set: Dual.
3. Shaft Expansion: Make provisions in shaft and bearing mounting to prevent distortion of shaft due to temperature expansion.

C. Bearing Lubrication: Grease with external grease fittings.
1. Size sufficiently to safely absorb heat energy normally generated in bearing under maximum ambient temperature of 60 degrees C.
2. Equip with grease relief pipe.

D. Bearing Life: Minimum L10 life of 100,000 hours at rated design point or 24,000 hours in accordance with ABMA 9 or 11 at bearing design load imposed by pump shutoff with scheduled stages at rated speed, whichever provides longest bearing life in intended service.

2.08 SHAFT STUFFING BOX

A. Size: As specified in Section 15050.

B. Materials: Same as pump casing.

C. Shaft Seal Type: As scheduled and as specified in Section 15050.

D. Drain Size: Minimum 3/4 inch with drain line routed to nearest equipment floor drain.

2.09 COUPLINGS

A. Types: When driver or gear coupled to pump, provide flexible coupling as specified in Section 15050.

B. Flexible Coupling Life: Infinite at up to 0.30-degree misalignment angle total or per disk for disk type at maximum operating loads.

C. Design coupling to withstand a minimum of 1.5 times the maximum operating torque and other imposed loads.

2.10 SUPPORTS, PEDESTALS, AND BASEPLATES

A. Pump Base: Design a single-piece structural steel base and support system for the drive arrangement specified and as schematically indicated on the Drawings, in accordance with Section 15050.

B. Materials: Same as pump casing or ASTM A 283 steel, hot-dip galvanized after fabrication and coated as specified in Section 09960.

C. Pump and Driver Support Strength: Able to withstand minimum 1.5 times maximum imposed operating loads or imposed seismic loads, whichever is greater.

D. Configuration: Allow easy access to stuffing boxes, bearing frames, and suction housing and couplings; suction flange at least 2 inches above pump foundation; factory-mount pump and driver to baseplate.

E. Dimensions: Baseplate and pump length dimension based on the pump components and motor configurations specified herein and indicated on the Drawings shall not exceed the following:

Tag Number	Service	Location
50-PMP-423 and 50-PMP-427	Sludge Dewatering Feed	Sludge Storage Tanks

F. Motor Arrangement: As scheduled.
   1. For Overhead, Piggyback, or Side-Mounted Motor Arrangements: Provide motor base with slide rails to allow for adequate belt and alignment adjustment of pump and motor.
   2. When In-Line Motor Arrangement Scheduled:
      a. Motor centerline to coincide with pump centerline.
      b. Provide gearbox as needed to provide specified pump speed.
   3. When Piggyback or Overhead Motor Arrangement Scheduled:
      a. Support motor directly above pump centerline.
      b. Mount motor minimum of 6 inches above top of pump on structural frame.
   4. When Side-Mounted Motor Arrangement Scheduled:
      a. Mount side-mounted motors adjacent to pump, secured directly to baseplates.
      b. Provide side-mounted motors "left-handed" or “right-handed" as indicated on the Drawings.

2.11 SPEED REDUCERS

A. Gear Reducers (When Scheduled or Required for a Pump in this Section):
   1. Provide with NEMA C face connection between motor and gearbox.
   2. Provide helical reduction gears, rated for AGMA Class II service with a 1.5 service factor.
   3. Provide oil bath lubrication.
   4. As specified in Section 15050.

B. V-Belt Drives (When Scheduled or Required for a Pump in this Section):
   1. Design to transfer torque of installed drives.
   2. Limit speed reduction ratio to 5 to 1.
   3. As specified in Section 15050.

C. Combined Gear Reducers and V-Belt Drives:
   1. Provide for fixed speed pumps when scheduled pump speed exceeds 5-to-1 speed reduction ratio from driver speed.

2.12 EQUIPMENT GUARDS

A. Provide equipment safety guards as specified in Section 15050.

2.13 DRIVERS

A. Horsepower: As scheduled.

B. Motors: As scheduled and as specified in Sections 15050 and 16222. When VFDs are scheduled, provide inverter-duty motors in accordance with Section 16222 suitable for operation with VFDs.

C. Variable Frequency Drives (VFD): CONTRACTOR shall provide VFD when scheduled below, per Section 16262.
   1. Pump manufacturer shall coordinate with VFD manufacturer for compatibility.

D. Other Drivers: If scheduled, provide as specified in scheduled sections.

2.14 CONTROL SYSTEM

A. Provide a control system with equipment protective devices for safe operation, including dry run protection, in a local control panel and with remote inputs and outputs, as indicated on the Drawings, to provide control functions as specified in Section 17100.

2.15 FINISHES

A. Prepare surfaces and apply protective coatings as specified in Section 09960.

2.16 SOURCE QUALITY CONTROL

A. Witnessing: Source or factory testing shall be witnessed by the ENGINEER or OWNER when scheduled. Provide advance notice of source testing as specified in Section 15958.

B. Equipment Performance Test: Test level as scheduled. Test as specified in Section 15958.

C. Vibration Test: Test level as scheduled. Test as specified in accordance with Section 15958.

D. Noise Test: Test level as scheduled. Test as specified in accordance with Section 15958.

E. VFD and Motor Factory Tests: Test as specified in scheduled section.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Section 15050.

3.02 FIELD QUALITY CONTROL

A. Witnessing: All field testing shall be witnessed by the ENGINEER. Provide advance notice of field testing as specified in Sections 01660 and 15958.

B. Inspection and Check-Out: As specified in Sections 15050 and 15958.

C. Equipment Performance Test: Test level as scheduled; Test as specified in Section 15958.

D. Vibration Test: Test level as scheduled. Test as specified in Section 15958.

E. Noise Test: Test level as scheduled. Test as specified in Section 15958.

F. Operational Testing: As specified in Section 01660.

3.03 MANUFACTURER'S FIELD SERVICES

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and Sections 15050 and 15958.

B. Training: As specified in Section 01660.

3.04 PUMP SCHEDULE

Tag Numbers	**50-PMP-423 and 50-PMP-427**
General Characteristics:	
Location	Sludge Storage Tanks
Service	Dewatering Feed
Quantity	2
Minimum Pumped Fluid Temperature, degrees F	50
Normal Pumped Fluid Temperature, degrees F	70
Maximum Pumped Fluid Temperature, degrees F	85
Percent Solids	5%

Tag Numbers	50-PMP-423 and 50-PMP-427
Pump Characteristics:	
Number of Rotor Sealing Stages	2
Bearing Lubrication	Grease
Shaft Seal Type	Cartridge Type Double Mechanical
Speed Control	VFD
Maximum Pump, rpm	200
Minimum Pump, rpm	40
Rated Design Point (At Maximum Revolutions per Minute):	
Flow, gpm	110
Head, Feet	127
Required Condition 2 (Maximum Turndown by VFD):	
Flow, gpm	24
Head Range, Feet	NA
Other Conditions:	
Maximum NPSHr at Every Specified Flow, Feet	10
Pump Materials per Paragraph 2.02:	
Pump Casing	Cast Iron
Stator	Buna-N
Rotor	Tool Steel
Shaft	As specified in Article 2.06
Pump Bearing Frame	Cast Iron
Driver Characteristics:	
Driver Type	Motor with VFD
Drive Arrangement	Belt-Driven Side-Mount
Non-Reverse Ratchets	Required
Minimum Driver Horsepower	20
Maximum Driver Speed, rpm	1,200
Motor Characteristics (When Motor is Driver Type):	
Motor Specification Section	16222
Service Factor	1.15
Voltage/Phases/Hertz	460/3/60
NEMA Enclosure Type	TEFC
Winding Temperature Detector per Section 16222,	Required

Tag Numbers	50-PMP-423 and 50-PMP-427
Source Quality Control Testing:	
Test Witnessing	Not Witnessed
Performance Test Level	2
Vibration Test Level	1
Noise Test Level	1
Field Quality Control Testing:	
Performance Test Level	2
Vibration Test Level	2
Noise Test Level	1

END OF SECTION

SECTION 11312J

SUBMERSIBLE SUMP PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Packaged submersible sump pumps, with a control panel and instrumentation.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01600 - Product Requirements.
      c. Section 01610 - Project Design Criteria.
      d. Section 01660 - Testing, Training, and Commissioning.
      e. Section 09960 - High-Performance Coatings.
      f. Section 15050 - Common Work Results for Mechanical Equipment.
      g. Section 15958 - Mechanical Equipment Testing.
      h. Section 16412 - Low Voltage Molded Case Circuit Breakers.
      i. Section 17201 - Level Measurement – Switches.
      j. Section 17710 - Control Systems – Panels, Enclosures, and Panel Components.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A 48 - Standard Specification for Gray Iron Castings.
   2. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
   3. D 2000 - Standard Classification System for Rubber Products in Automotive Applications.

B. Hydraulic Institute (HI):
   1. 1.1-1.2 - Centrifugal Pumps for Nomenclature and Definitions.
   2. 1.3 - Rotodynamic (Centrifugal) Pumps for Design and Application.
   3. 9.1-9.5 - Pumps - General Guidelines for Types, Application, Definitions, Sound Measurement, and Documentation.
   4. 11.6 - Submersible Pump Tests.

C. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 DEFINITIONS

A. NEMA:
   1. Type 4X enclosures in accordance with NEMA 250.

B. Pump head (Total Dynamic Head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 9.1-9.5 and 11.6 and as modified in this Section.

C. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.

1.04 SYSTEM DESCRIPTION

A. Components: Overhung impeller, close coupled, single stage, volute style, end suction submersible sewage pump. Other items include: Control panel, level control instrumentation, discharge piping, necessary valves, gauges, taps, lifting eyes, stands, and other items as required for a complete and operational system.

B. Design requirements:
   1. Pump performance characteristics: As specified in the Pump Schedule, Pump Performance Characteristics:
      a. As specified in the Pump Schedule.
      b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
   2. Motor characteristics: As specified in the Pump Schedule.
   3. Suitable for pumping raw sewage.

1.05 SUBMITTALS

A. Submit as specified in Section 15050.

B. Calculations per Section 15050 are not required for pumps specified in this Section.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Provide pumps specified in this Section from same manufacturer.

C. Require pump manufacturer to furnish and coordinate pump, driver, and pump components as scheduled and to provide written installation and checkout requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050.

1.11 MAINTENANCE

A. Special tools: For each type or size of pump specified, provide 1 set of all special tools required for complete assembly or disassembly of the pump system components.

B. Spare parts: Deliver the following as specified in Section 01600:
   1. Mechanical seal set**.**

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pumps: One of the following or equal:
   1. Barnes. (Crane Pumps & Systems), SE series.
   2. ITT Goulds Pumps, WS series.
   3. Hydromatic, SKHS series.

2.02 MATERIALS

A. Cast Iron: ASTM A 48, Class 30 minimum

B. Stainless Steel: ASTM A 276 or equal.

C. Buna N: ASTM D 2000.

2.03 PUMP CASING

A. Material: Cast iron.

B. Design Working Pressure: 1.5 times the shutoff pressure.

C. Provide support legs on sump bottom and clearance for suction entrance.

D. The discharge connection shall be a 2 or 3-inch NPT vertical connection.

2.04 IMPELLERS

A. Material: Cast iron.

B. 2-vane; maximum enclosed; non-clogging; with pump-out vanes on backside; dynamically balanced; close coupled to motors.

C. Method of securing to shafts: Treaded lock nut or similar connection.

2.05 PUMP SHAFTS

A. Material: 400 series stainless steel.

2.06 BEARINGS

A. Upper bearing: Single row; oil lubricated.

B. Lower bearing: Single row; oil lubricated.

2.07 SHAFT SEAL

A. Single mechanical seal.

B. Materials:
   1. Silicon carbide versus silicon carbide seal faces
   2. Carbon versus ceramic seal faces.

C. Elastomer and hardware: Buna-N and 300 series stainless steel.

2.08 DRIVERS

A. Motors:
   1. NEMA B design, suitable for a Class 1, Division 1 area.
   2. Oil filled submersible motor.
   3. Insulation:
      a. 1.5 horsepower and above: Class B.
      b. Under 1.5 horsepower: Class F.
   4. Power: 230/460 volt, 3 phase, 60 hertz.
   5. 1.15 service factor.
   6. Pumps shall be able to operate continuously without exceeding pumps service capacity when immersed in water up to 104 degrees Fahrenheit
   7. Cable: Minimum length sump depth to the VCP, plus 15 feet, armored, waterproof cable securely attached to motors with watertight fittings.

2.09 ACCESSORIES

A. Chains or cables: Stainless steel; attached to balance point of pump; suitable for lifting pump from sump; long enough to extend from sump cover or grating.
   1. Hooks: Suitable to provide storage of chain or cable at top of sump.

2.10 FINISHES

A. Pump manufacturer to factory prime pump/motor as specified in Section 09960.

B. Contractor to provide field coatings as specified in Section 09960.

2.11 CONTROLS

A. General:
   1. Provide a vendor control panel at each installation for control of the pumps, except as indicated on the pump schedule.

B. Vendor control panel:
   1. Construction and components as specified in Section 17710.
   2. Enclosure:
      a. As indicated in the pump schedule.
   3. Electrical components:
      a. Main circuit breaker:
         1) As specified in Section 16412.
         2) Flange-mounted operator:
            a) Pad-lockable in the off position.
         3) Disconnects all power to the panel.
         4) Interlock with the panel door.
            a) Defeat mechanism.
      b. Motor starter for each pump:
         1) As specified in Section 16422.
         2) Motor circuit protector circuit breaker.
         3) Full voltage non-reversing magnetic starter.
         4) Thermal or electronic overloads.
      c. Control power transformer:
         1) Primary voltage: 230/460 VAC, 3 phase, 60 hertz.
         2) Secondary voltages:
            a) Control and status points to the facility SCADA system: 120 volt.
            b) Additional voltages as required by the application.
         3) Sized for all panel components plus 10 percent spare capacity.
         4) Primary and secondary fuses.
   4. Control components:
      a. Terminal strips:
         1) Provide terminal strips for landing all external wiring.
      b. Relays, timers, and other components as required providing the specified functionality and remote monitoring connections.
   5. Duplex operation
      a. Front Panel Controls:
         1) HAND/OFF/AUTO switch.
         2) START pushbutton for each pump.
         3) STOP pushbutton for each pump.
         4) LEAD-STANDBY selector switch which will permit operator selection of either Pump Number 1 or Pump Number 2 as the lead pump during automatic operation
         5) Momentary LOW LEVEL OVERRIDE pushbutton.
         6) Running pilot light for each pump.
         7) Stopped pilot light for each pump.
         8) Power pilot light.
         9) Pump fault pilot light for each pump.
         10) High-High level alarm.
      b. Remote monitoring:
         1) Provide dry relay contact outputs for the following:
            a) Pump Fault alarm: one for each pump.
            b) Pump Run status: each pump.
            c) High-High Level Alarm.
      c. Operation:
         1) Hand:
            a) The pump shall run when the START pushbutton is pressed.
            b) The pump shall stop when the STOP pushbutton is pressed

c) The LOW-level switch shall stop the pump.
d) The LOW-level and LOW-LOW level switches shall be over ridden by the momentary LOW LEVEL OVERRIDE pushbutton.

2) Off: Pump shall stop operation.
a) Placing the hand switch in the OFF position shall re-set all alarm conditions.

3) Auto: The pump shall operate automatically in response to level switch signals.
a) The lead pump shall start when the rising water level in the sump causes level switch HIGH-level switch to activate.
b) The lead pump shall stop when the falling water level in the sump causes level switch LOW-level switch to activate.
c) If the lead pump fault alarm is activated the standby pump shall replace the lead pump.
d) A high- high level shall cause the HIGH–HIGH level switch to activate and activate the HIGH–HIGH level alarm.
e) A low- low level shall cause the LOW–LOW level switch to activate and activate the LOW–LOW level alarm.

2.12 LEVEL SENSORS

A. Type: Ball float as specified in Section 17201.

B. Suitable for a Class 1, Division 1 area.

C. Cable Length: The length of the cable shall be equal to sump depth to the VCP plus 5 feet.

2.13 SOURCE QUALITY CONTROL

A. Inspection and checkout: As specified in Sections 15050 and 15958.

B. Equipment performance test: None required.

C. Vibration test: None required.

D. Noise test: None required.

E. Operational testing: As specified in Section 01660.

F. Witnessing: Not required.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install submersible sump pumps as specified in Section 15050.

3.02 FIELD QUALITY CONTROL

A. Inspection and checkout: As specified in Sections 15050 and 15958.

B. Equipment performance test: Level 1 Pump Test as specified in Section 15958.

C. Vibration test: None required.

D. Noise test: None required.

E. Operational testing: As specified in Section 01660.

3.03 MANUFACTURER'S FIELD SERVICE

A. Start-up: Inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up.

B. Training: As specified in Section 01660.

3.04 PUMP SCHEDULE

A. Pump characteristics:

Tag Numbers	50-PMP-419A 50-PMP-419B
Location	B. Sludge Storage Tanks
Service	Drainage
Pump Type	Duplex
Capacity, Each Pump, gpm	50 gpm
Total Dynamic Head (TDH), Feet	11 feet
Motor Horsepower	0.4 minimum
Minimum Shutoff Head, feet	20
Motor Speed, revolutions per minute	1,750 rpm
VCP Required	Yes
VCP Enclosure	Weatherproof, 316 Stainless Steel, suitable for a Class 1, Division 2 Group D area

END OF SECTION

SECTION 11312K

MEDIUM CAPACITY SUBMERSIBLE PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Submersible pump with features scheduled in the Pump Schedule.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01610 - Project Design Criteria.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 09960 - High-Performance Coatings.
      e. Section 15050 - Common Work Results for Mechanical Equipment.
      f. Section 15052 - Common Work Results for General Piping.
      g. Section 15958 - Mechanical Equipment Testing.
      h. Section 16222 - Low Voltage Motors up to 500 Horsepower.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.

B. ASTM International (ASTM):
   1. A 48 - Standard Specification for Gray Iron Castings.

C. Hydraulic Institute (ANSI/HI):
   1. 1.1-1.2 - Centrifugal Pumps for Nomenclature and Definitions.
   2. 1.3 - Rotodynamic (Centrifugal) Pumps for Design and Application.
   3. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, Sound Measurement, and Decontamination.
   4. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

D. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

E. Underwriters Laboratories, Inc.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in ANSI/HI.

B. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; when multiple suction pressure taps are used, average pressure shall be suction head regardless of variation in individual taps.

C. Tolerances: As stipulated in the listed ANSI/HI standards, unless specified more restrictively.

1.04 SYSTEM DESCRIPTIONS

A. Submersible sump pumps with components: Pumps, motors, base elbows, guide rails and lifting devices, electrical devices internal to pump housing, all submersible cabling for power and control conductors, and Vendor Control Panels (if scheduled), and other items as required for a complete and operational system.

B. Design requirements:
   1. Pump performance characteristics: Refer to Sump Pump Schedule appended to this Section.
   2. Motor characteristics: Refer to Sump Pump Schedule appended to this Section.

1.05 SUBMITTALS

A. Submit as specified in Section 15050.

B. Furnish motor submittals as specified in Section 16222.

C. Furnish control panel submittals as specified in Section 17710.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Single source responsibility: Pumps specified in this Section shall be by 1 manufacturer.

C. Require pump manufacturer to furnish and coordinate pump, driver, controls, lifting rails, and pump components as specified and scheduled and to provide written installation and checkout requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions as specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050.

1.11 MAINTENANCE

A. Special tools: Deliver 1 set of special tools required for complete assembly or disassembly of pump system components for each type or size of pump specified.

B. Spare parts: Pack and label the following for warehouse storage. Deliver to OWNER for each type or size of pump specified:
   1. Thrust bearing set.
   2. Radial bearing set.
   3. Mechanical seal: 1 each size and type.
   4. O-Ring set.
   5. Power cable entry seal set.
   6. Wear ring set (rotating and stationary).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Submersible Pumps; One of the following or equal:
   1. Flygt.
   2. ABS.

2.02 MATERIALS

A. General: When materials are referenced in this Section or on the pump schedule, the compositions shall be the UNS Alloys, Types, or Grades in this Article unless specified or scheduled otherwise.

B. Cast iron: ASTM A 48, Class 35 B minimum.

C. Nickel cast iron: ASTM A 48, Class 35 minimum with 3 percent nickel added.

D. Steel: ASTM A 108, Grade or UNS Alloy as specified or scheduled.

E. Stainless steel: ASTM A 276 or ASTM A 582, Type or UNS Alloy as specified or scheduled.

F. Bronze: ASTM B 505 or ASTM B 584, UNS Alloy C83600.

G. Zincless bronze: ASTM B 505 or ASTM B 584, Leaded Tin Bronze, UNS Alloy C92700.

H. Aluminum bronze: ASTM B 148, ASTM B 505 or ASTM B 584, UNS Alloy C95200.

I. Fasteners: Stainless steel, ASTM F 593 or ASTM F 594, type or grade as specified

2.03 GENERAL PUMP CONSTRUCTION

A. The pump shall be an overhung impeller, close coupled, single stage, volute style, end suction submersible unit, capable of handling raw unscreened sewage, storm water and other solids laden fluids with out clogging

2.04 PUMP AND MOTOR CASING

A. Type: Watertight, air filled.

B. Material: Cast Iron (minimum).

C. Design working pressure: Minimum 1.10 times maximum shutoff total dynamic head with maximum diameter impeller at maximum operating speed plus maximum suction static head or minimum 20 pounds per square inch gauge.

D. O-ring seals: Capable of sealing mated surfaces (major components) watertight; with the following features:
   1. Machined surfaces and grooves.
   2. O-ring contact on 4 surfaces and O-ring compression on 2 surfaces.
   3. Does not require specific fastener torque or tension to obtain watertight joint.
   4. Does not require secondary sealing compounds, gasket, grease, or other devices.

E. Testing: Perform 5-minute hydrostatic test of pump casing at minimum 1.5 times Design Working Pressure.

2.05 IMPELLERS

A. General
   1. Water passages: Smooth enough to prevent clogging by stringy or fibrous materials.
   2. Passage sizes: Large enough to pass solids with sphere size of 3 inches or smaller for motors larger than 2 horsepower.
   3. Casting: 1 piece, free of cracks and porosity.
   4. Balance vanes: On impeller back shrouds.
   5. Method for securing impeller to shafts:
      a. For pumps 5 horsepower and less, secured by bronze nut or allen head bolt locked in place, but readily removable without the use of special tools.
      b. For pumps greater than 5 horsepower, keyed to the shaft and secured by bronze nut or allen head bolt locked in place, but readily removable without the use of special tools

B. Rotation: As indicated on the Drawings; clockwise looking from top when not indicated.

C. Balance: As specified in Section 15050.

D. Vibration criteria: As specified in Section 15958.

E. Type: As specified in the Pump Schedule:
   1. Standard Impeller:
      a. Material: Cast Iron (minimum).
      b. Dynamically balanced, double shrouded, multi-vane, non-clog design.
   2. Flygt Supplied Pumps:
      a. N-Style Impeller:
         1) Material: Cast Iron, Class 35B.
         2) Dynamically balanced, semi-open, multi-vane, backswept, non-clog design.
         3) The impeller vane leading edges shall mechanically self clean as they pass a spiral groove on located on the volute section.
         4) Impeller vanes shall have a screw shaped leading edge hardened to Rockwell Rc 45.
   3. ABS Supplied Pumps:
      a. ContraBlock Style:
         1) Material: Cast Iron, Class 40.
         2) Dynamically balanced, semi-open, single-vane, non-clog design.
         3) The cast iron, Class 40 front plate shall be mounted to the volute by four stainless steel adjusting screws.
         4) The front plate shall be designed to with a wave shaped inlet and outward spiraling V-shaped groove on the impeller side.

2.06 WEAR RINGS

A. Provide one of the following systems:
   1. Wear ring system:
      a. General: Used to provide efficient sealing between the volute and suction inlet of the impeller.
      b. Volute wear ring:
         1) Material: Brass.
         2) Fitted to the volute inlet.
      c. Impeller wear ring:
         1) Material: Type 316 stainless steel.
         2) Heat-shrunk fitted onto the suction inlet of the impeller.
         3) Flyght N impeller: part of replaceable suction cover.
   2. Wear plate system:
      a. Material: Cast iron, ASTM A 48, Class 40, with a minimum Brinell Hardness of 250.
      b. Attached to the pump volute to prevent rotation.
      c. Replaceable and adjustable to maintain proper clearances between the wear plate and the impeller.

2.07 PUMP SHAFTS

A. Material: Type 420 stainless steel; turned, ground, and polished.

B. Features:
   1. Strength: Able to withstand minimum of 1.5 times maximum operating torque and other loads.
   2. Resonant frequency: As specified in Sections 15050 and 15958.
   3. Maximum deflection: Minimum 0.002 inches under operating conditions.

C. Tapered to fit at impeller with key and bolt for securing impeller.

D. Pump and motor shaft shall be a solid continuous shaft.

2.08 BEARINGS

A. Pump shaft shall rotate on a minimum of 2 permanently sealed, grease lubricated bearings:
   1. Upper bearing for radial forces shall be self-aligning spherical roller type.
   2. Lower bearing for combined axial and radial forces shall be angular contact ball type.

B. Bearing type: Anti-friction meeting ABMA standards.

C. Bearing lubrication system shall be sized to safely absorb heat energy normally generated in bearing under maximum ambient temperature of 60 degrees Celsius.

D. Bearing life: 1 of the following whichever provides longer bearing life in intended service:
   1. Minimum ABMA 9 or 11 L10 bearing life of 50,000 hours at rated design point.
   2. Minimum 24,000 hours at bearing design load imposed by pump shutoff with maximum sized impeller at rated speed.

2.09 SHAFT SEALS

A. Upper seal unit material: 1 stationary tungsten-carbide ring and 1 positively driven rotating carbon ring or tungsten-carbide ring.

B. Lower seal unit material: 1 stationary and 1 positively driven rotating tungsten-carbide ring.

C. Features:
   1. Tandem arrangement running in an oil chamber.
   2. Design oil chamber to ensure that air is left in the oil chamber to absorb the expansion of the oil due to temperature variations.
   3. Oil in oil chamber shall be FDA approved, paraffin type, colorless, odorless, and non-toxic.
   4. Independent spring system between seal interfaces able to withstand maximum suction submergences.
   5. Does not require pressure differential to effect sealing.
   6. Does not use pumped media for lubrication.
   7. Lower mechanical seal effectively lubricated from oil chamber housings.
   8. Not damaged when pump is run dry (unsubmerged) for extended periods.
   9. Springs and other hardware: Stainless steel, 300 or 400 series.

2.10 DISCHARGE BASE AND ELBOW

A. Materials: Same as pump casing.

B. Features:
   1. Structurally capable of firmly supporting guide rails, discharge piping, and pumping unit under operating conditions.
   2. 1 or more integral support legs or pads with bolting to sump floor provisions.

3. Incorporates 90 degree flanged elbow that receives horizontal flow from pump and discharges flow vertically.
4. Discharge interface:
   a. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact.
   b. Self-aligning without having to enter the wet well.
   c. Discharge elbow to mate to pump discharge and transition to discharge piping.

2.11 GUIDE RAILS, BRACKETS, FASTENERS, AND LIFTING CHAIN FOR EACH PUMP

A. Material: Type 316 stainless steel, with the following features:
   1. Dual pipes or dual rails that extend from discharge base to upper bracket unless scheduled otherwise.
   2. Rail wall thickness sufficient to suspend pump unit between brackets plus minimum 50 percent safety factor.
   3. Sized to fit discharge base and sliding bracket of pump.
   4. Integral, self-aligning, guide rail sliding brackets that seal pump to discharge base under operating conditions.
   5. Upper guide rail bracket.
   6. Intermediate guide rail brackets where indicated on the Drawings or at 10-foot maximum intervals.
   7. Lifting chain of sufficient strength and length to permit safe removal of pump unit from sump.
   8. Cable/chain holder to hold chain at top of sump.

2.12 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
      c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors:
   1. Revolutions per minute: As scheduled:
   2. Enclosure: As scheduled.
   3. Electrical characteristics: As scheduled.

C. Motor Construction
   1. Squirrel cage induction motor, shell type design.
   2. If explosion proof motor is scheduled, provide motor that is UL or FM listed for NEC Class 1, Division 1, Groups C and D service, whether submerged or unsubmerged.
   3. NEMA design type: B.

4. Motor insulation, either one:
    a. Class F, moisture resistant, rated for 155 degrees Celsius.
    b. Class H, moisture resistant, rated for 185 degrees Celsius.
5. The motor shall be designed for continuous duty handling pumped media of 40 degrees Celsius and capable of a minimum of 15 evenly spaced starts per hour.
6. The motor shall be capable of continuous operation under load with the motor submerged, partially submerged, or exposed, without derating the motor.
7. Motor cooling, one of the following:
    a. Motor cooled by the surrounding media.
    b. Cooling jacket:
        1) Non-clogging ports and channels that use pumped fluid as the cooling media.
        2) Functional with motor submerged, partially submerged, or exposed.
        3) Provide capability to relieve entrapped air from the system.
    c. Spray systems, air moving equipment or other secondary cooling systems are not acceptable.
8. Motor sealing: Design motor case and seals to withstand 65 feet of submergence.
9. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive. Other drivers: As scheduled and as specified in sections listed in the Schedule.

D. Power and Control Cables:
1. Submersible to same water depth as motor casing.
2. Type SPC with Hypalon/Buna N or chloroprene rubber jacket.
3. Insulation rated for 90 degrees Celsius.
4. Non-wicking fillers.
5. Length: Sufficient to connect to surface junction box (without the need of splices) as indicated on the Drawings or 30 feet, whichever is greater.
6. All power and control conductors shall terminate at terminal blocks in the local control panel or junction box.
7. Sized in accordance with NEC, ICEA, and CSA specifications.
8. Provide stainless steel cable and stainless steel wire braid sleeve to support power cable from underside of wet well roof slab or access frame.

E. Cable Entry/Junction Chamber:
1. Cable entry seal design shall not require specific torque requirements to ensure a watertight and submersible seal.
2. Cable entry seal shall consist of a single cylindrical elastomer grommet, flanked by stainless steel washers.
3. The entry body shall perform compression and strain relief that is separate from the sealing function.
4. The cable entry junction chamber shall be separate from the motor chamber to prevent foreign material from gaining access to the motor interior through the top of the pump.

F. Control/Protection Module:
   1. Each pump shall be supplied with its own self-contained control/protection module to provide for the direct connection to all internal pump monitoring devices, including:
      a. Thermal protection: Provide automatic reset motor stator temperature detectors, 1 switch in each phase winding. If any detector is activated, the sensor shall activate an alarm and shut down the motor. The thermal detectors shall activate when the stator temperature exceeds 125 degrees Celsius.
      b. Moisture detection: one of the following:
         1) Provide capacitive type leakage sensor for the detection of water in the oil chamber or a moisture sensor in the lower motor chamber to detect any fluid in the motor. The sensor shall have an explosion proof rating.
         2) Provide a small float to detect the presence of water in the stator chamber.
   2. The module shall signal an alarm condition if any of the internal monitoring devices is activated.
   3. Install module in all manufacturer supplied VCP (if scheduled in the Pump Schedule) and provide necessary modules to the CONTRACTOR for installation in all control panels not provided by the manufacturer.

2.13 FINISHES

A. Pump manufacturer to factory prime pump/motor and discharge elbow as specified in Section 09960. CONTRACTOR to provide field coatings as specified in Section 09960.

2.14 SOURCE QUALITY CONTROL

A. Witnessing: Source or factory testing shall be witnessed by the ENGINEER or OWNER when scheduled; provide advanced notice of source testing as specified in Section 15958.

B. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

C. Vibration test: Test level as scheduled; test as specified in Section 15958.

D. Noise test: Test level as scheduled; test as specified in Section 15958.

E. Hydrostatic pressure tests: As specified for components in this Section.

F. Inspection and checkout: As specified in Sections 15050 and 15958.

G. Equipment performance test: Level 1 Pump Test as specified in Section 15958.

H. Operational testing: As specified in Section 01660.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products as specified in Section 15050.

3.02 FIELD QUALITY CONTROL.

A. Witnessing: All field-testing shall be witnessed by the ENGINEER; provide advanced notice of field-testing as specified in Section 15958.

B. Inspection and checkout: As specified in Sections 15050 and 15958.

C. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

D. Vibration test: None required.

E. Noise test: Test level as scheduled; test as specified in Section 15958.

F. Driver and motor tests: Test as specified in scheduled section.

G. Operational testing: As specified in Section 01660.

3.03 MANUFACTURER'S FIELD SERVICE

A. Start-up: Inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up.

B. Training: As specified in Section 01660.

3.04 PUMP SCHEDULE

Tag Numbers	**04-PMP-501 04-PMP-502**	**04-PMP-601 04-PMP-602**	**28-PMP-181 28-PMP-183**	**28-PMP-182 28-PMP-184**
General Characteristics				
Service	Plant Drain	Storm Water	Secondary Effluent	Secondary Effluent
Quantity	2	2	2	2
Maximum Noise, dBA at 3 Feet	Not Required	Not Required	Not Required	Not Required
Torsional Analysis	Not Required	Not Required	Not Required	Not Required
Minimum Pumped Fluid Degrees Fahrenheit	35	35	35	35
Normal Pumped Fluid Degrees Fahrenheit	70	70	70	70

Tag Numbers	04-PMP-501 04-PMP-502	04-PMP-601 04-PMP-602	28-PMP-181 28-PMP-183	28-PMP-182 28-PMP-184
Maximum Pumped Fluid Degrees Fahrenheit	85	85	85	85
Installation Configuration	Wet Pit	Wet Pit	Wet Pit	Wet Pit
Pump Characteristics				
Impeller Type	N or ContraBlock	N or ContraBlock	N or ContraBlock	N or ContraBlock
Pass Minimum Sphere Size, Inch	3	3	3	3
Speed Control	Variable	Constant	Variable	Variable
Maximum Pump Speed, rpm	1,780	1,780	1,735	1,755
Minimum Pump Speed, rpm	1,150	N/A		
Rated Design Point: (at Maximum rpm)				
Flow, gpm	500	150	825	1,150
Head, Feet	50	29	25	25
Minimum Hydraulic Efficiency, Percent	70	45	560	64
Required Condition 2 (at Maximum rpm)				
Flow, gpm	200	250	400	800
Head, Feet	68	25	40	34
Minimum Hydraulic Efficiency, Percent	50	60	65	65
Required Condition 3 (at Maximum rpm)				
Flow, gpm	800	450	1,000	1,600
Head, Feet	31	16	18	17
Minimum Hydraulic Efficiency, Percent	60	61	50	60
Other Conditions				
Shut Off Head, Feet	83	39	60	58
Minimum NPSHa at Every Specified Flow, Feet	35	35	35	35

Tag Numbers	04-PMP-501 04-PMP-502	04-PMP-601 04-PMP-602	28-PMP-181 28-PMP-183	28-PMP-182 28-PMP-184
Minimum Suction Static Head, Feet	3	3	3	3
Minimum Discharge Size, Inches	4	2.5	4	8
Motor Characteristics				
Minimum Submergence				
Maximum Driver Speed, rpm	1,800	1,800	1,800	1,800
Motor Horsepower, Minimum	10	3.2	10	15
Voltage/Phases/Hertz	460/3/60	460/3/60	460/3/60	460/3/60
Service Factor	1.15	1.15	1.15	1.15
Starting Current, Amperes	82	25	64	114
Rated Current, Amperes	14	5.5	13	19
Motor Efficiency (At 100-Percent Load) Minimum	80	73.5	83.5	87.5
Enclosure Type	Submersible, Explosion Proof	Submersible, Explosion Proof	Submersible, Explosion Proof	Submersible, Explosion Proof
NEMA Design Type	B	B	B	B
Accessories				
Hoist	Not Required	Not Required	Not Required	Not Required
Source Quality Control Testing				
Test Witnessing	Not Required	Not Required	Not Required	Not Required
Performance Test Level	2	1	3	3
Vibration Test Level	Not Required	Not Required	Not Required	Not Required
Noise Test Level	Not Required	Not Required	Not Required	Not Required
Field Quality Control Testing				
Performance Test Level	1	1	2	2
Vibration Test Level	Not Required	Not Required	Not Required	Not Required
Noise Test Level	Not Required	Not Required	Not Required	Not Required

END OF SECTION

SECTION 11312L

VERTICAL MULTISTAGE CENTRIFUGAL PUMP

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Vertical multistage centrifugal pumps with drivers and components.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01600 - Product Requirements.
      c. Section 01610 - Project Design Criteria.
      d. Section 01660 - Testing, Training, and Commissioning.
      e. Section 01740 - Warranties and Bonds.
      f. Section 09960 - High-Performance Coatings.
      g. Section 15050 - Common Work Results for Mechanical Equipment.
      h. Section 15958 - Mechanical Equipment Testing.
      i. Section 16222 - Low Voltage Motors up to 500 Horsepower.
      j. Section 17403 - Pressure/Vacuum Measurement - Switches.
      k. Section 17404 - Pressure/Vacuum Measurement - Gauges.

1.02 REFERENCES

A. American Bearing Manufacturers' Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.

C. ASTM International (ASTM):
   1. A 48 - Standard Specification for Gray Iron Castings.
   2. A 108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   3. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
   4. A 283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   5. A 582 - Standard Specification for Free-Machining Stainless Steel Bars.
   6. B 505 - Standard Specification for Copper Alloy Continuous Castings.

7. B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
8. E 10 - Standard Test Method for Brinell Hardness of Metallic Materials.

D. Hydraulic Institute (HI):
1. 1.1-1.2 - Rotodynamic (Centrifugal) Pumps for Nomenclature and Definitions.
2. 1.3 - Rotodynamic (Centrifugal) Pumps for Design and Application.
3. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, Sound Measurement and Decontamination.
4. 9.6.4 - Rotodynamic Pumps for Vibration Analysis and Allowable Values.
5. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

E. NSF International (NSF):
1. Standard 61 - Drinking Water System Components - Health Effects.

F. National Electrical Manufacturers Association (NEMA):
1. 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net-positive suction head available (NPSHa), and net-positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 9.1-9.5, 9.6.4, and 14.6 and as modified in the Specifications.

B. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.

1.04 SYSTEM DESCRIPTION

A. Vertical multistage centrifugal pumps with components: Pump, driver, motors, and drive arrangements as scheduled with seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as specified and as required for a complete and operational system.

B. Pumps suitable for intermittent or continuous service with up to 10 milligrams per liter residual chlorine concentration.

C. Design requirements:
1. Pump performance characteristics:
   a. As specified in the Pump Schedule.
   b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
2. Motor characteristics: As specified in the Pump Schedule.

1.05 SUBMITTALS

A. Submit as specified in Section 15050.

B. Furnish motor submittals as specified in Section 16222.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Provide pumps in this Section from same manufacturer.

C. Require pump manufacturer to furnish and coordinate pump, driver, and pump components as specified and scheduled and to provide written installation and checkout requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions as specified in Section 01140.

1.10 WARRANTY

A. The pump manufacturer shall guarantee that the materials and/or the workmanship of the equipment supplied be free of defects for a period of 2 years from the date specified in Section 01740.

1.11 MAINTENANCE

A. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

B. Spare parts: Deliver the following as specified in Section 01600:
   1. Pump thrust bearing set.
   2. Pump radial bearing set.
   3. Motor bearing set of each type.
   4. Pump impeller, trimmed to match installed impeller.
   5. Mechanical seal set.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Grundfos.

2.02 MATERIALS

A. General:
   1. Materials in the Pump Schedule shall be the type and grade as specified in this Section.
   2. Lead limits: As specified in Section 15050.

B. Bolts, studs, and cap screws:
   1. Material: All wetted bolts, studs, and cap screws shall be stainless steel in accordance with ASTM A193, Type 316 or 316N, Grade B8MA or B8MNA. Nuts shall be stainless steel in accordance with ASTM A194, Type 316 or 316N, Grade 8MA or 8MNA.
   2. Lubricant: Threads shall be coated before assembly with an anti-galling lubricant certified by ANSI/NSF 61 for contact with potable water.

2.03 DESIGN REQUIREMENTS

A. Pumps shall be non-self-priming, vertical inline multistage centrifugal pumps. Pumps shall consist of a base and a pump head. A chamber stack and outer sleeve, containing the impellers, are secured between the pump head and the base by means of staybolts. The base has suction and discharge ports on the same level. Pumps shall be Model CRN, by Grundfos, or equal. Pumps shall be designed and rated for the performance requirements as specified in the Equipment List.

B. Pump head:
   1. Flanges: Suction and discharge flanges shall be in accordance with ANSI B16.5, flat faced, 300-pound minimum.

C. Shaft seal: Shaft seal shall be a cartridge type, balanced, mechanical seal. Mechanical seals shall be specifically designed for the intended service.

D. Shafts shall be hard faced under all bearing/guide areas.

E. Accessories:
   1. Pressure gauge:
      a. The suction and discharge of each pump shall have a pressure guage per Section 17404.
   2. Pressure switch:
      a. The discharge of each pump shall have a pressure switch per Section 17403.
   3. Pump check valves:
      a. The discharge of each pump shall be fitted with a check or foot valve to prevent backflow through the pump when the pump stops.
   4. Pump isolation valves:
      a. The suction and discharge of each pump shall be fitted with a ball-type isolation valve.

F. Motors:
   1. Motors shall be in accordance with Section 16222 with additional features as specified herein and as shown on the Data Sheets.
   2. Each motor shall have a brake horsepower output equal to or greater than the horsepower required to operate the pump at any point on the head capacity curve, while pumping liquid of the specified specific gravity. The motor service factor shall not be used to meet this requirement.
   3. Bearings:
      a. Bearings shall be conical-type and shall be adequate to withstand the maximum anticipated motor and pump radial and axial loads.
      b. Bearing housings shall have seals to confine the lubricant and exclude moisture and dirt.

G. Nameplates:
   1. Equipment identification: Each individual piece of equipment shall bear a stainless steel nameplate attached with stainless steel screws. The nameplate shall be engraved with the following information:
      a. Manufacturer's name or trademark.
      b. Manufacturer's serial and model numbers.
      c. Metropolitan's piece mark number.
      d. Pump rated flow, head and rpm.
      e. Maximum allowable working pressure and hydrotest pressure for the pump.

H. Each pump shall be designed and anchored in accordance with the requirements of Section 15050.

2.04 COATINGS

A. General:
   1. Surface preparation and protective coatings shall be in accordance with Section 09960.
   2. The coatings shall not be applied until the equipment has been fabricated, hydrostatic tests completed, weld-spatter removed, welds ground smooth, sharp edges and corners ground to a curve, surfaces cleaned with clean mineral spirits, and abrasive blasting performed.

2.05 SHOP ASSEMBLY

A. Pumping units including pump and motor shall be completely assembled in the manufacturer's plant, and the clearance and alignment between components shall be checked for compliance with the applicable shop drawings.

B. Pump shafts shall be aligned to the motor with a maximum runout of 0.003 inch.

2.06 SHOP TESTING

A. Each pump shall be performance tested at rated speed to determine the head, capacity, and brake horsepower. Tests shall be conducted in accordance with Hydraulic Institute Standards for Vertical Pumps and as specified herein and/or on the pump data sheet. Test data shall be sufficiently comprehensive to produce guaranteed performance curve showing head versus:
   1. Capacity.
   2. Efficiency.
   3. Net positive suction head required, when specified.
   4. Brake horsepower.
   5. A minimum of 7 points shall be tested. One point shall be at shutoff. One point shall be at run out. One point shall be the rated point. The remaining points shall be spaced evenly between the rated point and shutoff.

B. Flow rates for pumps operating in parallel shall match within 4 percent at any head throughout the operating range specified on the pump data sheet.

C. Hydrostatic testing:
   1. A hydrostatic test shall be performed on all process pressure containing components at the greater of:
      a. 150 percent of the shut-off head plus maximum suction pressure.
      b. 200 percent of the sum of rated head and maximum suction pressure.
   2. During the pressure test, components shall not show signs of weakness or undue deflection, as determined by the ENGINEER. The external surfaces of the casings shall not show sweating through metal or leakage through gaskets or seals. The minimum hydrotest time shall be 30 minutes. Testing shall be performed prior to performance testing and the application of coatings, except for heat fused epoxy.

2.07 SPARE PARTS

A. The CONTRACTOR shall provide one complete set of the following for each pump provided:
   1. Stack wear components.
   2. Shaft bearings.
   3. Mechanical seals.
   4. Gaskets.

B. The CONTRACTOR shall provide one set of any special tools needed for maintaining the pumps.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Section 15050.

B. Pump drainpipes:
   1. Connect galvanized steel pipe drains from drip pockets to point indicated on the Drawings or as directed by the ENGINEER.
   2. Carry drainpipes on continuous downgrade to point of discharge using plugged tees and crosses for changes in direction.

3.02 FIELD QUALITY CONTROL

A. Witnessing: All field-testing shall be witnessed by the ENGINEER. Provide advance notice of field testing as specified in Section 15958.

B. Inspection and checkout: As specified in Sections 15050 and 15958.

C. Equipment performance test: Test level as scheduled and as specified in Section 15958.

D. Vibration test: Test level as scheduled and as specified in Section 15958.

E. Noise test: Test level as scheduled and as specified in Section 15958.

F. Driver and motor tests: Test as specified in scheduled Section.

G. Operational testing: As specified in Section 01660.

3.03 MANUFACTURER'S FIELD SERVICES

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and Sections 15050 and 15958.

B. Training: As specified in Section 01660.

3.04 PUMP SCHEDULE

Tag Numbers	**60-PMP-731, 60-PMP-732, 60-PMP-733, 60-PMP-761, 60-PMP-762, 60-PMP-763**
General Characteristics:	
Service	Potable Water
Quantity	3
First Named Manufacturer's Model Number	MCP-E 2CRE 5-7
Maximum Noise, dBA at 3 feet	85
Torsional Analysis	Not Required
Minimum Pumped Fluid Temperature, degrees F	50
Normal Pumped Fluid Temperature, degrees F	65
Maximum Pumped Fluid Temperature, degrees F	80
Pump Characteristics:	
Pump and Driver Mounting	Vertical
Suction Configuration	Single
Impeller Type	Enclosed Type
Number of Impellers	Per Manufacturer
Bearing Lubrication	Grease
Shaft Seal Type	Single Mechanical, Balanced
Speed Control	Fixed
Maximum Pump rpm	3,460
Minimum Pump rpm	3,460
Rated Design Point (At Maximum Revolutions per Minute):	
Flow, gpm	30.4
Head, Feet	148

Tag Numbers	60-PMP-731, 60-PMP-732, 60-PMP-733, 60-PMP-761, 60-PMP-762, 60-PMP-763
Minimum Efficiency, Percent	60%
Required Condition 2 (At Maximum Revolutions per Minute):	
Flow, gpm	25
Head Range, Feet	165
Minimum Efficiency, Percent	58
Required Condition 3 (At Maximum Revolutions per Minute):	
Flow, gpm	20
Head Range, Feet	172
Minimum Efficiency, Percent	55
Required Condition 4 (At Maximum Revolutions per Minute):	
Flow, gpm	35
Head Range, Feet	130
Minimum Efficiency, Percent	58
Required Condition 5 (At Maximum Revolutions per Minute):	
Flow, gpm	40
Head Range, Feet	115
Minimum Efficiency, Percent	55
Other Conditions:	
Shutoff Head, Feet	195
Maximum NPSHr at Every Specified Flow, Feet	25
Minimum NPSHa at Every Specified Flow, Feet	12
Maximum Suction Static Head, Feet	51
Minimum Suction Static Head, Feet	34
Pump Materials:	
Pump Head	Stainless Steel AISI 304
Impeller	Stainless Steel AISI 316 or AISI 431
Shaft	Stainless Steel, AISI 304
Chamber	Stainless Steel, AISI 304
Outer Sleeve	Stainless Steel, AISI 304
O-Ring for Outer Sleeve	EPDM or FKM

Tag Numbers	60-PMP-731, 60-PMP-732, 60-PMP-733, 60-PMP-761, 60-PMP-762, 60-PMP-763
Base	Cast Iron, A48-30B
Neck Ring	PTFE
Shaft Seal	Cartridge Type
Rubber Parts	EPDM or FKM
Driver Characteristics:	
Driver Type	Motor
Drive Arrangement	Vertical, Flexibly Coupled
Minimum Horsepower	2 hp
Maximum Speed, rpm	3,460
Motor Characteristics (When Motor is Driver Type):	
Inverter Duty Rated	No
Motor Voltage/Phases/Hertz	460/3/60
Enclosure Type	TEFC
Source Quality Control Testing:	
Test Witnessing	Not Witnessed
Performance Test Level	None
Vibration Test Level	None
Noise Test Level	None
Field Quality Control Testing:	
Performance Test Level	1
Vibration Test Level	1
Noise Test Level	None

END OF SECTION

SECTION 11312Y

INLINE BOOSTER PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Close coupled inline mounted water booster pumps.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01600 - Product Requirements.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 09960 - High-Performance Coatings.
      e. Section 15050 - Common Work Results for Mechanical Equipment.
      f. Section 15082 - Piping Insulation.
      g. Section 15954 - HVAC Systems Testing, Adjusting, and Balancing.
      h. Section 15958 - Mechanical Equipment Testing.
      i. Section 16222 - Low Voltage Motors Up to 500 Horsepower.

C. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the Specifications.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Inch Standard.

B. ASTM International (ASTM):
   1. A 159 - Standard Specification for Automotive Gray Iron Castings.
   2. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
   3. B 111 - Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock.
   4. B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. Hydraulic Institute (/HI):
   1. 1.1-1.2 - Centrifugal Pumps for Nomenclature and Definitions.
   2. 1.3 - Rotodynamic (Centrifugal) Pumps for Design and Application.
   3. 1.6 - Centrifugal Pump Tests.
   4. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, and Sound Measurement and Decontamination.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 1.6, and 9.1-9.5 and as modified in this Section.

B. Flow, head, efficiency, and motor horsepower specified in this Section are minimums unless stated otherwise.

1.04 SYSTEM DESCRIPTION

A. Components: Pumps shall be close coupled inline, designed for mounting horizontal or vertical piping systems.

B. Design requirements:
   1. Pump performance characteristics:
      a. As specified in the Pump Schedule.
      b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
   2. Motor characteristics: As specified in the Pump Schedule.

1.05 SUBMITTALS

A. Submit as specified in Section 15050.

B. Torsional analysis: Submit as specified in Section 15050 when scheduled below.

C. Furnish motor submittal as specified in Section 16222.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Provide pumps specified in this Section from same manufacturer.

C. Require pump manufacturer to furnish and coordinate pump, driver, and pump components as scheduled below and to provide written installation and check-out requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 15050.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050.

1.11 MAINTENANCE

A. Special tools: Deliver one set of special tools required for complete assembly or disassembly of pump system components for each type or size of pump specified.

B. Spare parts: Deliver the following as specified in Section 01600:
   1. None.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pump: One of the following or equal.
   1. Bell & Gossett Division of ITT Corporation.
   2. Paco Pumps.
   3. Armstrong.

2.02 MATERIALS

A. General: Materials in the Pump Schedule shall be the type and grade as specified below.

B. Cast iron: ASTM A 159.

C. Bronze: ASTM B 584.

D. Aluminum bronze: ASTM B 111.

E. Stainless steel: ASTM A 276, type as scheduled.

F. Steel: SAE 1144.

2.03 GENERAL PUMP CONSTRUCTION

A. Type: Close coupled pump designed for horizontal or vertical in-line mounting as indicated on the Drawings.

B. Bronzed fitted pump or all iron pump as scheduled.

2.04 PUMP CASING

A. Type: 1 piece volute type with integral suction and discharge nozzles.

B. Material: Cast iron.

C. Construction: Of sufficient strength, weight, and thickness to provide accurate alignment, prevent excessive deflection.

D. Rotating assembly: Removable without disturbing suction or discharge connections.

E. Design Working Pressure: Minimum 1.10 times maximum shutoff total dynamic head with maximum installable impeller diameter at maximum operating speed plus maximum suction static head.

F. Suction and discharge piping connections: Flanged meeting ASME B 16.1, Class 125, or ASME B 16.5, Class 150, or higher pressure class as required to meet Design Working Pressure.

G. Vent and taps:
   1. Provide castings with suction and discharge taps.

2.05 IMPELLERS

A. Bronze fitted pump: Cast bronze.

B. All iron pump: Cast iron.

2.06 PUMP SHAFTS

A. The pumps shall have a ground and polished steel shaft, heat-treated, with a hardened integral thrust collar.

B. Shaft sleeve:
   1. Bronze fitted pump: Aluminum bronze.
   2. All iron pump: Type 304 Stainless Steel.

2.07 SEAL

A. Standard seal:
   1. Bellows: Buna or EPR as scheduled.
   2. Faces: Carbon-ceramic.
   3. Metal parts: Stainless steel.
   4. Spring: Stainless steel.

2.08 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
      c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors: Provide motors as specified in Section 16222 and as specified in this Section:
   1. Revolutions per minute: As scheduled.
   2. Enclosure: As scheduled.
   3. Electrical characteristics: As scheduled.
   4. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222.
   5. Motor accessories: As specified in Section 16222 and in this Section.

2.09 FINISHES

A. Prepare surfaces and apply shop coat compatible with coating system specified in Section 09960.

B. If scheduled: All hot surfaces on the equipment shall be insulated in accordance with Section 15082.

2.10 SOURCE QUALITY CONTROL

A. Witnessing: Source or factory testing shall be witnessed by the ENGINEER or OWNER when scheduled; provide advanced notice of source testing as specified in Section 15958.

B. Equipment performance test: test level as scheduled; test as specified in Section 15958.

C. Vibration test: Test level as scheduled; test as specified in Section 15958.

D. Noise test: Test level as scheduled; test as specified in Section 15958.

E. Hydrostatic pressure tests: As specified for components in this Section.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Section 15050.

3.02 FIELD QUALITY CONTROL

A. Witnessing: All field testing shall be witnessed by the ENGINEER; provide advanced notice of field testing as specified in Section 15958.

B. Inspection and check-out: As specified in Sections 15050 and 15958.

C. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

D. Vibration test: Test level as scheduled; test as specified in Section 15958.

E. Noise test: Test level as scheduled; test as specified in Section 15958.

F. Driver and motor tests: Test as specified in scheduled section.

G. Operational testing: As specified in Section 01660.

H. If scheduled, CONTRACTOR shall flow balance as specified in Section 15954.

3.03 MANUFACTURER'S FIELD SERVICES

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and in Sections 15050 and 15958.

B. Training: As specified in Section 01660.

3.04 PUMP SCHEDULE

Tag Numbers	**28-PMP-185** **28-PMP-186**
General Characteristics:	
Service	Secondary Effluent
Quantity	2
First Named Manufacturer's Model	1531-1-1/2BC
Maximum Noise, dBA at 3 feet	Not Required
Torsional Analysis	Not Required
Minimum Pumped Fluid Temperature, degrees Fahrenheit	60
Normal Pumped Fluid Temperature, degrees Fahrenheit	70
Maximum Pumped Fluid Temperature, degrees Fahrenheit	75
Insulate pump per Section 15082	Not Required
Flow balance system per Section 15954	Not Required
Pump Characteristics:	
Pump Type	All Iron Pump
Shaft Seal Type	Standard with Buna N
Pump Revolutions per Minute	1150
Flange Size, Inches	2
Flow, Gallons per Minute	78
Head, feet	30
Minimum Efficiency Percent	58

Tag Numbers	28-PMP-185 28-PMP-186
Shut Off Head	37
Minimum NPSHa	30
Maximum NPSHr	8
Driver Characteristics:	
Driver Type	Motor
Drive Arrangement	Close Coupled
Minimum Driver Horsepower	2
Maximum Driver Speed, Revolutions per Minute	1,200
Motor Characteristics (when motor is driver type):	
Motor Specification Section	16222
Voltage/Phases/Hertz	460/3/60
NEMA Enclosure Type	TEFC
Inverter Duty Rated	No
Source Quality Control Testing:	
Test Witnessing	Not Witnessed
Performance Test Level	2
Vibration Test Level	None
Noise Test Level	None
Field Quality Control Testing:	
Performance Test Level	1
Vibration Test Level	NA
Noise Test Level	NA

END OF SECTION

SECTION 11313F

SUBMERSIBLE CHOPPER CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for provision of pump systems including submersible non-clog motor-driven chopper pumps for service as scheduled.

B. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01410 - Regulatory Requirements.
      c. Section 01600 - Product Requirements.
      d. Section 01610 - Project Design Criteria.
      e. Section 01660 - Testing, Training, and Commissioning.
      f. Section 09960 - High-Performance Coatings.
      g. Section 15050 - Common Work Results for Mechanical Equipment.
      h. Section 15958 - Mechanical Equipment Testing.
      i. Section 16222 - Low Voltage Motors up to 500 Horsepower.

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):
   1. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
   2. ASME B16.5 - Pipe Flanges and Flanged Fittings.

C. American Society for Testing and Materials (ASTM):
   1. A 48 - Standard Specification for Gray Iron Castings.
   2. A 108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   3. A 148 - Specification for Steel Castings, High Strength, for Structural Purposes.
   4. A 276 - Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes.
   5. A 283 - Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   6. A 536 - Ductile Iron Castings.
   7. D 2240 - Test Method for Rubber Property - Durometer Hardness.

8. E 10 - Test Method for Brinell Hardness of Metallic Materials.
9. F 593 - Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
10. F 594 - Specification for Stainless Steel Nuts.

D. American National Standards Institute and Hydraulic Institute (ANSI/HI):
1. 1.1-1.2 - Centrifugal Pumps - Nomenclature, Definitions, Application and Operation.
2. 1.3 - Centrifugal Pumps for Design and Application.
3. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Applications, Definitions, Sound Measurement, and Documentation.
4. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 9.1-9.5 and 14.6 and as modified in this Section.

B. Suction Head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.

C. Tolerances: In accordance with Hydraulic Institute 1.1 to 1.5, 9.1 to 9.5, and 14.6 unless specified more restrictively.

1.04 SYSTEM DESCRIPTIONS

A. Submersible Chopper Centrifugal Pumps With Components: Submersible pumps, motors, drivers, bearings, seals, supports, self-aligning discharge connection, base elbows, guide rails and lifting devices, electrical devices internal to pump housing, all submersible cabling for power and control conductors, and other items as required for a complete and operational system.

B. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter box at the intake opening.

C. Pump shall be capable of continuous operation while pumping primary or secondary scum containing up to 6 percent solids with heavy rags, plastics, grease, hair, grit, and other stringy fibrous material.

D. Design Requirements:
1. Pump Performance Characteristics:
   a. As specified in the Pump Schedule.
   b. Performance tolerances shall be the same as the test tolerances specified in Section 15958.
2. Motor Characteristics: As specified in the Pump Schedule.

1.05 SUBMITTALS

A. Submit as specified in Section 15050.

B. Certifications: Submit Certification of Rockwell C Hardness for cutter bars and impeller.

C. Furnish motor submittals as specified in Section 16222.

D. Torsional analysis: Submit when scheduled and as specified in Section 15050.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Provide pumps in this Section from the same manufacturer.

C. Require pump manufacturer to furnish and coordinate pump, driver, lifting rails, and pump components as specified and scheduled and to provide written installation and checkout requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

A. Environmental Requirements: As specified in Section 01610.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions as specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050.

1.11 MAINTENANCE

A. Special tools: Deliver 1 set for every furnished pump type and size needed to assemble and disassemble pump system.

B. Spare parts: Provide one of the following for each size or type of pump; deliver as specified in Section 01600.
   1. Mechanical seals: Upper and lower mechanical seal set.
   2. Pump bearings: Upper and lower bearing set.
   3. Impeller and cutter bar: One set.
   4. Casing seal gaskets or O-rings: One set.
   5. Power cable entry seal set: One set.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pump: One of the following or equal:
   1. Vaughan Company, Inc., SE series.
   2. WEMCO Pumps, Model CF.

2.02 MATERIALS

A. General: When materials are referenced in this Section or on the pump schedule, the compositions shall be the UNS Alloys, Types, or Grades in this article unless specified or scheduled otherwise.

B. Cast Iron: ASTM A 48, Class 35 B minimum.

C. Cast Alloy Steel: ASTM A148, Grade 90-60, case hardened to minimum Rockwell C 60.

D. Ductile Iron: ASTM A 536.

E. Steel: ASTM A 108, Grade or UNS Alloy as specified or scheduled.

F. Stainless Steel: ASTM A 276 or ASTM A 582, Type or UNS Alloy as specified or scheduled.

G. Fasteners: Stainless steel, ASTM F 593 or ASTM F 594, type or grade as specified.

2.03 GENERAL PUMP CONSTRUCTION

A. Type: Industrial heavy-duty submersible chopper centrifugal pumps.

B. Other requirements:
   1. Vibration: As specified in Section 15958.

C. All fasteners shall be 316 stainless steel.

2.04 PUMP AND MOTOR CASING

A. Type:
   1. Two-piece construction with pump and motor casing bolted together. Seal faces shall be machined and fitted with Nitrile or Buna-N rubber O-ring seals. Bolting shall be Type 304 stainless steel.
   2. Pump casing shall be of volute design, spiraling outward to a 125-pound flanged centerline discharge.
   3. Back pullout adapter plate shall allow removal of pump components from above the casing, and allow external adjustment of impeller-to-cutter bar clearance.

B. Material: Cast Iron or Ductile Iron.

C. Watertightness: Able to run submerged up to 50 feet and to run dry.

D. Construction: Of sufficient strength, weight, and thickness to provide accurate alignment and watertightness.

E. Motor Cooling: Adequate for continuously submerged operation or unsubmerged operation for a minimum of 15 minutes as scheduled.

F. Design Working Pressure: Minimum 1.10 times maximum shutoff total dynamic head with maximum diameter impeller at maximum operating speed plus maximum suction static head; suitable for submergence in up to 65 feet of water.

G. O-Ring Seals: Capable of sealing mated surfaces (major components) watertight; with the following features:
   1. Machined surfaces and grooves.
   2. O-ring contact on four surfaces and O-ring compression on two surfaces.
   3. Does not require specific fastener torque or tension to obtain watertight joint.
   4. Does not require secondary sealing compounds, gasket, grease, or other devices.

H. Testing: Perform 5-minute hydrostatic test of pump casing at minimum 1.5 times Design Working Pressure.

I. Discharge Interface:
   1. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact.
   2. Self-aligning without bolting or having to enter the wet well.

2.05 IMPELLERS

A. Impellers:
   1. Type: Semi-open, chopper-centrifugal impeller with pump-out vanes to reduce seal area pressure and smooth water passages to reduce clogging by rags, stringy, or fibrous materials on impellers or shafting.
   2. Chopping/maceration shall be accomplished by the cupped and sharpened edge of the impeller blade moving across the cutter bar.
   3. Impeller shall be threaded to the shaft with no axial adjustments and no set screws.
   4. Casting: 1-piece, free of cracks and porosity.
   5. Material: Cast alloy steel heat-treated to a minimum Rockwell C 60 hardness.

B. Cutter Bar Plate:
   1. Material: Cast alloy steel or T1 alloy steel heat-treated to a minimum Rockwell C 60 hardness.
   2. Design cutter bar plate to prevent blockage of intake and binding of debris at the shaft and impeller vanes.
   3. Cutter bar shall be replaceable.

C. Upper Cutter:
   1. Shall be threaded into the back pullout adapter plate above the impeller.
   2. Designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area.
   3. Material: Cast steel heat treated to a minimum Rockwell C 60 hardness.

D. Balance: As specified in Section 15050 to meet the vibration criteria as specified in Section 15958.

2.06 PUMP SHAFTS

A. Material: Heat-treated AISI 4140 or 316 stainless steel. Turned, ground, and polished.

B. Features:
   1. Connects motor shaft by a bolt and key way.
   2. Strength: Able to withstand minimum of 1.5 times maximum operating torque and other loads.
   3. Resonant Frequency: As specified in Sections 15050 and 15958.
   4. Deflection: Maximum 0.002 inch under operating conditions.

2.07 MECHANICAL SEALS

A. Provide dual tandem mechanical seal system with oil for seal lubrication and cooling:
   1. Shaft sealing system shall be capable of withstanding volute pressure up to 1.5 times pump shutoff head.
   2. No seal damages shall result from operating the pumping unit in its liquid environment, from running pump dry, or from reverse pump operation.

B. Oil chamber:
   1. Provide oil chamber for shaft sealing system. Design oil chamber to assure that air is left in the oil chamber to absorb the expansion of the oil due to temperature variations.
   2. Provide drain and inspection plug, with positive anti-leak seal, easily accessible from the outside.
   3. Oil in oil chamber shall be FDA approved, paraffin type, colorless, odorless, and non-toxic.

C. Upper seal:
   1. Tungsten carbide or silicon carbide rotating seal and tungsten carbide stationary seal or a carbon rotating seal and ceramic stationary seal as specified in Section 15050.
   2. Submerged in oil chamber located below the stator housing.

D. Lower seal:
   1. Tungsten carbide rotating and stationary seals as specified in Section 15050.

E. Springs and other hardware: Stainless steel, 300 or 400 series.

2.08 BEARINGS

A. Pump shaft shall rotate on a minimum of 2 permanently sealed, grease lubricated bearings:
   1. Upper bearing for radial forces.
   2. Lower bearing for combined axial and radial forces.

B. Bearing type: Anti-friction meeting ABMA standards.

C. Bearing lubrication system shall be sized sufficiently to safely absorb heat energy normally generated in bearing under maximum ambient temperature of 60 degrees Celsius under full load conditions.

D. Bearing life: Minimum L_{10} life of 100,000 hours at rated design point or 24,000 hours in accordance with ABMA 9 or 11 at bearing design load imposed by pump shutoff with maximum sized impeller at rated speed, whichever provides the longest bearing life in intended service.

2.09 MOTOR AND POWER CABLES

A. Motors: Features as specified and as scheduled.
   1. Squirrel cage induction motor, in an air chamber, moisture resistant, UL or FM listed for Class I, Groups C and D, Division 1 service, whether submerged or unsubmerged
   2. Material:
      a. Motor enclosure: ASTM type A-48, Class 25 or better.
      b. Windings: Copper.
      c. Shaft: 416 stainless steel.
      d. Rotor: Cast aluminum or copper
      e. Insulation: Class F, moisture resistant, able to withstand 40 degrees C ambient temperature plus 105 degrees C temperature rise.
   3. Horsepower:
      a. As scheduled.
      b. Listed motor hp is minimum to be supplied. Increase motor hp if required to prevent motor overload while operating at any point on supplied pump operating head-flow curve, including runout. However, VFDs, generator, and other electrical equipment are sized for scheduled motor hp.
   4. Motor shall be capable of continuous operation under load with the motor submerged, and a minimum of 15 minutes of full load operation when partially submerged or exposed, without derating the motor.
   5. Motor Cooling System:
      a. Design to provide adequate cooling:
         1) At the minimum operating speed with a variable frequency drive.
         2) With motor submerged.
         3) With motor dry for a minimum of 15 minutes.
         4) Motor shall be designed for continuous duty handling pumped media of 40 degrees C
   6. Motor Sealing: Design to withstand 200 psi water pressure at all seal locations.
   7. When VFD is scheduled, motor shall be capable of continuous inverter duty over the speed range specified.

B. Control/Protection Module:
   1. Each pump shall be supplied with its own self-contained control/protection module to provide for the direct connection to all internal pump monitoring devices, including:
      a. Thermal protection: Provide automatic reset motor stator temperature detectors, 1 switch in each phase winding. If any detector is activated, the sensor shall activate an alarm and shut down the motor. The thermal detectors shall activate when the stator temperature exceeds 125 degrees Celsius.
      b. Moisture detection: One of the following:
         1) Provide capacitive-type leakage sensor for the detection of water in the oil chamber or a moisture sensor in the lower motor chamber to detect any fluid in the motor. The sensor shall have an explosion proof rating.
         2) Provide a small float to detect the presence of water in the stator chamber.
   2. The module shall signal an alarm condition if any of the internal monitoring devices is activated.

C. Power Cables:
   1. Submersible to same water depth as motor casing.
   2. Type SOOW with Carolprene jacket, approved for extra hard usage per NEC Article 501-11.
   3. Insulation rated for 90 degrees C.
   4. Non-wicking fillers.
   5. Length: Sufficient to connect to surface junction box (without the need of splices) as indicated on the Drawings or 30 feet, whichever is greater.
   6. Sized to conform to NEC, ICEA, and CSA specifications.
   7. Provide stainless steel cable and stainless steel wire braid sleeve to support power cable from underside of wet well roof slab or access frame.

D. Monitoring or Control Cables:
   1. Provide separate cabling (not in common sheath with power cables) for low-voltage or DC cables for monitoring devices.

E. Cable entry seal and junction chamber:
   1. Designed to prevent moisture from wicking through the cable entry.
   2. Cable entry seal to be epoxy encapsulated.
   3. Provide Buna-N power and control cable grommets in addition to the epoxy seal leads.
   4. The cable entry seal shall provide strain relief for the cable.
   5. The cable entry junction chamber shall be separate from the motor chamber to prevent foreign material from gaining access to the top of the pump.

2.10 SUPPORT BASE AND DISCHARGE ELBOW

A. Provide ductile iron support base and discharge elbow for installation in wet pit.

B. Discharge elbow to mate to pump discharge and transition to discharge piping.

C. The entire weight of the pump/motor shall be borne by the pump discharge elbow.

2.11 GUIDE RAILS AND LIFTING DEVICES

A. General: Provide guide rails and lifting devices suitable for wet pit installation as scheduled in Execution and as indicated on the Drawings.

B. Materials:
   1. Wet pit: Type 304 stainless steel guide rails, lifting cable or chain and wall supports; Type 316 stainless steel anchor bolts and fasteners.

C. Wet pit guide rails:
   1. Type: Dual pipe or dual rail able to accurately guide the pump to mate with the discharge elbow.
   2. Strength: Withstand the greater of a minimum of 1.5 times the maximum imposed operating loads or seismic loads in accordance with building code as specified in Section 01410 seismic loads.
   3. Intermediate supports: Provide at 10-foot maximum intervals; less as required to provide specified support.

D. Lifting device:
   1. Type: Chain or cable attached to lifting eye on the pump casing.

2. Length: Able to lower pump from top of wet well to operating position as indicated on the Drawings plus 5 additional feet of length.
3. Retainer: Provide Type 316 stainless steel locking hook or clasp at top of wet well to securely retain the upper end of the lifting chain or cable during pump operation.
4. Lifting device shall be sized for combined weight of pump and motor.
5. Cable/chain holder to hold chain at top of sump.

2.12 FINISHES

A. Pump manufacturer to factory coat the pump/motor and discharge elbow as specified in Section 09960.

2.13 SOURCE QUALITY CONTROL

A. Witnessing: Source or factory testing shall be witnessed by the ENGINEER or OWNER when scheduled; provide advanced notice of source testing as specified in Sections 01660 and 15958.

B. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

C. Driver test: Test driver as part of pump test.

D. Temperature, noise, and vibration testing specified within the general equipment performance and pump performance test sections is not required for wet pit installations.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Sections 15050.

3.02 FIELD QUALITY CONTROL

A. Witnessing: All field testing shall be witnessed by the ENGINEER; provide advanced notice of field testing as specified in Sections 01660 and 15958.

B. Inspection and checkout: As specified in Sections 15050 and 15958.

C. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

D. Operational testing: As specified in Section 01660. Temperature, noise, and vibration testing specified within the general equipment performance and pump performance test sections is not required for wet pit installations.

3.03 MANUFACTURER'S FIELD SERVICE

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and in Sections 15050 and 15958.

B. Training: As specified in Section 01660.

3.04 PUMP SCHEDULE

Tag Numbers	**23-PMP-131** **23-PMP-132**
General Characteristics	
Service	Secondary Scum
First Named Manufacturer's Model Number	Model SE3F
Quantity	2
Installation Configuration	Wet Pit
Torsional Analysis	Not required
Pump Characteristics	
Speed Control	Fixed
Maximum Pump Speed	1,800 rpm
Rated Design Point	
Flow	200 gpm
Head	25feet
Minimum Hydraulic Efficiency	45%
Required Condition 1	
Flow	350 gpm
Head	18 feet
Minimum Hydraulic Efficiency	45%
Required Condition 2	
Flow	100 gpm
Head	30.5 feet
Minimum Hydraulic Efficiency	30%
Minimum NPSHa at Every Specified	30feet
Minimum Discharge Size	3 inches
Minimum Shutoff Head	35 feet
Driver Characteristics	
Driver Type	Motor
Variable Frequency Drive	N/A

Tag Numbers	23-PMP-131 23-PMP-132
Minimum Submergence	Exposed
Maximum Driver Speed	1,800 rpm
Motor Power, Minimum	5.0 hp
Voltage/Phases/Hertz	460/3/60
Service Factor	1.15
NEMA, Design Type	B
Accessories	
Hoist	Not Required
Testing	
Test Witnessing	Not Witnessed
Performance Test Level	1
Vibration Test Level	None
Noise Test Level	None
Performance Test Level	1
Vibration Test Level	None
Noise Test Level	None

END OF SECTION

SECTION 11313I

SUBMERSIBLE DEEP WELL TURBINE PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Submersible vertical turbine pumps for water wells with features as scheduled in the Pump Schedule.

B. Related section:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01610 - Project Design Criteria.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 15050 - Common Work Results for Mechanical Equipment.
      e. Section 15958 - Mechanical Equipment Testing.
      f. Section 16222 - Low Voltage Motors up to 500 Horsepower.
      g. Section 17407 - Pressure Measurement - Submersible.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C654 - Disinfection of Wells.

B. ASTM International (ASTM):
   1. A 53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   2. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
   3. A 283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   4. A 536 - Standard Specification for Ductile Iron Castings.
   5. A 582 - Standard Specification for Free Machining Stainless Steel Bars.
   6. B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
   7. F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   8. F 594 - Standard Specification for Stainless Steel Nuts.

C. The Hydraulic Institute (HI):
   1. 2.1-2.2 - Rotodynamic (Vertical) Pumps for Nomenclature and Definitions.

2. 2.3 - Rotodynamic (Vertical) Pumps for Design and Applications.
3. 2.4 - Rotodynamic (Vertical) Pumps for Installation Operations and Maintenance.
4. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, Sound Measurement, and Decontamination.
5. 14.6 – Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

D. National Electrical Manufacturers Association (NEMA).

E. NSF International (NSF):
1. Standard 61 - Drinking Water System Components - Health Effects.

F. International Standards Organization (ISO):
1. 9001 - Quality Management Systems --Requirements.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 2.1-2.2, 2.3, 2.4, 9.1-9.5, and 14.6 and as modified in the Specifications. The pump head and efficiency are evaluated at the outlet of the discharge head and include the net losses in the pump column and discharge.

B. Flow, head, efficiency, and motor horsepower specified in this Section are minimums unless stated otherwise.

C. Suction head: Gauge pressure available at pump intake in feet of fluid above atmospheric.

D. Tolerances: This Section and related sections contain tolerances that may be more stringent than Hydraulic Institute Standard tolerances. Where tolerances are not mentioned, Hydraulic Institute Standards 2.1-2.2, 2.3, 2.4, and 9.1-9.5 shall apply.

1.04 SUBMITTALS

A. Submit as specified in Section 15050.

B. Furnish motor submittals as specified in Section 16222.

C. Furnish submersible pressure transmitter as specified in Section 17407.

1.05 QUALITY ASSURANCE

A. General: As specified in Section 15050.

B. Provide pumps specified in this Section from same manufacturer.
1. Require pump manufacturer to furnish and coordinate pump, driver, drive, and pump components as scheduled and to provide written installation and checkout requirements.

C. Pump manufacturer: ISO 9001 certified.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.07 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 01610.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions as specified in Section 01140.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions as specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050.

1.11 MAINTENANCE

A. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following:
   1. Grundfos Model SP.
   2. Goulds Pumps, equivalent product.

2.02 MATERIALS

A. General:
   1. Materials in the Pump Schedule shall be the type and grade as specified in this Section.
   2. Lead Limits: As specified in Section 15050.

B. Cast iron: In accordance with ASTM A 48, Class 30 minimum.

C. Ductile Iron: In accordance with ASTM A 536, 65-45-12.

D. Tin Bronze: In accordance with ASTM B 584, Alloy C90300.

E. Silicon Bronze: In accordance with ASTM B 584, Alloy C87600.

F. Red Bronze: In accordance with ASTM B 584, Alloy C83600.

G. Type 416 Stainless Steel: In accordance with ASTM A 582.

H. Types 304 and 316 Stainless Steel: In accordance with ASTM A 276.

I. HDPE: Polyethylene.

J. Steel: In accordance with ASTM A 283, Grade D or ASTM A 516 Gr. 70.

K. Steel pipe: In accordance with ASTM A 53, Grade B.

2.03 GENERAL PUMP CONSTRUCTION

A. Pumps are to be of the deep well, multi-stage, vertical turbine, submersible type.

B. Provide discharge column and sealed well head.

C. Fasteners: Provide Type 304 stainless steel fasteners in accordance with ASTM F 593 or ASTM F 594.

D. Provide anti backspin protection on the pump.

2.04 IMPELLER BOWL ASSEMBLIES

A. Pump impeller assembly:
   1. Type: As scheduled in the Pump Schedule.
   2. Number of stages: As scheduled in the Pump Schedule.
   3. Material: Type 304 stainless steel.
   4. Required balance: As specified in Section 15050 to meet vibration criteria as specified in Section 15958.

B. Shafts:
   1. Material: Type 304, 316, or 416 stainless steel.

C. Impeller bowls:
   1. Material: Type 304 stainless steel.

D. Pump impeller bowl bearings:
   1. Materials: NBR.

E. Discharge and Suction bearing:
   1. Material: NBR.

F. Design with smooth water passages to reduce clogging by stringy or fibrous materials on impellers or shafting and the build-up of sand.

2.05 SUCTION ADAPTOR

A. Material: Type 304 stainless steel.

B. Provide a Type 304 stainless steel strainer.

C. Designed to prevent entrance of abrasive material into the top end of the motor.

2.06 COLUMN PIPE

A. Material: Seamless Type 304 stainless steel pipe.

B. Size: As scheduled in the Pump Schedule.

C. Head connection: Threaded connection to discharge head and impeller assembly.

D. Design Working Pressure: Design to withstand a design working pressure not less than 1.20 times the maximum shutoff total dynamic head with the maximum diameter impeller at the maximum operating speed plus the maximum suction static head.

E. Pressure test: Design to withstand a 5-minute hydrostatic test pressure not less than 1.5 times the design working pressure; perform test at source.

F. Lengths and connections:
   1. Design with maximum 20-foot length.
   2. Threaded with modified ACME threads.

2.07 WELL HEAD

A. Manufacturer: The following or equal:
   1. As indicated on the Drawings.

2.08 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. Increase motor horsepower if required to prevent operation in the service factor.
      c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors:
   1. Manufactures: One of the following or equal:
      a. Grundfos.
   2. NSF Standard 61 certified.
   3. Revolutions per minute: 3,600 maximum.
   4. Enclosure: Submersible.
   5. Electrical characteristics: As scheduled in the Pump Schedule.
   6. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222.
   7. Motor construction:
      a. Motor can: Type 304 stainless steel.
      b. The motor coupling: Stainless steel either keyed or splined as required to fit the motor shaft.
      c. Temperature rating: Continuous duty in water at 30 degrees C.

C. Cables:
   1. The flat cable shall be shielded and comprised of 4 separate conductors or a single cable assembly with 4 conductors.
   2. Each conductor shall be insulated by synthetic rubber or plastic insulation suitable for continuous immersion in water.
   3. The cable shall be protected with steel guard where it passes the bowl assembly to prevent damage from contact with the well casing.
   4. Type 304 stainless steel bands shall be provided to support the cable along the column pipe at intervals of not more than 20 feet.
   5. The power cable shall be sized such that the voltage drop will not exceed 5 percent at the motor rated full load current and voltage.

2.09 ACCESSORIES

A. Air-line tubing:
   1. Manufacturer: The following or equal:
      a. Eaton Control Systems.
   2. Type 1005-44204 Dekoron, 1/4-inch O.D., 0.035-inch wall thickness, single line, stainless steel tubing with 0.032-inch wall thickness, PVC coating.
   3. One unbroken continuous length from the bowl assembly discharge case through the discharge head base to the air line gauge assembly.
   4. Secured to each column pipe joint, a minimum of 1 location, utilizing vinyl filament tape, or approved equal.
   5. Secured to the top side of the discharge head base utilizing a CGB connector, straight male thread, steel finish, 1-1/2-inch I.P. thread size, complete with gland nut and neoprene bushing.
      a. Manufacturer: The following or equal:
         1) Crouse-Hinds - Catalog No. CGB 293.
   6. One bossed vent hole in the discharge head shall be adapted for the 1-1/2-inch thread size connector on the top side of the discharge head base.

B. Air-line gauge:
   1. Manufacturer: The following or equal.
      a. Marshalltown.
   2. Size: 4-1/2-inch, dual scale, calibrated in feet of water and pounds per square inch with pressure gauge span from 0 to 200 pounds per square inch.

C. Pressure transmitter enclosing tube:
   1. The pressure transmitter enclosing tube shall be 1-1/4-inch Schedule 80, NSF-PW PVC (polyvinyl chloride) plastic pipe.
      a. The PVC pipe shall be furnished in 1-1/4-inch I.D., color-gray, 20 feet – 0 inches foot joints with bell and spigot ends for PVC cement-solvent welding.

D. Submersible pressure transmitter:
   1. Furnish submersible pressure transmitters with each pump to measure well water level.
      a. The pressure transmitters shall be attached to pump assembly.
   2. As specified in Section 17407.

3. The pressure transmitter enclosing tube shall be 1 continuous length from the top of the pump bowl assembly to no more than 5 feet below the pitless adapter connection.
4. The cable shall be routed through the spool, upper casing, and well cap and suspended by a method proposed by the CONTRACTOR and approved by the ENGINEER.

E. Pump check valves:
1. The pump shall be fitted with a check or foot valve to prevent backflow through the pump when the pump stops.
2. Valve shall be Type 304 stainless steel.

2.10 SOURCE QUALITY CONTROL

A. Witnessing: Source or factory testing shall be witnessed by ENGINEER or OWNER when scheduled; provide advanced notice of source testing as specified in Sections 01660 and 15958.

B. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

C. Driver test: Test driver as part of pump test.

D. Temperature, noise, and vibration testing specified within the general equipment performance and pump performance test sections is not required for wet pit installations.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Section 15050.

3.02 STERILIZATION

A. Disinfection procedures shall be in accordance with AWWA C654.

B. Samples for bacteriological analysis shall be collected in a sterile container at the pump discharge, and a test made for coliform organisms.
1. After sterilization, the well shall be pumped at open discharge until at least 200 gallons of water have been pumped before the samples are collected.
2. Water samples shall be collected from the well on 3 successive days and analyzed for coliform organisms with each sample showing that no organisms were found before the well is accepted for showing the water is coliform free.
3. The samples shall be collected by a laboratory approved by the OWNER and the test for coliform organisms shall be made by the laboratory, and the OWNER shall be furnished a copy of the laboratory report.

4. If any coliform organisms are found present in the samples, the CONTRACTOR shall re-sterilize the pump and have the water resampled as stated above until such time as no coliform organisms are found present in a water samples collected after at least 200 gallons of water have been pumped from the well following sterilization, or until such time as the OWNER becomes convinced that coliform organisms exist naturally in the water-bearing formation and are not present in water produced from the well as a result of the operations of the CONTRACTOR.
5. All expenses of sterilization of the pump and laboratory analyses for coliform organisms shall be borne by the CONTRACTOR.

C. The water discharged by the pump following disinfection shall be dechlorinated to a level of 2.0 or less milligrams per liter chlorine before it is allowed to leave the site.

3.03 FIELD QUALITY CONTROL

A. Witnessing: All field testing shall be witnessed by the ENGINEER; provide advanced notice of field testing as specified in Sections 01660 and 15958.

B. Inspection and checkout: As specified in Sections 15050 and 15958.

C. Equipment performance test: Test level as scheduled; test as specified in Section 15958.

D. Operational testing: As specified in Section 01660.
1. Temperature, noise, and vibration testing specified within the general equipment performance and pump performance test sections is not required.

3.04 MANUFACTURER'S FIELD SERVICE

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and in Sections 15050 and 15958.

B. Training: As specified in Section 01660.

3.05 PUMPS SCHEDULE

Tag Numbers	**60-PMP-711 and 60-PMP-712**
General Characteristics	
Well No.	1 and 2
Service	Raw Well Water
Quantity	2
Inner Casing Diameter, Inches	6-inch, SDR21 ASTM F 480 PVC
Estimated Static Water Level, feet(1)	50
Estimated pumping water level, Feet(1)	120
Estimated Discharge Head Above Ground at 20 gpm, Feet of Water	20

Tag Numbers	60-PMP-711 and 60-PMP-712
Pump Inlet Setting, Feet(1)	160
Estimated Field Head at 20 gpm, Feet	148
Column Pipe, Air Line and Pressure Transducer Setting, Feet(1)	160
Maximum Pumped Fluid Degrees F	90
Pump Characteristics	
Number of Stages	Per Manufacturer
Maximum Diameter of Motor, Inches	4
Maximum Diameter Pump Bowl Assembly, Inches	4
Maximum Column Section Lengths, Feet	20
Column Pipe Internal Diameter, Inches	1.61
Speed Control	Constant Speed
Maximum Pump rpm	3,600
Rated Design Point	
Flow, gpm	20
Head, Feet	148
Minimum Efficiency, Percent	60
Required Condition 2	
Flow, gpm	30
Head Range, Feet	110
Minimum Efficiency, Percent	55
Required Condition 3	
Flow, gpm	15
Head Range, Feet	180
Minimum Efficiency, Percent	55
Other Conditions:	
Minimum Shut Off Head, Feet	200
Maximum NPSHr at Every Specified Flow, Feet	20
Pump Materials	
Bowls	Type 304 Stainless Steel
Column Material Thickness, Inch	Type 304 Stainless Steel Pipe, 0.145

Tag Numbers	60-PMP-711 and 60-PMP-712
Motor Characteristics	
Variable Frequency Drive	Not Required
Maximum Driver Speed, rpm	3,600
Driver Horsepower (minimum)	1.5
Motor Voltage	460
Service Factor	1.15
Enclosure Type	Submersible
Source Quality Control Testing	
Test Witnessing	Not Witnessed
Performance Test Level	None
Vibration Test Level	None
Noise Test Level	None
Field Quality Control Testing	
Performance Test Level	2
Vibration Test Level	None
Noise Test Level	None
Notes: (1) Depth in feet below grade.	

END OF SECTION

SECTION 11332

MECHANICAL FINE SCREENS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Two self-cleaning fine screen units.
   2. Two power and control panels, each with a PLC for the following equipment. Each panel shall be dedicated to a screen and its associated screening compactor.
      a. Two screens described herein.
      b. Two screenings compactors described in Section 11333.
   3. Local instruments and controls as described herein.

B. Tag numbers:
   1. Screen No. 1: 10-MBS-43.
   2. Screen No. 2: 10-MBS-53.
   3. Screen No. 1 Upstream Level Sensor/Transmitter 10-LIT-041.
   4. Screen No. 1 Downstream Level Sensor/Transmitter 10-LIT-042.
   5. Screen No. 2 Upstream Level Sensor/Transmitter 10-LIT-051.
   6. Screen No. 2 Downstream Level Sensor/Transmitter 10-LIT-052.

C. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01330 - Submittal Procedures.
      c. Section 01612 - Seismic Design Criteria.
      d. Section 01614 - Wind Design Criteria.
      e. Section 01660 - Testing, Training, and Commissioning.
      f. Section 01740 - Warranties and Bonds.
      g. Section 01782 - Operation and Maintenance Data.
      h. Section 05120 - Structural Steel.
      i. Section 10400 - Identification Devices.
      j. Section 11333 - Screenings Compactors.
      k. Section 15050 - Basic Mechanical Materials and Metals.
      l. Section 16050 - General Requirements for Electrical Work.
      m. Section 16075 - Electrical Identification.
      n. Section 16125 - Fiber Optic Cable and Appurtenances.
      o. Section 16134 - Boxes.
      p. Section 16222 - Low Voltage Motors up to 500 Horsepower.

q. Section 16412 - Low Voltage Molded Case Circuit Breakers.
r. Section 16422 - Motor Starters.
s. Section 17050 - Process Control and Instrumentation Systems General Requirements.
t. Section 17100 - Control Strategies.
u. Section 17101-10 - Headworks/Septage Receiving.
v. Section 17710 - Control Systems-Panels, Enclosures, and Panel Components.
w. Section 17206 - Level Measurement - Ultrasonic.
x. Section 17720 - Control Systems - Programmable Logic Controllers Hardware PLCs.
y. Section 17721 - Human Machine Interface Hardware.
z. Section 17733 - Network Materials and Equipment
aa. Section 17761 - PLC Programming Software.
bb. Section 17765 - Human Machine Interface Software.
cc. Section 17950 - Testing, Calibration, and Commissioning.

1.02 REFERENCES

A. National Electric Manufacturers Association (NEMA): MG1.

B. National Electric Code (NEC).

C. American Society of Mechanical Engineers (ASME).

D. American National Standard Institute (ANSI).

E. American Society of Testing Materials (ASTM).

1.03 DEFINITIONS

A. System supplier: Factory-authorized supplier of the mechanical fine screen.

1.04 SUBMITTALS

A. Submit product data and shop drawings, operation and maintenance manuals, and test reports as specified in Section 01330, and as detailed herein.

B. Provide a common shop drawings submittal that also addresses equipment specified under Section 11333.

C. Shop drawings:
1. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials for construction.
2. Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items. Include:
   a. Dimensions, size, and locations of connections to other work.
   b. Details of attachment and support in channel.
3. Gear output torque.
4. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and motor modifications. See Section 16222 for motor submittal requirements.
5. Functional description of internal and external instrumentation and controls including list of parameters monitored, controlled, or alarmed.

6. Control panel elevation drawings showing fabrication and placement of operator interface devices and associated elements.
7. Detailed control narrative of the programming for the screens and screenings compactors that includes:
    a. Operator-adjustable setpoints, their ranges, recommended initial setpoint value.
    b. Diagram depicting sequence of operation.
8. Power and control wiring diagrams, including terminals and numbers.
9. See Section 17710 for additional submittal requirements.
10. External utility requirements for air, water, power, drain, etc., for each component.

D. Provide detailed requirements, instructions, and drawings for fabricating and connecting the screen discharge chute to the compactor. The discharge chute shall allow the screen to be pivoted without removal of the discharge chute.

E. Information submittals:
1. Written factory test report of inspection and testing.
2. Statements of Qualification: Professional structural engineer.
3. Special shipping, storage and protection, and handling instructions including equipment weights and lifting points, and recommendations for short- and long-term storage.
4. Manufacturer's installation instructions including anchor bolt layouts and details, support details, and other drawings required for proper installation.
5. Manufacturer's Certificate of Proper Installation.
6. Field functional test reports.

F. Operation and maintenance (O&M) manuals:
1. Operation and maintenance manual submittals shall be complete in one comprehensive submittal. Individual submittals for components of the system will not be accepted for review.
2. Submit operation and maintenance manuals in accordance with Section 01782. Start-up of the system will not be permitted until O&M manuals have been submitted and approved by the ENGINEER. The submittal shall include the following:
    a. Operation and maintenance instruction bulletins for each equipment item.
    b. Complete parts list.
    c. Schematic, physical wiring diagrams, and any as-built field modifications.

1.05 QUALITY ASSURANCE

A. System Supplier shall be responsible for furnishing the mechanical fine screens, screenings compactors, and associated vendor control panels including PLCs and programming. System Supplier shall provide a coordinated package that meets the requirements of both this Section and Section 11333.

B. Manufacturer of equipment specified herein shall have completed and made operational not less than 20 separate installations of fine screen units of similar size and type in the United States, with not less than 10 years operating experience.
1. Multiple screens at a plant shall be considered as 1 installation toward meeting the experience requirements.
2. Fulfillment of the specified experience requirements shall be a condition of acceptance.

C. Equipment furnished shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with approved Drawings, Specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

D. The fine screen units shall be factory assembled and then tested for a minimum of 8 hours prior to delivery. Individual equipment shall be delivered to the site fully assembled (shipping requirements may require minor disassembly). The units shall be capable of being set in place and field erected by the CONTRACTOR with minimal field assembly.

E. Manufacturer's shop welds, welding procedures, and welders: Qualified and certified in accordance with the requirements of ANSI/AWS D1.1.

F. Manufacturer shall have established quality management system and environmental program.

G. The stainless steel components and enclosure panels shall be passivated after fabrication to remove embedded iron, surface rust, and weld burn. After passivation, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and passivation acid, and promote the formation of an oxidized passive layer on the stainless steel surface, which is critical to the long life of the stainless steel.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050 and as specified herein.

B. Preparation for shipment:
   1. All materials shall be suitably packaged and braced to protect against damage during transit, handling, and unloading.
   2. Manufacturer shall package equipment, be responsible for, and make good, any and all damage until the equipment is delivered to the job site.
   3. Accessories shall be packaged separately in containers clearly marked “ACCESSORIES ONLY”.
   4. A packing list, listing the contents of each container, shall be placed in a moisture proof envelope and securely fastened to the outside of the container.
   5. Provide written storage procedures for all equipment.

C. Delivery to job site: Manufacturer shall fabricate and deliver materials to the job site in conformance with the CONTRACTOR’S construction schedule to minimize handling and on-site storage of equipment.

D. Storage and protection: Protect the system components at the site and during installation prior to project completion. As a minimum, provide cover, ventilation, and proper stacking to prevent warping of any equipment stored on site.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate work with work sequence specified in Section 01140.

1.08 WARRANTY

A. The screen equipment manufacturer shall guarantee that the materials and/or the workmanship of the equipment supplied be free of defects for a period of 3 years. The warranty shall commence from the date specified in Section 01740.

1.09 MAINTENANCE

A. Spare parts: Furnish the following spare parts suitably packaged and marked. Include a price list and name, address, and telephone number of local supplier:
   1. Fine-screen (quantities per screen):
      a. HDPE spacers: 50 each.
      b. Fixed blades: 5 each.
      c. Plastic double-thicks for the top of the fixed blades: 5 pairs (if applicable).
      d. Moving blades: 5 each.
      e. Flange bearings: 4 each.
      f. Proximity or limit switch: 2 each.

B. Special Tools: Provide the following special tools:
   1. Tools required to assemble, disassemble, repair, and maintain equipment, and that have been specifically made for use on the equipment.
   2. Necessary eyebolts, hooks, and rods for handling equipment parts.
   3. List of tools with the maintenance and operation data describing the uses of the tools.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following or equal:
   1. Vulcan Industries, Inc. Model ESR-28.
   2. Huber Technology. Model SSF-HE 4000.

B. ENGINEER is not aware of any “equal” manufacturer.

2.02 SERVICE CONDITIONS

A. Screen shall be constructed to withstand the conditions specified in Section 01612 and Section 01614.

B. Wastewater temperature:
   1. Maximum 80 degrees Fahrenheit.
   2. Minimum 50 degrees Fahrenheit.

C. Material handled: Raw sewage and septage.

D. Location: Outdoors.
   1. Exposure: Variable concentrations of hydrogen sulfide and methane. Exposure to industrial solvents and petroleum products.

E. Channel dimensions:
   1. Depth: 5.50 feet.
   2. Width: 2.00 feet.

F. Maximum flow rate: 4.8 mgd with less than 15 inches head loss with flow passage area 40 percent blocked and downstream channel liquid depth of 2.0 feet.

G. Minimum flow rate: 0.3 mgd and downstream liquid depth of 0.5 feet.

H. Discharge screenings above channel top to mate with the inlet hopper of screenings compactor. Minimum angle of inclination for screenings discharge plates or chutes shall be 60 degrees above horizontal.

I. Fine screen inclination angle: Minimum 53 degrees from horizontal.

J. Equipment environment application rating:
   1. Outside the channel on the operating deck at the headworks including any portion of the equipment: NEC, Class I, Division 1, Group D.
   2. Inside the channel: NEC, Class I, Division 1, Group D.

2.03 MATERIALS

A. The fine screen and support frame shall be manufactured from AISI 316 Ti austenitic stainless steel shapes (rods, angles, and channels), pipes, and sheets. Welded fabrications involving plates thicker than 5/8-inch thick shall be manufactured from AISI 316 L stainless steel. All mechanical parts shall be designed to handle the forces that may be exerted on the screen during fabrication, shipping, erection, and proper operation according to the O&M manual.

B. Fine screen shall be manufactured in a stainless steel only factory to prevent contamination of the stainless steel with rusty dust.

2.04 FINE SCREEN

A. Frame of fine screen:
   1. Frame shall be fabricated from 0.2-inch (5 mm) thick AISI 316 Ti stainless steel. The frame shall accommodate fixed fine blade packages, blade cross pieces, slewing bracket unit, eccentrics, and drive unit including gear, shaft, and motor.
   2. Frame shall be accurately set into position in the channel and shall be capable of supporting the entire screening assembly when suspended from the pivot shaft attached to the support legs. The screen shall be installed with a minimum angle of 53 degrees from the horizontal. The frame shall be sealed to the channel walls with rubber seals.
   3. Frame sides shall be fully welded to a 0.2-inch (5 mm) thick base plate, stationary 0.16-inch (4 mm) thick fine blade cross member brackets and a 0.2-inch (5 mm) thick drive console. The drive console shall be designed to accommodate 8 adjusting bolts. Four adjustment bolts shall be parallel to the screen angle and 4 shall be perpendicular to the screen angle. The parallel bolts shall adjust the horizontal position of the moveable fine blades. The perpendicular bolts shall adjust the vertical position of the moveable fine blades.
   4. The frame sides shall form the supports for cover panels at the sides, the front, and the back of the screen.

B. Fine screen blades:

1. Moveable fine blades shall be cut from 1/12-inch (2 mm) thick cold-rolled stainless steel sheets. The fine blades shall have a horizontal length of 2-inch (50 mm) and a vertical height of 4-1/8-inch (105 mm) from fine to fine. The rear-face of the moveable fine blade shall have a series of saw-tooth or half-moon patterns cut into the straight edge of the fine blade to slice through any debris that may accumulate on the cross member supports for the stationary fine blades.
2. The upper discharge end of the moveable fine blades shall be constructed of UV-stabilized polypropylene to prevent stringy material from falling through the screen prior to discharge. The resulting tolerance between the moveable plastic step blade and the adjacent stationary fine blade shall be a minimum 0.02-inch (0.5 mm). The moveable fine blades shall be mounted in a series of cross member brackets anchored to the moveable side plate.
3. Stationary fine blades shall be manufactured from 1/12-inch (2 mm) thick cold-rolled stainless steel sheets. The stationary fines of the stationary fine blades shall have exactly the same shape as those of the movable fine blades. The stationary fine blades shall be mounted in a series of cross member brackets anchored to the fine screen frame.
4. The effective screening area of the fine screen shall be produced by alternating stationary fine blades with moveable fine blades and spacing the fine blades 1/4-inch (6 mm) apart. The open space between the lamina is maintained by 3-inch long HDPE spacer inserts mounted along the length of the moveable fine blades at a distance not less than 2 feet apart. The resulting effective screening area shall have a minimum of 60-percent free open area.
5. The movable fine blades lift the screenings to the next higher stationary fine with each rotation cycle of the gear motor. The number of rotation cycles performed in each operating cycle is dependent upon the hydraulic conditions in the channel. After completion of an operating cycle, the fine blades shall come to rest in the home position such that the horizontal surface of the fine blades are aligned across the width of the channel. A proximity sensor or limit switch shall send a signal to the PLC when the moveable fine blades are in their home position causing the gear motor to stop and hold the fine blades in alignment.
6. Screen shall utilize 2 sets of fine blades consisting of upper and lower packages. The lower blade package shall consist of 2-mm thick stainless steel blades and the upper blade package shall consist of nominal 8-mm thick polypropylene blades to prevent debris falling into the channel prior to discharge.

C. Bottom directing plate (Vulcan):

1. The fine screen shall be provided with a directing plate at the base of the screen perpendicular to the flow and level with the lowest step on the lamellas. The directing plate shall direct heavier material, such as grit and gravel onto the top shelf of the bottom row of steps on the lamellas to prevent a buildup of material in front of the screen. The overall height of the directing plate from the bottom of the channel to the bottom step shall be approximately 2-1/2 inches.
2. The directing plate shall be manufactured from AISI 316 Ti stainless steel and shall be a minimum 3/16-inch (4.7 mm) thick. The directing plate shall be provided with a replaceable nylon brush to seal between the downstream edge of the plate and the upstream edge of the bottom row of steps.

D. Bottom fine face plate and flushing pipe (Huber):
   1. Fine screen shall be designed with a blind face plate as the bottom fine to prevent grit deposits from accumulating below the fine blades. The blind plate shall be manufactured from AISI 316 Ti stainless steel plate 1/12-inch (2 mm) thick and shall be approximately 10-inches (250 mm) tall covering the width of the effective screening area. The base of the face plate shall bolt on to the screen sole plate. The top of the face plate shall bolt on to a 5/32-inch (4 mm) thick cross member support comb for the stationary fine blades. A lower grit flap or movable plates are not acceptable.
   2. A 1-1/4-inch diameter stainless steel flushing pipe shall be mounted parallel to the back of the face plate along the width of the channel to prevent heavy material from depositing below the fine blades. The flushing pipe shall have 1/2-inch diameter perforations every 8 inches. The flushing pipe shall be fitted with a Class I Division 1 1-1/4-inch diameter Burkert solenoid valve controlling the feed water to the flushing pipe.
   3. Plant effluent will be used to supply the flush water at pressures ranging from 85 to 110 psi. Provide the following equipment at the flush water point of connection at fine screen.
      a. Provide a pressure reducing valve (PRV) as required for proper operation of the flushing system.
      b. Provide a rotometer sized appropriately for anticipated flush water rates.

E. Home position proximity sensor or limit switch:
   1. Home-position proximity sensor or limit switch shall send a signal to the PLC that shall cause the gear motor to stop the rotation of the moveable fine blade package, when it is aligned with the stationary fine blade package. The signal shall be generated when the metal flag attached to the eccentrically rotated block passes the frame mounted sensor or switch.
   2. Mounting mechanism of the proximity sensor shall be adjustable to enable the moveable fine screen package to be stopped in the proper location.
   3. The proximity sensor shall be an inductive proximity sensor. The sensing distance of this sensor shall be 5/64 inch (2 mm).
   4. The limit switch shall be a single pole, double throw (SPDT) and rated at not less than 10 amps at 120 volt AC.

F. Chain Drive System (Vulcan):
   1. The chain and sprocket transmission system shall consist of endless dual chain, an upper sprocket connected to a bearing in a fixed housing and a lower sprocket connected to a bearing in a pivoting housing. The drive system shall be identical on each side of the screen.
   2. The drive system shall be designed so that the lower sprocket, lower bearing assembly and associated chain are located above the maximum water level. The lower bearing assembly shall be designed to pivot or slip to automatically accommodate uneven chain stretch.
   3. The chain shall be arranged in the same plane as the fixed lamella package and the same plane as the movable lamella package when in the parked position to ensure maximum efficiency in the drive system.
   4. Automatic shock absorber type chain tensioning devices shall be provided to ensure that the drive chains maintain proper tension and to eliminate the need for adjustment.
   5. Automatic, adjustable, oil drip-type chain lubricators shall be provided to lubricate the screen drive chains. Lubricators shall be equipped with replaceable oil canisters.

G. Linkage system (Huber):
   1. The fine screen shall be designed with a linkage system on each side of the unit that transfers the rotation of the gear motor to the moveable fine blade package. Each linkage system shall consist of an eccentrically rotated rectangular eccentric block, a flange bearing, rocker arm assembly, moveable side plate, slewing bracket, linkage arms, and bushings. Cable drives are not acceptable.
   2. The rectangular eccentric block shall be made of high-tension steel and be approximately 6-inches long by 3-1/2 inches high by 2 inches thick with two 2-inch diameter clamping connections and associated keyways bored through the block. One connection shall be clamped to the drive shaft of the gear motor, thereby causing the rectangular block to eccentrically rotate around the drive shaft. The other connection shall be clamped to an eccentric crank shaft to convert circular motion to elliptical motion. The eccentric stub shaft on the opposite side of the crank connects to the moveable side plate through the flange bearing.
   3. The moveable side plate shall carry the fine support brackets that secure the moveable fine blades. The elliptical path of motion that the moveable side plates follow shall be controlled and stabilized by linkage arms and lateral linkage rods.
   4. Each side of the screen shall be fitted with 1 set of 2 upper and 2 lower linkage arms to connect the moveable side plates to the screen frame through lateral linkage rods. Each end of the linkage arms shall be free to rotate around stainless steel stub shafts. The upper and lower linkage assemblies shall be arranged such that one end of one linkage arm rotates around a stub shaft connected to the frame and the other end rotates around a stub shaft connected to the lateral linkage rod. One end of the other linkage arm shall rotate a stub shaft connected to the lateral linkage rod, and the other end shall rotate around a stub shaft connected to a moveable side plate.

H. Gear motor drive mechanism:
   1. The drive unit shall be a gear motor rated for continuous duty and shall be selected to match the requirements of the particular screen in accordance with Section 16222. The drive motor shall be a minimum 2-hp and designed for application in a Class I, Division 1, Group D hazardous location. The motor shall be a constant speed unit rotating at 1,800 rpm and shall be powered by 230/460-VAC, 60-Hz, 3-phase power.
   2. The drive unit shall be direct coupled to the screen drive shaft through the gear box. The gear box housing shall be constructed from ASTM A-48, Class 30 cast iron. The drive unit shall be sealed from the screenings transport area with a stainless steel plate, which is welded to the frame and forms the drive console.
   3. A unit shall be incorporated within the drive unit console mounting arrangement to enable the movable blade package to be correctly and accurately positioned across the screen frame and without the necessity of any special tools.
   4. Nominal and minimum motor efficiencies shall comply with NEMA MG 1. The gear box shall be designed for AGMA Class II, 24-hour duty.
   5. The screen shall be equipped with electronic overload protection by a true-power monitor to stop the screen and initiate an alarm in the event of overload. Shear pins for overload protection are not acceptable.
   6. The drive unit and monitoring devices shall be wired internally within the unit and shall be cabled to separate power, control, and signal terminal boxes located on the stop-screen unit.

I. Pivoting support frame:
   1. A pivoting support frame shall be provided with each fine screen consisting of support legs and a pivot shaft. The frame shall be constructed of AISI 316 L stainless steel. The frame shall be designed by the manufacturer to support the weight of the fouled screen in both the in-channel and pivoted positions. The frame shall allow the screen to be rotated from the in-channel position to the pivoted position without moving the screenings compactor. The frame shall be designed to support the screen under seismic and wind conditions described in Section 01612 and Section 01614. Anchor bolts for the screen shall be Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05120.

J. Lifting lugs:
   1. Sized by manufacturer to support the full weight of a fouled screen.
   2. Located at positions that allow the fine-screen to be rotated out of the tank and/or detached and removed from the tank.
   3. A lifting bar shall be provided that is accessible from the top of the channel and has been designed by the manufacturer as the lift point for pivoting a fouled screen.

K. Covers:
   1. The screen shall be fully enclosed with a covering system so that odors are retained within the system. Removable covers or doors shall be provided for servicing and inspection. Removable covers shall be a minimum of 1-mm thick AISI 316 Ti stainless steel with engineered bends on all sides to prevent deflection. Internal support framework shall be installed where required to assure a sound, rigid enclosure. Seams shall be continuously welded. Covers shall be attached to the screen with a 1/4-turn latching mechanism. Covers bolted directly to the frame shall not be allowed.
   2. The covers shall extend from the deck level to the top of the screen. The covers shall enclose the drive reducer and home proximity/limit switch. Portions of the drive motor may protrude from the cover provided that the gap between motor and cover is minimized or sealed to allow negligible amounts of vapors to migrate from the covered regions.

L. Discharge chute:
   1. Provide a Type 316 stainless steel discharge chute for each screen that directs screenings from the screen discharge point into the screenings compactor at an angle no less than 60 degrees from the horizontal. The chute must allow the screen to be pivoted without removing the chute.

M. Appurtenances:
   1. Nuts, bolts, and other fasteners, Type 316 stainless steel.
   2. Mechanical equipment identification plates as provided in Section 10400.

2.05 ELECTRICAL, INSTRUMENTATION, AND CONTROLS

A. General:
   1. Electrical work shall conform to Section 16050.
   2. Electrical elements identification as provided in Section 16075.
   3. Electrical connections shall provide flexibility to allow full pivot without disconnecting power or cables.

B. Control panel:
   1. The controls for both fine screens and screenings compactors shall be incorporated into common control panels as indicated on the drawings and in accordance with Section 17710. A common vendor control panel (VCP) shall be provided for each channel and serve the screen and screenings compactor associated with the channel. The VCPs shall be NEMA 4X of stainless steel Type 316 construction.
      a. Power to each Control Panel shall be through a single 480-volt, 3-phase, 60-Hertz feeder. Provide fine-down transformers and power supplies inside the control panel to power the 120-volt loads and 24-volt DC loads.
   2. Main overcurrent device shall be a flange mounted disconnect handle operating a molded case circuit breaker in accordance with Specification Sections 17710 and 16412.
      a. Provide all other VCP Circuit breakers in accordance with Specification Section 16412.
   3. Each VCP shall include a programmable logic controller (PLC) that complies with Sections 17720 and 17761.
   4. Provide Ethernet communications to communicate with the facility PLC and SCADA systems as indicated on the Drawings. Coordinate data points and addressing with the ICSC.
   5. Each VCP shall include a managed ethernet switch and panel mounted fiber optic patch panel that complies with Section 17733.
   6. Each VCP shall include a human machine interface screen that complies with Sections 17721 and 17765. Provide a hinged cover for protection of the operator interface.
   7. Each VCP shall include a closed circuit air conditioning system, temperature switches, strip heaters, and corrosion inhibiting vapor capsules or strips per Section 17710.
   8. Each VCP shall include all motor starters, contactors, and overload relays required to operate the screen and the screenings compactor. The panel shall also include a 460/120 volt control power transformer.
      a. As specified in Section 16422.
   9. Each VCP shall include the following pilot lights for the screen and screenings compactor:
      a. Common functions:
         1) Control Power On.
      b. Bar screen:
         1) Running.
         2) High Current.
         3) Overload.
         4) High Temperature.
      c. Screenings Compactor:
         1) Running.
         2) High Current or Overtorque.
         3) Overload.
         4) High Temperature.
   10. Each VCP shall provide the following signals to SCADA via Ethernet connection.
      a. Bar screen:
         1) Running
         2) Overload.
         3) High Current.

4) High Temperature.
5) Screen in HAND.
6) Screen in AUTO.
7) E-STOP.
8) System Fail.

b. Screenings Compactor:
1) Running.
2) High Current or Overtorque.
3) Overload.
4) High Temperature.
5) Compactor in HAND.
6) Compactor in AUTO.
7) E-STOP.
8) System Fail.

11. Each VCP shall receive the following signals from SCADA via Ethernet connection.
a. System run permissive.
b. Channel upstream level.
c. Channel downstream level.

12. Each VCP shall include the following controls for the screen and screenings compactor:
a. E-Stop pushbutton to stop all motors and solenoids.
b. Bar screen:
1) Screen Motor Hand-Off-Auto Selector Switch.
2) Screen Wash Hand-Off-Auto Selector Switch.
c. Screenings Compactor:
1) Hand-Off-Auto Selector Switch.
2) Forward-Off-Reverse Selector Switch with spring return from Reverse.
3) Initiate pushbutton to allow starting of a cleaning sequence when the local controls are utilized.

13. The control panel shall include Emotron M20 True Power Monitors or Tsubaki TSBSS Series Shock relays to detect over-current power consumption by the fine screen and screenings compactor motors. The power monitor shall measure the input power and display shall show values for: 3-phase current, 3-phase voltage, power (kW), energy consumption (kWh), power factor, Torque (Nm), elapsed time, and motor thermal capacity. The unit shall allow for Inhibit Pre-Alarm Signal setting as well as Auto Setting and will provide an analog output stopping the operation of the unit in the event of a jam or overtorque condition.

C. Programming:
1. The PLC in each VCP shall be programmed by the System Supplier to control the operation of the associated screen and screenings compactor based on different level and timer. The system shall be capable of handling normal flow conditions and high flow conditions.
2. In addition, the system shall be capable of executing the Screen control strategy outlined in Section 17101-10 and operate using inputs provided by, and shall send outputs to, the Plant PLC.

D. Ultrasonic level monitor:
   1. In automatic mode, the fine screen shall operate based on the water level differential from upstream to downstream of the screen. Ultrasonic level monitors shall be installed upstream and downstream of each fine screen. The ultrasonic level monitor shall be provided by the CONTRACTOR as specified in Section 17206.
      a. The ultrasonic level monitors will be powered and monitored by the Plant PLC.
      b. Channel level signals will be transmitted to the VCP via fiber optic Ethernet connection.

E. Emergency stop local control panel:
   1. Provide an emergency stop local control panel for each channel. The local control panel shall be dual rated for NEMA 7 and NEMA 4X, and will be located adjacent to the screen and washer compactor unit as indicated on the Drawings. The local control panel shall consist of the following components:
      a. One red mushroom-head emergency stop button to stop the bar screen.
      b. One red mushroom-head emergency stop button to stop the washer compactor unit.

F. Termination Box:
   1. For each channel, provide a dual rated NEMA 7 and NEMA 4X termination box in accordance with Specification Sections 16134 and 17710 containing all terminations required for the bar screen and washer compactor units. Provide additional terminations required for all other ancillary devices including but not limited to proximity switches and solenoid valves. Provide breather and drain fitting for the termination box.

2.06 SOURCE QUALITY CONTROL

A. Factory inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory tests and adjustments:
   1. Test each screen assembly, in its operating position, to ensure proper fine movement and alignment.
   2. Run equipment and test for minimum of 8 hours. Testing shall be done in factory with unit oriented in its installed position.
   3. Refer to Sections 01660 and 17950.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide flexible connections to allow full pivot of the screen without needing to disconnect electrical or water connections.

B. Installation of equipment specified herein shall be in strict accordance with the contract documents and requirements of the manufacturer's written instructions and shop drawings. It is the CONTRACTOR'S responsibility to verify the accuracy of all necessary dimensions in the field to ensure compatibility with the specifications and equipment.

C. Route non-potable water piping to the flushing pipe and provide a true union shut-off ball valve upstream of each individual connection (Huber only).

3.02 FIELD QUALITY CONTROL

A. Testing, training, and start-up: As specified in Section 01660 and the following requirements below.

B. Tests:
   1. General: Conduct tests in presence of the ENGINEER.
   2. Upon completion of installation by the CONTRACTOR and certification of proper installation of the equipment by the Manufacturer's factory employed service technician, the equipment shall be functionally tested under supervision of CONTRACTOR and Manufacturer's factory employed service technician for a minimum of 8 hours to ensure that all clearances, vibration, tracking, and motor operating characteristics are within acceptable limits.

C. Required results:
   1. In the event fine screen fails to meet field quality control test requirements of this Section, make necessary changes and retest.
   2. If fine screen remains unable to meet test requirements to satisfaction of the ENGINEER, remove and replace such equipment with satisfactory equipment at no additional cost.

D. Manufacturer's field service:
   1. CONTRACTOR to coordinate field service work with the manufacturer's service representative, OWNER, and ENGINEER prior to initiating such work.
   2. Manufacturer's service representative: Manufacturer is to furnish services of representative experienced in erection and operation of fine-screens.
   3. Period of services: The manufacturer shall include in his bid a minimum of five 8-hour days and two trips. The specified durations are the minimum time on the job site and do not include travel time.
   4. Services are to include the following:
      a. Installation consultation and advice.
      b. Final inspection and adjustment prior to testing.
      c. Supervision of testing.
      d. Instruction of personnel on operation and maintenance of equipment as specified in Section 01660.

END OF SECTION

SECTION 11333

SCREENINGS COMPACTORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Screenings compactor units.
   2. Power and control panel with reversing starter, programmable logic controller (PLC), control switches and indicating lights, and electrical equipment shall be wired to a termination box located on or next to the compactor.
   3. Tag numbers:
      a. Screenings Compactor No. 1: 10-CMP-044.
      b. Screenings Compactor No. 2: 10-CMP-054.

B. All equipment shall conform to the requirements of Section 15050, except as modified herein.

C. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01330 - Submittal Procedures.
      c. Section 01600 - Product Requirements.
      d. Section 01612 - Seismic Design Criteria.
      e. Section 01660 - Testing, Training, and Commissioning.
      f. Section 01740 - Warranties and Bonds.
      g. Section 01782 - Operation and Maintenance Data.
      h. Section 09960 - High-Performance Coatings.
      i. Section 10400 - Identification Devices.
      j. Section 11332 - Mechanical Fine Screens.
      k. Section 15050 - Basic Mechanical Materials and Metals.
      l. Section 15958 - Mechanical Equipment Testing.
      m. Section 16050 - General Requirements for Electrical Work.
      n. Section 16075 - Electrical Identification.
      o. Section 16134 - Boxes.
      p. Section 16125 - Fiber Optic Cable and Appurtenances
      q. Section 16222 - Low Voltage Motors up to 500 hp.
      r. Section 16412 - Low Voltage Molded Case Circuit Breakers
      s. Section 16422 - Motor Starters
      t. Section 17050 - Process Control and Instrumentation Systems General Requirements.

u. Section 17100 - Control Strategies.
v. Section 17101-10 - Headworks/Septage Receiving.
w. Section 17710 - Control Systems-Panels, Enclosures, and Panel Components.
x. Section 17206 - Level Measurement - Ultrasonic.
y. Section 17720 - Control Systems – Programmable Logic Controllers Hardware PLCs.
z. Section 17721 - Human Machine Interface Hardware.
aa. Section 17733 - Network Materials and Equipment
bb. Section 17761 - PLC Programming Software.
cc. Section 17765 - Human Machine Interface Software.
dd. Section 17950 - Testing, Calibration, and Commissioning.

D. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the Specifications.

1.02 REFERENCES

A. American National Standard Institute (ANSI).

B. American Society of Mechanical Engineers (ASME).

C. American Society of Testing Materials (ASTM).

D. Anti-Friction Bearings Manufacturers Association (AFBMA).

E. National Electric Code (NEC).

F. National Electric Manufacturers Association (NEMA):
1. NEMA MG1.

1.03 DEFINITIONS

A. System Supplier: Factory-authorized supplier of the mechanical fine screens as defined in Section 11332.

1.04 SYSTEM DESCRIPTION

A. System Supplier shall be responsible for furnishing the mechanical fine screens, screenings compactors, and associated vendor control panels including PLCs and programming. System Supplier shall provide a coordinated package that meets the requirements of both this section and Section 11332.

B. Screenings compactor unit shall dewater, compact, and transport screenings to the screenings bin. Operation of screenings compactor shall be coordinated with the operation of the fine screens as specified in Section 17101-10.

C. Each screenings compactor unit shall consist of a screenings feed hopper, a preliminary compaction zone, a main compaction zone, a drive unit, a discharge conveyance pipe, instrumentation, and control devices.

D. Units shall be designed to receive screenings directly from the headworks screens, as indicated on the Drawings. Units shall reduce water content of screenings using a pressing action. Screenings shall fall from the screens by gravity into unit's feed hopper. Within the preliminary compaction zone, screenings shall be crushed and compacted. From the preliminary compaction zone, screenings shall be conveyed into the main compaction zone where dewatering and compaction of screenings shall take place. From this zone, screenings shall then be conveyed to the discharge conveyance pipe. Discharge conveyance pipe shall transport compacted screenings plug for a distance and height suitable for discharge into a common screenings bin as indicated on the Drawings and as specified herein. Water expelled from screenings by screenings compactor shall drain through appropriately sized drainage area in the bottom of the press chamber. Said drainage water shall be piped for gravity drainage from the screenings compactor to a drain pipe as indicated on the Drawings.

E. All mechanical parts shall be designed to handle the forces that may be exerted on them during fabrication, shipping, installation, and operation.

F. Screenings compactor unit shall have a screenings compacting capacity of not less than 70 cubic feet per hour of wet screenings in continuous operation mode based on 25-percent trough loading.

G. Screenings compactor unit shall be capable of minimum 50-percent volume reduction of the screenings material.

H. Screenings compactor unit shall have a parallel drive unit.

I. Screenings compactor unit shall discharge the screenings as indicated on the Drawings.

J. The drive motor shall be reversible and shall be rated for continuous operation.

K. A common termination box for both fine screens and screenings compactors for mounting near the equipment. A common termination box shall be provided for each channel and will serve the screen and screenings compactor associated with the channel. Refer to Specification Section 11332 for requirements.

L. A common emergency stop local control panel both fine screens and screenings compactors for mounting near the equipment. A common emergency stop local control panel shall be provided for each channel and will serve the screen and screenings compactor associated with the channel. Refer to Specification Section 11332 for requirements.

M. The controls for both fine screens and screenings compactors shall be incorporated into common control panels as indicated on the drawings. A common vendor control panel (VCP) shall be provided for each channel and will serve the screen and screenings compactor associated with the channel. Refer to Specification Section 11332 for control panel requirements.

1.05 SUBMITTALS

A. In addition to the requirements of Sections 01330 and 15050, submit information specified herein.

B. Provide a common shop drawings submittal that also addresses equipment specified under Section 11332.

C. Shop drawings shall consist of a cover sheet indicating the drawing number and Specification page and number to which referenced, intended use and data summary, outline drawings, cut-away drawings, parts lists, material specification lists, and all information required to substantiate that proposed equipment meets the specifications. Shop drawings submittals will not be considered complete if cut-away or assembly drawings with part and material specification lists are not included.

D. Field verify dimensions and submit layout drawings (plans and sections) showing the equipment installation in the field. Include screenings discharge piping and their supports.

E. Provide detailed requirements, instructions, and drawings for connecting the screenings discharge chute to the compactor hopper.

F. Coordinate submittal with other submittals and with the requirements of the Contract Documents.

G. Shop drawings:
   1. Make, model, and weight of each equipment assembly.
   2. Complete catalog information, descriptive literature, specifications, and materials of construction.
   3. General arrangement drawings showing the complete assembly, part number, and material list.
   4. Detailed structural, mechanical, and electrical drawings showing the equipment dimensions, size, and installation. The Drawings shall include plan, elevation, and sectional views of the installation.
   5. Recommended configuration of the screenings discharge piping from the equipment in order to discharge the materials into one common bin.
   6. Process data and design calculations.
   7. Factory protective coatings.
   8. Anchor bolt layout drawings.
   9. Motor characteristics and performance information.
   10. Gear reducer data including service factor, efficiency, torque rating, and materials.
   11. Control panel elevation drawings showing fabrication and placement of operator interface devices and associated elements.
   12. Power and control wiring diagrams, including terminals and numbers.
   13. See Section 17710, for additional submittal requirements.

H. Information required later in this Section under Article 2.03 Control Systems.

I. Calculations: Detailed calculations and design data verifying conformance with the Drawings and Specifications:
   1. Structural calculations for the complete system, including all welded joint details and anchor bolts, signed by a Professional Engineer registered in California.
   2. Seismic design as specified in Section 01612.

J. Quality control submittals:
   1. Detailed performance test procedures: Factory and field testing.
   2. Performance test data.
   3. Certificates:
      a. Manufacturer's certification that the equipment was installed in accordance with the manufacturer's instructions, inspected by the manufacturer, serviced with the proper lubricants, and equipped with applicable safety equipment and controls.
      b. Manufacturer's certification that all welding was performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code, or equivalent.
      c. Manufacturer's certification that the stainless steel materials of the equipment were passivated after fabrication to remove embedded iron, surface rust, and weld burn.
      d. A copy of documents proving certification of the Manufacturer's Quality Management System and Environmental Program.

K. List of spare parts and special tools.

L. List of recommended spare parts.

M. Manufacturer's installation instructions.

N. Submit operating instructions with descriptive literature.

O. Documentation of required maintenance for all equipment including an approved list of lubricants and the required quantities.

P. Operation and maintenance (O&M) manuals:
   1. Operation and maintenance manual submittals shall be complete in one comprehensive submittal. Individual submittals for components of the system will not be accepted for review.
   2. Submit operation and maintenance manuals (paper copies and electronic copy) in accordance with Section 01782. Start-up of the system will not be permitted until O&M manuals have been submitted and approved by the ENGINEER.

Q. Technician qualifications resume: Submit resume of technician to perform Manufacturer's Field Services.

R. Submit location of the nearest permanent service headquarters of the compactor and motor manufacturer for the compactor and motor submitted.

S. Warranties.

T. Training course outlines.

U. Installation reference list:
   1. Provide a reference list, including the following information as a minimum:
      a. Name and location of installation in the United States.
      b. Name and telephone number of the person in direct responsible charge of the equipment.
      c. Month and year the equipment was placed in operation.

d. Size of equipment.
e. Number of units installed.
f. Service.

1.06 QUALITY ASSURANCE

A. System Supplier shall be responsible for furnishing the mechanical fine screens, screenings compactors, and associated vendor control panels including PLCs and programming. System Supplier shall provide a coordinated package that meets the requirements of both this Section and Section 11332.

B. Manufacturer of equipment specified herein shall have completed and made operational not less than 20 separate installations of screenings compactor units of similar size and type in municipal wastewater application in the United States, with not less than 10 years operating experience.
   1. Multiple screenings compactors at a plant shall be considered as one installation toward meeting the experience requirements.
   2. Fulfillment of the specified experience requirements shall be a condition of acceptance.

C. Equipment furnished shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with approved Drawings, Specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

D. Screenings compactor units shall be factory assembled and then tested for a minimum of 8 hours prior to delivery. Individual equipment shall be delivered to the site fully assembled (shipping requirements may require minor disassembly). The units shall be capable of being set in place and field erected by the CONTRACTOR with minimal field assembly.

E. Manufacturer's shop welds, welding procedures, and welders: Qualified and certified in accordance with the requirements of ANSI/AWS D1.1.

F. Manufacturer shall have established quality management system and environmental program.

G. The stainless steel components and enclosure panels shall be passivated after fabrication to remove embedded iron, surface rust, and weld burn. After passivation, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and passivation acid, and promote the formation of an oxidized passive layer on the stainless steel surface, which is critical to the long life of the stainless steel.

1.07 PROJECT CONDITIONS

A. Compactor shall be constructed to withstand conditions specified in Section 01612.

B. Wastewater Temperature:
   1. Maximum 80 degrees F.
   2. Minimum 50 degrees F.

C. Equipment and devices, with the exception of the Vendor Control Panels, shall be located in a Class 1, Division 1 area.

D. The Vendor Control Panels shall be located in an unclassified area.

1.08 DELIVERY, STORAGE, AND HANDLING

A. As specified in Sections 01600 and 15050 and as specified herein.

B. Preparation for Shipment:
   1. All materials shall be suitably packaged and braced to protect against damage during transit, handling, and unloading.
   2. Manufacturer shall package equipment, be responsible for, and make good, any and all damage until the equipment is delivered to the job site.
   3. Accessories shall be packaged separately in containers clearly marked “ACCESSORIES ONLY”.
   4. A packing list, listing the contents of each container, shall be placed in a moisture-proof envelope and securely fastened to the outside of the container.
   5. Provide written storage procedures for all equipment.

C. Delivery to Job Site:
   1. Manufacturer shall fabricate and deliver materials to the job site in conformance with the CONTRACTOR’s construction schedule to minimize handling and on-site storage of equipment.
   2. Ship in one piece, assembled for erection by the CONTRACTOR unless shipping limitations dictate otherwise. If knocked-down, equipment shall be shipped in the minimum practical number of pieces for field assembly by the CONTRACTOR.

D. Storage and Protection: Protect the system components at the site and during installation prior to project completion. As a minimum, provide cover, ventilation, and proper stacking to prevent warping of any equipment stored on site.

1.09 WARRANTY

A. In addition to the requirements specified in Section 15050, warrant equipment parts free of defects in material and workmanship for a period of 3 years. Warranty shall commence from the date specified in Section 01740.

1.10 MAINTENANCE

A. Spare Parts: Provide the following spare parts (quantity per screenings compactor):
   1. A complete screw brush.
   2. Two complete sets of wear bars (if applicable).
   3. Last flight of screw (if applicable).
   4. One complete gear motor assembly (gear box and motor).
   5. One set of thrust bearings.

B. Spare parts shall be packaged with labels indicating the contents of each package, and shall be delivered to OWNER as directed.

C. Include a price list and name, address, and telephone number of local supplier.

D. Special Tools:
   1. Any special tools required to assemble, disassemble, repair, and/or maintain any item of mechanical equipment shall be furnished with the equipment.
      a. Special tools shall include any type of tool that has been specifically made for use on an item of equipment for assembly, disassembly, repair, and maintenance.
      b. When special tools are provided, they shall be marked or tagged and a list of such tools shall be included with the maintenance and operation instructions describing the use of each marked tool.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following and or equal:
   1. Vulcan Industries, EWP 250/600.
   2. Huber Technology, Inc., WAP-4.

B. ENGINEER is not aware of any “equal” manufacturer.

C. Listing of a manufacturer does not necessarily indicate that the manufacturer’s standard equipment model meets the specification. Listing a manufacturer does not relieve the manufacturer of meeting all the requirements of the Specifications and may require the manufacturer to modify its standard equipment in order to meet the requirements of this Specification.

2.02 MATERIALS AND CONSTRUCTION

A. Unless otherwise specified, use materials of construction specified below for all components:
   1. Screenings compactor shall be manufactured from AISI 316 Austenitic stainless steel shapes (rods, angles, and channels), pipes, and sheets.
   2. Welded fabrications involving plates thicker than 5/8-inch thick shall be manufactured from AISI 316L stainless steel.
   3. All fasteners, anchor bolts, and hardware shall be Type 316 SST.
   4. All threaded fasteners shall be coated with a nickel based anti-seize thread lubricant prior to assembly.
   5. The stainless steel components and enclosure panels shall be passivated after fabrication to remove embedded iron, surface rust, and weld burn. After passivation, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and passivation acid, and promote the formation of an oxidized passive layer on the stainless steel surface, which is critical to the long life of the stainless steel.

B. Equipment shall be the standard product of the manufacturer, modified as necessary to conform to the Specifications.

C. Screenings Compactor Unit:
   1. The screenings compactor shall be equipped with lifting lugs sized by the manufacturer to support the weight of a fully loaded unit.
   2. Mounting legs shall be attached to the screenings compactor and anchored to the equipment pad/floor with appropriately sized anchor bolts per manufacturer in accordance with Specification Section 01612.

D. Screenings Compactor Body:
   1. Screenings compactor body shall include a trough opening for screenings deposit. A level-mounting flange shall be provided around the trough for the transitional inlet hopper that directs screenings into the trough of the screenings compactor unit.
   2. Inlet hopper:
      a. Fabricated from minimum 12-gauge 316 stainless steel.
      b. Compatible with the screen/screenings compactor configuration as shown on the Drawings.
      c. Hinged access door with maximum dimensions to be recommended by the compactor manufacturer.
   3. The screenings compactor body shall house the center-shafted screw, shall include a minimum of two spray water connections to the unit, to include at least one connection in the screenings trough and one connection to mount the drain pan. The screenings compactor body shall include perforations in a vertical alignment in the compaction zones. The bottom of the housing shall contain a 1/2-inch thick, 316 stainless steel wedge wire section for drainage.
   4. The screenings compactor body shall be equipped with a minimum of six guide bars made of Hardox 400 abrasion resistant plate unless shafted screw is cantilevered using a thrust bearing. The guide bar shall be bolted from the outside of the tube for easy access and removal. The guide bars shall be at least 6 inches long and the thickness shall be a minimum of 3/8 inch. Welded guide bars shall not be acceptable unless shafted screw is cantilevered using a thrust bearing.
   5. The removable cover for the unit shall be held in place by a latching system to allow easy removal. A resilient seal shall be mounted to the cover to form a watertight seal with the screw housing.

E. Shafted Screw:
   1. The hollow shafted screw shall transport screenings from the trough area and shall force the compacted screenings through the discharge pipe.
   2. Screw flights shall be constructed from either:
      a. 200 Brinnel alloy steel, with minimum thickness of 3/4-inch, or
      b. 316 stainless steel with a minimum thickness of 10 mm. The flights in the compression zone shall have a 10-mm thick layer of Hardox 400 welded to the surface of the flights.
   3. Stainless steel backed brush with nylon bristles shall be attached to the flights of the shafted screw by means of stainless steel holder clips and fasteners along the entire length of the wedge wire drain section.
   4. A shaftless screw is not acceptable.

F. Water Manifold and Water Connections:
   1. Screenings compactor unit shall be equipped with a manifold to supply water to the different spray water inlet zones. Screenings compactor shall be provided with a minimum of two brass bodied solenoid valves for injecting

spray water into compactor. One of the injection locations shall be into the screenings trough. In addition, manual 316 stainless steel ball valves and a pressure gauge shall be provided as part of the valve wash water manifold. Unit shall be designed to accept spray water from the facility's plant water system, which is sourced from tertiary effluent. Plant water pressure ranges from 85 to 110 psi. Provide a PRV as required for proper operation of the compactor spray water system.

2. Spray water connections shall be sized and positioned by the unit manufacturer. Maximum water consumption for the unit shall be 25 gpm.
3. Main spray water supply line to manifold shall be minimum 1-inch diameter.
4. The valve manifold and the local operator control station shall be mounted on a common floor mounted 316 stainless steel support stand.

G. Drain Pan:
1. Drain pan shall collect wash water filtrate. Drain pan shall be fabricated from minimum 1/8-inch thick Type 316 stainless steel plate and shall be attached to the screenings compactor body with stainless steel clasps for easy removal.
2. Drain pan shall include a threaded inlet connection for spray water from the manifold for flushing on one end. A minimum 4-inch drain connection shall be provided at the lowest portion of the drain pan at its opposite end.

H. Screenings Discharge Pipe:
1. The entire screenings discharge piping system including supports shall be designed by the equipment supplier.
2. Screenings discharge pipe shall be constructed of minimum 11-gauge 316 SST and shall be of the configuration shown on the Drawings or as recommended by the manufacturer, in order to discharge the material from the parallel equipment into a common bin.
3. Screenings discharge pipe shall be connected to the screenings compactor body with a flange.
4. Diameter of the straight section of the discharge pipe shall increase in size to ease the transport of the screenings; size shall be determined by screenings compactor manufacturer.
5. Provide bends of appropriate angle in the discharge pipe as required to direct screenings to the discharge bin.
6. Discharge conveyance pipe shall be provided with floor-mounted 316 SST supports to support the weight of a fully loaded discharge conveyance pipe. Provide at least 2 supports per discharge conveyance pipe.

I. Continuous bagging system:
1. Equip an engineered, continuous bagging system onto discharge pipe.
2. Provide a stainless steel chute transition piece if required to accommodate a continuous bagging system.
3. Cassette holder:
   a. Manufactured in stainless steel and ABS plastic.
   b. Configured for vertical discharge of solids into bag.
4. Bag:
   a. Length: Minimum 200 feet per cassette.
   b. Material: Polyethylene.
5. Manufacturer:
   a. Paxxo, Model Longofill.
   b. Or equal.

J. Spraywater Solenoid Valves:
   1. Provide minimum 2 normally closed solenoid explosion-proof valves to provide spray water intermittently during cleaning and flushing cycles.
   2. Solenoid valves shall have a brass body.
   3. Solenoid valves shall be rated for installation in a Class 1, Division 1 area as specified in this Section.
   4. Solenoid valves shall be suitable for a maximum operating pressure of 125 psig.
   5. Solenoid valves shall be suitable for 120-volt AC operation.
   6. Solenoid valves shall have Class F molded coils.
   7. Provide a valve manifold stand minimum 1/4-inch thick 316 SST plate supported by 316 SST elements.

K. Gear Motor Drive Mechanism:
   1. Screenings compactor shall be complete with an integrated drive assembly consisting of an electric reversing motor coupled to a gear reducer with a right angle gear drive.
   2. Motor shall be a minimum 5.0 horsepower, 230/460 volt, 3-phase, 60-Hertz with a service factor of 1.15. Motors shall be rated at 50 degrees C ambient with Class F insulation and shall have a Class B temperature rise at full load. Nominal motor speed shall be 1,800 rpm. Motor shall be in accordance with Specification Section 16222.
   3. Gear reducers shall have ball or roller bearings throughout with all moving parts immersed in oil. Gears shall be of alloy steel with threads precision ground and polished after casehardening. Shafts shall be of high strength alloy steel ground to required tolerances. All ball or roller bearings shall be rated and manufactured by a member of the Antifriction Bearing Manufacturer's Association. At least one bearing on each shaft shall be of the combined radial and thrust type.

2.03 POWER AND CONTROL SYSTEM

A. Provide a complete control system, ready for operation as soon as field piping and electrical power are connected.

B. Controls shall be as specified in Section 17101-10 and as shown on the P&IDs. Coordinate controls with the ICSC to provide complete functioning system.

C. Control Panel, termination box, and emergency stop local control station:
   1. As specified in Section 11332.

2.04 FABRICATION

A. Shop Assembly:
   1. Screenings compactor shall be factory assembled and tested.
   2. Mount all accessories and appurtenances so that the complete system may be tested.

2.05 FINISHES

A. Stainless steel and plastic components shall not be painted. The stainless steel structural components and enclosure panels shall be passivated after fabrication to remove embedded iron, surface rust and weld burn.

B. All other surfaces shall be surface prepared, factory primed, field primed, and finish coated as specified in Section 09960.

2.06 SOURCE QUALITY CONTROL

A. Factory Testing:
   1. Screenings compactor shall be factory assembled and tested before shipment.
   2. Test equipment in accordance with Section 15958.
   3. Run screenings compactor to verify proper operation of the mechanism.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Testing, Training, and Start-Up: As specified in Section 01660 and the following requirements.

B. Tests:
   1. General: Conduct tests in presence of the ENGINEER.
   2. Upon completion of installation by the CONTRACTOR and certification of proper installation of the equipment by the manufacturer's factor employed service technician, the equipment shall be functionally tested under supervision of CONTRACTOR and manufacturer's factory employed service technician for a minimum of 8 hours to ensure that all clearances, vibration, tracking, and motor operating characteristics are within acceptable limits.
   3. In addition, perform additional, "stress" testing as described herein to ascertain strength and durability. As a minimum, stress testing shall demonstrate that each compactor can pass four 12-inch long oak 2x4s, four red bricks, and four 12-inch long pieces of 4-inch diameter Schedule 80 PVC pipe. The equipment shall demonstrate operation without vibration, jamming, or overheating and perform its specified function satisfactorily. The CONTRACTOR shall furnish all test materials as described.

C. Required Results:
   1. In the event the screenings compactor fails to meet field quality control test requirements of this Section, make necessary changes and retest.
   2. If the screenings compactor remains unable to meet the test requirements to the satisfaction of the ENGINEER, remove and replace such equipment with satisfactory equipment at no additional cost.

D. Manufacturer's Field Service:
   1. CONTRACTOR to coordinate field service work with the manufacturer's service representative, OWNER, and ENGINEER prior to initiating such work.
   2. Manufacturer's Service Representative:
      a. Manufacturer is to furnish services of representative experienced in erection and operation of supplied screenings compactors.

b. Period of Services: The manufacturer shall include in his bid a minimum of two 8-hour days and one trip. The specified duration's are the minimum time on the job site and do not include travel time.

c. Services are to include the following:
   1) Installation consultation and advice.
   2) Final inspection and adjustment prior to testing.
   3) Supervision of testing.
   4) Instruction of personnel on operation and maintenance of equipment as specified in Section 01660.

END OF SECTION

SECTION 11334

IN-LINE GRINDER

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: In-line grinder including main housing, cutter-drive assembly, and motor controller.

B. Equipment Numbers:
   1. Dewatering Feed Grinder No. 1: 50-GDR-422.
   2. Dewatering Feed Grinder No. 2: 50-GDR-426.

C. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01600 - Product Requirements.
      b. Section 01612 - Seismic Design Criteria.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 01740 - Warranties and Bonds.
      e. Section 09960 - Coatings.
      f. Section 13411 - Process Control Strategies.
      g. Section 15050 - Basic Mechanical Materials and Methods.
      h. Section 16412 - Low Voltage Molded Case Circuit Breakers.
      i. Section 16422 - Motor Starters.
      j. Section 16222 - Low Voltage Motors up to 500 hp.
      k. Section 17710 - Control Systems-Panels, Enclosures, and Panel Components.

D. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the Specifications.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI 4130 B - Heat Treated Alloy Steel.
   2. ANSI 4140 B - Heat Treated Hexagon Steel.

B. American Society for Testing Materials (ASTM):
   1. A 395 B - Standard Specification for Ferritic Ductile Iron Pressure Retaining Castings.
   2. A 536-84 B - Specifications for Ductile Iron Castings.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

Application	Dewatering Feed
Percent Solids:	5%
Flow Rates:	
Maximum	150 gpm
Minimum	50 gpm
Pressure Drop:	
Maximum	0.9 psi
Pipe Sizes:	
Inlet	6 inches
Outlet	6 inches

1.04 SUBMITTALS

A. Shop Drawings:
   1. The following shall be submitted in compliance with Section 15050:
      a. Make, model, and weight of each equipment assembly.
      b. Complete catalog information, descriptive literature, specifications, and materials of construction.
      c. Detailed structural and mechanical drawings showing the equipment dimensions, size, and installation.
      d. Process data and design calculations including flow rates and pressure loss.
      e. Factory protective coatings.
      f. Anchor bolt calculations as required by Section 01612.
      g. Anchor bolt layout drawings.

B. Quality Control Submittals:
   1. Factory functional test report.
   2. Field performance test report.
   3. Certificate of Installation.

C. Maintenance Manual:
   1. Data shall be included in the Maintenance Manual.

D. Warranties.

E. Certificates.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer shall have at least 10 years of experience in the design, application, and supply of in-line grinders for wastewater sludge, and shall provide a list of not less than 25 operating installations in the United States as evidence of meeting the experience requirement.
   1. Multiple gates at a plant shall be considered as one installation toward meeting the experience requirements.
   2. Fulfillment of the specified experience requirements shall be a condition of acceptance.

B. Modifications: Modify standard equipment to meet, as a minimum, the values specified for dimension, design, and intent of this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Sections 01600 and 15050.

1.07 WARRANTY

A. As specified in Sections 01740 and 15050 unless noted otherwise.

B. Warrant equipment free of defects in material and workmanship for 2 years from the date specified in Section 01740. Cover parts and labor.

C. Manufacturer’s warranty shall be issued in the OWNER’s name.

1.08 MAINTENANCE

A. As specified in Section 15050.

B. Provide the following spare parts:
   1. Bearings, Mechanical Seals, O-Rings: One complete set.
   2. Fuses: 3.
   3. 6-Volt, Long-Life Lamps: 3. (Not required if Push-to-Test LEDs).
   4. Complete Gasket Set: 1.
   5. Cutters: 3.
   6. Spacers: 3.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following, or equal:
   1. JWC Environmental, "Muffin Monster."
   2. Monoflo, “TR Muncher.”

2.02 IDENTIFICATION

A. Each unit of equipment shall be identified with a Type 316 stainless steel nameplate, securely affixed in a conspicuous place. Nameplate information shall

include equipment model number, serial number, manufacturer's name, and location.

2.03 MATERIALS

A. General:
   1. Sewage grinders shall consist of the following three main components:
      a. Main housing.
      b. Cutter cartridge and drive assembly.
      c. Motor controller.
   2. Cutter cartridge and drive assembly shall be two-shaft design and be capable of continuous operation, processing wet or dry. Single-shaft devices using a single rotating cutter bar with stationary cutters will not be acceptable.
   3. Two-shaft design shall consist of parallel shafts alternately stacked with intermeshing cutters and spacers positioned on the shaft to form a helical pattern. The shafts shall counter-rotate with the driven shaft operating at approximately two-thirds of the speed of the drive shaft for the JWC Environmental Muffin Monster design. For the Monoflo TR Muncher design, the fast shaft shall be no faster than 72 rpm and the slow shaft no faster than 60 rpm.

B. Main Housing:
   1. JWC Environmental Muffin Monster:
      a. Main housing shall be a solid-cast structure made of ASTM A 536-84 ductile iron. One-piece flanged body to be capable of remaining in-line if removal of the cutter cartridge and drive assembly is required for service.
      b. Inside profile of the main housing shall be concave to follow the radial arc of the cutters. To direct larger particles toward the cutters and ensure fineness of grind, the main housing must maintain a clearance not to exceed 5/16 inch between the major diameter of the cutter and the concave arc of the housing.
      c. Main housing to be provided with a covered access port for equipment inspection. Access port covers to be ASTM A 536-84 ductile iron.
      d. Maintenance and Service Components:
         1) Provide easy access opening in the top cover of the grinder to allow external tightening of cutter stacks. Stack compression to be accomplished by torquing the stack nuts through the opening at the top of the grinder.
   2. Monoflo TR Muncher:
      a. Main housing shall be manufactured from ASTM A 536-GR 60-40-18 ductile iron.
      b. Bearing housing and cover plates shall be manufactured from AISI A48-30B or 40 B cast iron.
      c. Cutter shall be inclined toward the flow at an angle not less than 25 degrees from vertical.
      d. The body shall include a trash trap below the cutter. The trash trap shall have two clean out ports.

C. Cutter Cartridge and Drive Assembly:
   1. Cutter cartridge and drive assembly to be removable from the housing as a complete segment without further disassembly. The components of that assembly include cutters, spacers, shafts, reducer, motor, bearings, and seals.

2. Cutters and Spacers:
    a. Inside configuration of both cutters and spacers shall be hexagonal so as to fit the shafts with a total clearance not to exceed 0.015 inch across the flats to ensure positive drive and increase the compressive strength of the spacers.
    b. Cutters and spacers to be AISI 4130 Heat-Treated Alloy Steel, surface ground for uniformity and through-hardened to a minimum 43 to 48 Rockwell C.
    c. Cutter configuration shall consist of 1 shaft with cutters with at least 5 teeth and 1 shaft with cutters with at least 11 teeth. To maintain particle size, the height of the tooth must not exceed 2 inches above the root diameter. Cutter root diameter overlap to be not less than 1/16 inch or greater than 1/4 inch to maintain the best possible cutting efficiency while incurring the least amount of frictional losses.
    d. The cutter shall exert a minimum force of 450 pounds per hp continuously and 1,430 pounds per hp at momentary load peaks at the tooth tip.
3. Grinder drive and driven shafts to be made of AISI 4140 Heat-Treated Hexagon Steel with a tensile-strength rating of not less than 149,000 pounds per square inch. Each shaft hex to be a minimum of 2 inches.
4. Reducer:
    a. JWC Environmental Muffin Monster:
        1) The gear speed reducer to be a grease-filled planetary type of reducer with "Heavy Shock" load classification. The reduction ratio to be 29:1. High-speed shaft of the grinder to be directly coupled with the reducer using a two-piece coupling.
    b. Monoflo TR Muncher:
        1) The gearbox shall be oil-filled helical bevel type with “Heavy Shock” load classification. The reducer shall be shaft-mounted to the high-speed shaft of the grinder and flanged to the bearing housing.
5. Motor:
    a. In accordance with Section 16222.
    b. Motor to be of TEFC design, 3 hp, 1,725 rpm, 460 volts, 60 Hertz, three-phase. Motor service factor to be 1.15, the efficiency factor not less than 81 percent at full load and the power factor not less than 75 percent at full load.
6. Required Running Torque per Horsepower:
    a. Continuously: 1,000 inch pounds minimum.
    b. At Momentary Load Peaks: 3,300 inch pounds.
7. Cutter cartridge seal housing and cover to be cast of ASTM A536-84 ductile iron (JWC Environmental Muffin Monster) or cast iron (Monoflo TR Muncher) and designed to protect the seal labyrinth while guiding particles directly into the cutting chamber.
8. Bearings and Seals:
    a. Radial and axial loads of the shafts to be borne by 4 sealed oversize deep-groove ball bearings. Bearings to be protected by a combination of a replaceable and independent tortuous path device and end-face mechanical seals. Face materials must be a minimum of tungsten carbide to tungsten carbide, not requiring an external flush or any type of lubrication. The mechanical seal to be rated at 90 pounds per square inch continuous duty by the seal manufacturer. Bearings and seals to be housed in a replaceable cartridge that supports and aligns the bearings and seals as well as protects the shafts and end housings. O-rings to be

made of Buna N elastomers. Products requiring continuous or occasional lubrication or flushing will not be accepted.

D. Motor Control:
   1. General:
      a. Upon the grinder encountering a jam condition, the motor controller shall stop the grinder and reverse its rotation to clear the obstruction. If the jam is cleared, the controller shall return to normal operation. If the jam condition still exists, the controller shall go through 2 additional reversing cycles within a maximum of 60 seconds of the first jam condition (3 times total) before indicating a GRINDER JAM condition at the controller. Upon a GRINDER JAM condition, the controller shall shut off the grinder and activate a COMMON FAIL contact that will in turn generate a COMMON FAIL signal at SCADA.
   2. Control Panel:
      1) Power to the control panel shall be 480 V, 3-phase, 3-wire, 60 Hertz. Control voltage shall be 120 volts.
      2) Provide a NEMA 4X, 316 Stainless steel control panel.
      3) The control panel and all associated components shall be provided in accordance with Section 17710.
      4) Provide programmable controller system to control equipment as described herein and per Section 17720.
      5) All electrical devices for the control panel and instruments shall be provided for a complete, operable system as specified.
      6) Provide indicator lights for POWER ON, GRINDER JAM, COMMON FAIL, and RUNNING conditions.
      7) Provide normally open dry contact for COMMON FAIL and AUTO MODE signals.
      8) Provide two normally open dry contacts for GRINDER RUNNING signals.
      9) Provide HAND/OFF/AUTO selector switch for local manual or automatic operation.
      10) Provide pushbuttons for START, STOP, REVERSE, and TEST operations when the control panel is in HAND mode.
      11) Provide RESET button or switch to reset all fail conditions. The equipment shall be inhibited from operation until all FAIL conditions are cleared.
      12) Provide control panel with an input for a REMOTE START operation when the control panel is in AUTO mode.
      13) Provide control panel with an input for an EMERGENCY STOP which will shut down the grinder in any mode of operation.
      b. Reversing Motor Starter:
         1) Provide in accordance with Section 16422.

2.04 FINISHES

A. As specified in Section 09960.

2.05 SOURCE QUALITY CONTROL

A. Performance Test:
   1. If alternative manufacturers are proposed, the OWNER or OWNER's representative will require alternative manufacturers and specified equipment manufacturer to perform a comparative test to qualify performance of the alternative grinding equipment by demonstration. The test will be conducted in the presence of the OWNER or OWNER's representative. All costs such as providing test grinders, test materials, and electric power hook-up will be borne by the CONTRACTOR. A proof of performance demonstration test certificate shall be submitted by the CONTRACTOR.
   2. Test equipment to be of the same model number, size, horsepower, and configuration as the unit to be provided under this Section. The performance test to be a dry test.
   3. The test shall be conducted such that test materials are fed into the grinder by item. The full quantity of each item shall be fed at one time and each set of items shall be fed at separate times. The grinder shall be allowed to clear after the full quantity of each item is fed through.
   4. The following occurrences shall be recorded:
      a. Alarms (based on three reversals).
      b. Motor overheat.
      c. Motor overload.
   5. The test items are as specified below:
      a. 5 soda cans.
      b. 5 each 12-inch square rags (mechanical shop rags).
      c. 8 pairs of pantyhose.
      d. 4 medium-size rubber gloves.
      e. 1/4-inch plastic rope, 20 feet long.
      f. 2 pairs of long athletic socks.
      g. 2-inch-wide steel strapping band, 5 feet long.
      h. 1 woman's wig (synthetic or human hair).
      i. 1 box of 12 plastic tampons with applicators.
      j. 1 wooden broom handle cut into 1-foot lengths.
      k. 5 medium-size disposable diapers.
      l. 1 pair of size-8 canvas tennis shoes.
   6. The individually ground material to be kept segregated for evaluation of particle size.
   7. Categories of evaluation of test results shall include:
      a. Number of alarm status occurrences with number of motor overheat and motor jam situations counted. The alarm status shall be limited to 2 alarms during the entire test. The alarm activation to be based upon 3 reversals.
      b. Before and after test, inspect and record grinder motor amperage to verify motor nameplate data, revolutions per minute of cutters, and motor reversal amperage. Motor reversal amperage shall not be more than 80 percent of locked rotor amperage.

PART 3 EXECUTION

3.01 EXAMINATION

A. As specified in Section 15050.

3.02 INSTALLATION

A. Install grinder and motor controller in accordance with the manufacturer's installation instructions.

3.03 FIELD QUALITY CONTROL

A. Provide the services of a factory-trained representative to check installation and to place grinder in service. Factory representative shall have complete knowledge of proper installation, operation, and maintenance of equipment supplied. Representative shall inspect the final installation and supervise a start-up test of the equipment.

B. Before installation, the grinder shall be opened and inspected.

C. Performance and Function Testing:
   1. Comply with Section 01660.

D. Certificate of Installation:
   1. Comply with Section 01660.

3.04 DEMONSTRATION

A. Demonstrate operation of equipment as specified in Section 01660.

END OF SECTION

SECTION 11353B

CIRCULAR SECONDARY CLARIFIER EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Specification of equipment for installation in circular secondary clarifiers of center feed, peripheral overflow design.
   2. Clarifier accessories:
      a. Density current baffle.
   3. Not all clarifier accessories described in this specification are necessarily supplied by the sludge collector mechanism manufacturer. The CONTRACTOR shall coordinate among the different manufacturers to ensure a compatible and complete installation as indicated on the Drawings.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01410 - Regulatory Requirements.
      c. Section 01610 - Project Design Criteria.
      d. Section 01612 - Seismic Design Criteria.
      e. Section 01660 - Testing, Training, and Commissioning.
      f. Section 01740 - Warranties and Bonds.
      g. Section 05500 - Metal Fabrications.
      h. Section 06611 - Fiberglass Reinforced Plastic Fabrications.
      i. Section 09960 - High-Performance Coatings.
      j. Section 16222 - Low Voltage Motors up to 500 Horsepower.
      k. Section 17710 - Control Systems - Panels, Enclosures, and Panel Components.

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. American Gear Manufacturers Association (AGMA):
   1. 908 - Information Sheet - Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical and Herringbone Gear Teeth.

2. 915-1 - Inspection Practices - Part 1: Cylindrical Gears - Tangential Measurements.
3. 915-2 - Inspection Practices - Part 2: Cylindrical Gears - Radial Measurements.
4. 2001 - Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
5. 2004 - Gear Materials, Heat Treatment and Processing Manual.
6. 2009 - Bevel Gear Classification, Tolerances and Measuring Methods.
7. 2011 - Cylindrical Wormgearing Tolerance and Inspection Methods.
8. 2015-1 - Accuracy Classification System - Tangential Measurements for Cylindrical Gears.
9. 2015-2 - Accuracy Classification System - Radial Measurements for Cylindrical Gears.
10. 6013 - Standard for Industrial Enclosed Gear Drives.
11. 6022 - Design Manual for Cylindrical Wormgearing.
12. 6034 - Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
13. 9005 - Industrial Gear Lubrication.

C. American Institute of Steel Construction (AISC):
1. 360 - Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design.

D. American Welding Society (AWS):
1. D 1.1 - Structural Welding Code for Steel.

E. ASTM International (ASTM):
1. A 36 - Standard Specifications for Structural Steel.
2. A 48 - Standard Specification for Gray Iron Castings.
3. A 148 - Standard Specification for Steel Castings, High Strength, for Structural Purposes.
4. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
5. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
6. A 536 - Standard Specification for Ductile Iron Castings.
7. D 638 - Standard Test Method for Tensile Properties of Plastics.
8. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
9. D 2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

F. International Organization for Standardization (ISO):
1. 53 - Cylindrical Gears for General and Heavy Engineering - Standard Basic Rack Tooth Profile.

G. National Electrical Manufacturers Association (NEMA):
1. 250 - Enclosures for Electrical Equipment (1,000 volts maximum).

1.03 DEFINITIONS

A. NEMA:
1. Type 4X enclosure in accordance with NEMA 250.
2. Type 7 enclosure in accordance with NEMA 250.

B. Continuous operation: 24 hour-per-day operation for design life of not less than 20 years, which equals 175,200 hours.

C. Intermittent operation: Periodic operation, including starts and stops, and prolonged periods of resting.

D. Subassemblies: Includes, but may not be limited to, complete center column, drive cage, drive assembly, truss arms, and scum skimming system.

E. Set: Equipment necessary to completely furnish 1 clarifier.

F. Continuous running torque:
   1. The 100 percent AGMA torque, assumed to be continuously applied, 24 hours a day, to the drive system.
   2. Bearing life, gear strength, gear durability, gear rating, mechanism structural design, and alarm and shutdown setpoints are specified as a percentage of the continuous running torque.

G. Momentary peak torque:
   1. The maximum torque for rating yield strength or ultimate strength of center drive mechanism components.
   2. The numerical value for momentary peak torque shall be 2.0 times continuous running torque.

H. Spiral scraper angle of attack: The angle between the clarifier radial line and the line tangent to the spiral scraper.

I. Manufacturer:
   1. Firm responsible for the design, operation, delivery, installation certification, and warranty of sludge collection equipment. Warranty shall commence from the date specified in Section 01740.
   2. Manufacturer shall also provide sludge collector drive mechanism.

J. Fabricator:
   1. Firm responsible for the fabrication of sludge collection equipment conforming to the manufacturer's design.
   2. Manufacturer may also be the fabricator if fabrication of all components is self-performed.

1.04 SYSTEM DESCRIPTION

A. Nominal clarifier dimensions:
   1. Diameter: As indicated on the Drawings.
   2. Side water depth: As indicated on the Drawings.
   3. Bottom slope: As indicated on the Drawings.

B. Sludge collector mechanism:
   1. Supply as a complete and operational system by a single manufacturer.
   2. Equipment to include, but not be limited to, the following components:
      a. Walkways and access bridges with guardrail and grating.
      b. Center column.
      c. Influent well.
      d. Flocculating well.

e. Center drive cage.
f. Sludge collector truss arms.
g. Scum skimming system.
h. Tapered spiral scraper blades.
i. Center drive mechanism.
j. Drive motor.
k. Electrical controls.
l. Overload devices and alarms.
m. Other components necessary to provide a complete system.

3. Process description:
   a. Mixed liquor enters the clarifier through a center column and is discharged into the influent well through openings in the center column.
   b. The influent well dissipates the kinetic energy of the influent mixed liquor flow. Peripheral outlet ports in the influent well create a controlled discharge of the mixed liquor into the flocculating well to enhance flow distribution and flocculation.
   c. The flocculating well promotes flocculation of the mixed liquor suspended solids and allows for a gradual redirection of the flow velocity into the clarifier.
   d. A central drive mechanism mounted on a center column supports and rotates a center cage with 2 truss arm assemblies, each supporting a tapered spiral scraper blade and 1 surface skimming arms.
   e. Clarifier connected directly to RAS pump suction:
      1) Sludge is transported in a single revolution toward a manifold or center sludge hopper.
      2) Sludge removal is accomplished by the combined action of the continuously rotating sludge collection mechanism and the return activated sludge pumping system.
   f. The sludge accumulated in the clarifier is scraped to a center sludge hopper by tapered spiral scraper blades mounted on the truss arms for continuous removal.
   g. The scum skimming system consists of a full radius skimming arm that collects secondary scum from the surface of the clarifier and deposits it into the scum collection hopper.
   h. The density current baffle extends along the periphery of the clarifier and keeps the rising density current from carrying solids over the weirs.

C. Design requirements:
   1. Operating parameters:
      a. Process flows:

Parameter (Per Clarifier)	Minimum	Average	Maximum	Peak
Effluent Flow, million gallons per day (mgd)	0.392	0.524	0.80	2.01
Return Activated Sludge (RAS) Flow, mgd	0.39	0.48	0.48	0.48
Total Mixed Liquor (ML) Flow, mgd	0.431	0.572	1.28	2.49

b. Maximum allowable head loss through the center column, the influent well, and the flocculating well at peak flow = 4 inches.
c. Mixed liquor suspended solids concentration range: 2,500 milligrams per liter to 3,500 milligrams per liter.

2. Mechanical design:
   a. Design for a continuous running torque of 9,000 foot-pounds.
   b. Design collector mechanism to operate at a tip speed, measured at the ends of the rake arms, of approximately 8 feet per minute.
   c. Use no chains, sprockets, bearings, or gears below the water surface for the sludge collector mechanism.
3. Structural design:
   a. Design the sludge collector mechanism in accordance with AISC 360, except:
      1) Provide a 1/4 inch minimum thickness for all members, except where specifically modified by this Section.
      2) Include stresses in members caused by bending and twisting due to eccentricities of members at joints.
   b. Slenderness ratio (Kl/r) using K Value of 1.0 shall not exceed the values specified below:
      1) Tension members: Not greater than 240.
      2) Compression members: Not greater than 200.
   c. Corrosion allowance:
      1) For all structural members and center column, add 1/8 inch to the thickness used for the final design calculations to check member stresses and buckling.
      2) This corrosion allowance is to be applied to the design thickness and not to the minimum member thickness specified.
      3) The final member thickness shall be the greater of the specified minimum thickness or the sum of the design thickness and the corrosion allowance.
   d. Base member weights used for design on final full member thickness.
   e. Full member thicknesses may be used for performing deflection calculations.
   f. Design the center cage and the truss arms as an integral structure. Design the center cage and the connections to the truss arms for the reactions from the truss arms.
   g. Do not include live load where its inclusion results in lower stresses in a member under investigation.
   h. Seismic loads: Seismic loads shall be as required by the Building Code specified in Section 01410, where load and resistance factor design (strength design) is used.
      1) Hydrodynamic loads for load and resistance factor design (strength design):
         a) Flocculating well: Total load of 91.60 kilopounds applied appropriately to the inside and outside surfaces.
         b) Influent well: Total load of 4.70 kilopounds applied appropriately to the inside and outside surfaces.
         c) Center column: Total load of 1.30 kilopounds applied appropriately to the outside surfaces.
         d) All other elements: Hydrodynamic loads as determined using the seismic criteria specified in Section 01612.

2) Hydrodynamic loads for allowable stress design (alternate design method) shall be equal to the load and resistance factor design loads divided by 1.4.
3) Seismic loads due to weight of mechanism, as determined using the seismic criteria specified in Section 01612. Include the water inside the center column as part of the weight of the center column.

i. Load combinations: Design each structural member of the sludge collector mechanism for the most critical load combination resulting from the following load combinations:
1) Dead load plus live load plus continuous running torque.
2) Dead load plus live load plus continuous running torque plus seismic load.
a) Seismic load shall include seismic load from the water inside the clarifier acting on members of the clarifier mechanism.
b) For elements of the clarifier such as the center column, the influent well, and the flocculating well, impulsive and convective seismic loads from the water shall be applied appropriately on both the inside and outside surfaces.
c) These seismic loads shall be in addition to the seismic loads due to the dead loads of the elements.
3) Dead load plus live load plus torque due to screeding grout topping on slab using sludge collector mechanism.
4) Dead load plus live load plus torque due to cutout torque test.
5) Other load combinations selected by the manufacturer.
6) Truss arm load cases: Use the following load cases on the truss arms for load combinations:
a) Equal uniform horizontal load along the full length of both truss arms, which results in a combined torque equal to the continuous running torque.
b) Uniform horizontal loads along the full length of both truss arms, which results in 70 percent of the torque from 1 truss arm and 30 percent of the torque from the other truss arm for a combined torque equal to the continuous running torque.
c) Load on truss arms due to spreading grout topping on slab using sludge collector mechanism.
d) Load on truss arms due to cutout torque load test.

j. Deflections:
1) The horizontal deflection of the truss arm, due to truss arm deflection plus rotational deflection of the center cage for load cases which contain continuous running torque, shall not exceed a deflection equal to the radius of the clarifier divided by 400 (L/400).
a) Not more than 60 percent of the total horizontal deflection shall be due to center cage rotation.
b) Horizontal deflection of the truss arm shall be measured at the end of the truss arm furthest from the center column.
2) The vertical deflection of the truss arm due to equipment dead load shall not exceed the length of the truss arm divided by 800 (L/800).

k. Seismic design criteria: As specified in Section 01612.

l. With sufficient strength to sweep in a 2-inch grout layer on the basin bottom under its own power.

1.05 SUBMITTALS

A. Submit product data and shop drawings, operation and maintenance manuals, and test reports.

B. Product data and shop drawings:
   1. Shop drawings shall consist of a cover sheet indicating the drawing number and specification page and number to which referenced, intended use and data summary, outline drawings, cut-away drawings, parts lists, material specification lists, and all information required to substantiate that the proposed equipment meets the specifications.
      a. Shop drawing submittals will not be considered complete if cut-away or assembly drawings with part and material specification lists are not included.
   2. General arrangement drawings showing the complete assembly, part numbers, and materials list.
   3. Detailed drawings:
      a. Sludge collector mechanism indicating dimensions, member sizes and thicknesses, welding, and connection details.
      b. Drive mechanism showing sizes, dimensions, and arrangement of each drive component.
      c. For gears, except those contained in the gearmotor speed reducer, detailed drawings with the following minimum data for each gear:
         1) Number of teeth.
         2) Net face width.
         3) Outside diameter of external gears.
         4) Inside diameter of internal gears.
         5) Normal diametral pitch or axial pitch for worm gears.
         6) Normal generating pressure angle.
         7) Lead angle (for worm gears).
         8) Operating center distance.
         9) Addendum modification coefficient.
         10) Tooth thickness or pin or span measurements.
         11) Quality numbers in accordance with AGMA 915-1, 915-2, 2009, 2011, 2015-1, and 2015-2.
         12) Material alloy.
         13) Type of heat treatment.
         14) Tooth surface hardness.
         15) Tooth core hardness.
         16) For case hardened gears, effective case depth to Rc 50.
         17) Lubricant type (mineral/synthetic/EP).
         18) Lubricant viscosity.
      d. Setting drawings, templates, and directions for the installation of anchor bolts and other anchorages. In addition to the manufacturer supplying installation instructions as specified, the manufacturer shall supply storage procedures for all equipment as required. Submit design calculations as shop drawings prior to the completion of all shop drawings.
   4. Certified motor data sheets.
   5. Shop primer and coating data.
   6. Control system data, schematics, and wiring diagrams.
   7. Spare parts list.

8. Qualifications and resume of installation engineer.
9. Training course outlines.
10. Manufacturer’s experience and reference list as specified in Article Quality Assurance.

C. Manufacturer's installation instructions.

D. Calculations: Include, without necessarily being limited to:
1. Structural calculations:
   a. Calculations shall be prepared and signed by a professional civil engineer licensed in the state where the Project is located demonstrating compliance with structural criteria specified in this Section and seismic design criteria as specified in Section 01612.
   b. Submit design calculations with complete shop drawings.
2. Mechanical and hydraulic calculations: Performed by a professional civil or mechanical engineer licensed in the state where the Project is located. Calculations are intended to:
   a. Substantiate continuous running torque loading and overload torque rating of each component of drive mechanism.
      1) Calculations shall be in accordance with AGMA 908.
      2) Calculations shall clearly specify all design parameters used in developing the ratings, including materials in accordance with AGMA 2004.
      3) All ratings in accordance with AGMA 2001 and AGMA 6034.
   b. Demonstrate that each bearing in drive mechanism complies with bearing life requirements of this Section.
   c. Verify that the tapered spiral scraper blade design, as proposed by the manufacturer, is capable of transporting settled sludge from the entire floor area of the clarifier to the withdrawal point under all specified flow and sludge loading conditions without resulting in excessive sludge accumulation. An excessive accumulation is defined as a depth of settled sludge, which exceeds the spiral scraper blade depth.
      1) The manufacturer shall submit modeling results, which incorporate both hydraulic and mechanical transport mechanisms for review.

E. Reference list: Include the following information as a minimum:
1. Name and location of installation.
2. Name and telephone number of the person in direct responsible charge of the equipment.
3. Name and contact information for equipment fabricator.
4. Name and contact information for manufacturer’s engineer responsible for structural design.
5. Month and year the equipment was placed in operation.
6. Size of equipment.
7. Number of units installed.
8. Service.

F. Quality control submittals:
1. Welder’s certificates.
2. Submit Manufacturer's or designated contract fabrication facility’s structural steel fabrication qualifications and information.
3. ENGINEER’s qualifications to complete structural analysis and design.

G. Fabrication certification report:
   1. Provide fabrication certification report prior to equipment delivery to project site.

H. Test reports:
   1. Method of conducting cutout torque test and verification that method of testing will not impose stresses in any member that exceeds maximum allowable stresses specified in this Section.
   2. Results of field torque tests on sludge collector mechanism.

I. Operation and Maintenance Manuals.

J. Certificates: Manufacturer's certification that equipment was installed in accordance with the manufacturer's instructions, inspected by the manufacturer, serviced with the proper initial lubricants, and equipped with applicable safety equipment and controls.

K. Technician's Qualifications Resume: Submit resume of technician to perform Manufacturers Field Service.

1.06 QUALITY ASSURANCE

A. Manufacturer qualifications:
   1. Experience: Demonstrate minimum 5 years experience in the manufacture and fabrication of tapered spiral scraper sludge collectors that have been successfully utilized in domestic wastewater applications.
      a. Experience of fabricator, if manufacturer does not self-perform fabrication, shall meet or exceed that required of manufacturer.
      b. Submit substantial information as necessary to establish qualifications of fabricator, if manufacturer does not self-perform fabrication, including location (address), experience, qualifications, and certifications of all fabricator's staff to be utilized.
      c. Manufacturer's engineer responsible for structural design shall also demonstrate minimum 5 years experience designing sludge collectors to withstand operational and seismic loads, including sloshing of tank contents on sludge collection mechanism.
   2. References: Provide a reference list of at least 5 different installations in domestic wastewater treatment plants of not less than 5 mgd in the continental United States, where the manufacturer has supplied equipment substantially similar in design and characteristics to that proposed in this Section.
      a. The installations listed must:
         1) Have been designed and fabricated by the manufacturer. If manufacturer does not self-perform fabrication, the installation list shall also include the experience of the Project equipment fabricator.
         2) Be at least 60 feet in diameter.
         3) Have been currently operating for last 5 years.
      b. Provide the following information related to the installation:
         1) OWNER name, address, and telephone number.
         2) Design flow of plant.
         3) Sludge collector dimensions.

4) Time in operation.
5) References for manufacturer's engineer responsible for the structural design.

B. Welding and welder qualifications:
1. Perform welding and qualify and certify welders in accordance with AWS D1.1 and D1.6.
2. Welds:
a. Use shielded arc welding.
b. Conform to requirements of design loads.
c. Conform to information indicated on the Drawings.
d. Use continuous watertight seal welds.
e. Use a minimum weld size of 1/4 inch.
f. Field welding is permitted only for bridge splice (if required).
g. ENGINEER may check materials, equipment, and qualifications of welders.
h. Remove welders performing unsatisfactory Work, or require to requalify.
i. ENGINEER may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
j. Manufacturer shall bear costs of retests on defective welds.
k. Manufacturer shall also bear costs in connection with qualifying welders.

C. Steel fabrication:
1. Manufacturer's authorized representative shall be present during fabrication of equipment.
2. Manufacturer's authorized representative shall provide a fabrication certification report complete with certified fabrication drawings, a journal of the fabrication work process, photo documentation of the shop assembly of all components required to be field erected, and a certification that the fabricated equipment is complete and ready for installation by the CONTRACTOR.

D. Equipment subassemblies:
1. Each component subassembly requiring field erection shall be test assembled and documented at the manufacturer's fabrication facility.
2. Digital photographic evidence of assembly shall be submitted as part of the fabrication certification report.
3. Mark parts with erection matchmarks for ease of field erection.
4. Lubricate moving parts before shipment.
5. When necessary to disassemble parts for shipping, coat uncoated exposed machine surfaces with suitable, easily removable, rust-preventive compound before shipping.

1.07 PROJECT CONDITIONS

A. Environmental project conditions:
1. Installation in a wastewater treatment plant.
2. Moderate quantities of commercial and industrial waste.
3. Exposure to industrial solvents and petroleum products.
4. Environmental requirements: As specified in Section 01610.

1.08 DELIVERY, STORAGE, AND HANDLING

A. As required by Section 15050.

B. Preparation for shipment:
   1. All materials shall be suitably packaged and braced to protect against damage during transit, handling, and unloading.
   2. Manufacturer shall package equipment, be responsible for, and make good, any and all damage until the equipment is delivered to the job site.
   3. Accessories shall be packaged separately in containers clearly marked “ACCESSORIES ONLY”.
   4. A packing list, listing the contents of each container, shall be placed in a moistureproof envelope and securely fastened to the outside of the container.
   5. Provide written storage procedures for all equipment.

C. Delivery to job site:
   1. Manufacturer shall fabricate and deliver materials to the job site in conformance with the CONTRACTOR’s construction schedule to minimize handling and on-site storage of equipment.

D. Storage and protection:
   1. Protect the system components at the site and during installation prior to project completion.
   2. As a minimum, provide cover, ventilation, and proper stacking to prevent warping of any equipment stored on site.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with work sequence specified in Section 15050.

1.10 MAINTENANCE

A. Spare parts: Furnish the following spare parts suitably packaged and marked. Include a price list and name, address, and telephone number of local supplier:
   1. 2 sets of scum skimmer blade wear strips.
   2. 1 set of squeegees for each spiral scraper mechanism furnished.
   3. 4 sets of shear pins.
   4. 1 set of scum skimmer wipers.
   5. 1 set each of oil seals for the worm shaft and pinion shaft.

B. Special tools: Provide the following special tools:
   1. Tools required to assemble, disassemble, repair, and maintain equipment, and that have been specifically made for use on the equipment.
   2. Necessary eyebolts, hooks, and rods for handling equipment parts.
   3. List of tools with the maintenance and operation data describing the uses of the tools.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sludge collector mechanism:
   1. All equipment components of the sludge collector mechanism including the walkways and access bridges, center column, influent well, flocculating well, center drive cage, sludge collector truss arms, scum skimming system, tapered spiral scraper blades, center drive mechanism, drive motor, electrical controls, and overload devices and alarms, shall be furnished by the same manufacturer.
   2. Some equipment may require modification from the manufacturer's standard.
   3. Exercise care to assure that the electrical, mechanical, structural, and miscellaneous systems comply with the requirements specified or in other referenced sections.
   4. Manufacturers: One of the following or equal:
      a. Ovivo/Eimco Water Technologies.
      b. Siemens Water Technologies/Envirex, Inc.
      c. Westech, Inc.

B. Density current baffle:
   1. Manufacturer:
      a. Nefco, Inc.

2.02 MATERIALS

A. For all components unless specified otherwise the materials of construction are specified below.

B. Structural steel:
   1. In accordance with ASTM A 36.
   2. Grind all edges of steel members to approximately 1/16 inch minimum radius using standard workmanship and a grinder.

C. Stainless steel, ASTM A 276, Type 304 or 316.
   1. Components or structural shapes which are welded:
      a. Materials: Type 304L or 316L stainless steel.
      b. Manufacturer's shop welds, welding procedures, and welders:
         1) Qualified and certified in accordance with the requirements of AWS D1.6.

D. Anchor bolts: Type 316 stainless steel.

E. Weir plate: Fiberglass reinforced plastic as specified in Section 06611.

F. Scum baffles: Fiberglass reinforced plastic as specified in Section 06611.

G. Fasteners and washers: Type 304 stainless steel, except for bolts which will be removed during installation and any high strength bolts.

H. High strength bolts: In accordance with ASTM A 325 hot-dip galvanized high strength bolts in attaching truss arms to cage, and cage to center drive gear casting.

I. Do not use cadmium plated parts and fasteners.

J. Dissimilar metals: All aluminum components shall be isolated from steel components as specified in Section 05500, to prevent electrolysis.

2.03 SLUDGE COLLECTOR MECHANISM

A. Walkways and access bridges:
   1. Materials:
      a. Welded 304L stainless steel beam construction.
   2. Design:
      a. Composed of 2 main members laterally braced together.
      b. Minimum live load of 100 pounds per square foot.
      c. Maximum deflection not to exceed span length divided by 360 (L/360) for dead plus live loads.
      d. Support light standards and fixtures as indicated on the Drawings.
      e. Supported using:
         1) Center column at one end and the outer concrete clarifier wall at the other as indicated on the Drawings.
         2) Make allowance at outer concrete wall for expansion and contraction of walkway due to temperature changes.
            a) Use self-lubricating bearings.
            b) Do not use non-lubricated metal-to-metal slide plates or direct metal-to-concrete bearing.
            c) Prevent lateral movement of bridge at outer wall.
      f. Provide additional structural supports as required for piping and conduit on the bridge as indicated on the Drawings.
   3. Platform at the center turntable: Provide a minimum clearance of 2 feet 6 inches around all sides of drive mechanism and allow uninhibited access to all parts of the drive unit.
   4. Guardrail with kickplate:
      a. On both sides of walkway and all around center turntable platform.
      b. Guardrail and kickplate as specified in Section 05500 and matching other railing supplied for Project.
   5. Walking surface:
      a. Materials: Aluminum grating as specified in Section 05500.
      b. Location: Over entire bridge and center turntable platform.

B. Center column:
   1. Materials:
      a. Vertically mounted, cylindrical 304L stainless steel column.
         1) Inside diameter: As indicated on the Drawings.
         2) Wall thickness: 1/4-inch minimum.
   2. Design:
      a. Support the entire sludge collector mechanism including inboard end of bridge.
      b. Size and anchor the center column to be capable of resisting design loads when the tank is empty or full.

3. Center column anchorage: Mount the center column over the influent port at the center of the clarifier floor. Connect the base flange of the center column to the concrete foundation using anchor bolts.
    a. Use a rigid steel template of minimum 1/4 inch thickness to accurately locate anchor bolts for the center column during concrete placement.
    b. Supplier shall coordinate with the CONTRACTOR to ensure proper anchor bolt location.
    c. Center column base anchor bolts:
        1) Not less than 12 in number.
        2) Anchor bolt embedment as required by equipment manufacturer but not less than 2 feet -6 inches.
        3) Not less than 3/4 inches in diameter.
        4) Use a minimum edge distance for anchor bolts of the larger of 6 inches or 6 anchor bolt diameters, and as required to clear reinforcing bars located around opening.
    d. Center column base mounting flange:
        1) Size and reinforce using gussets or other stiffeners as necessary to adequately transfer loads from the sludge collector mechanism to clarifier structure.
        2) Bolt holes in flange to accommodate anchor bolts shall not exceed 1/8 inch plus bolt diameter.
4. Center column outlet ports: Provide outlet ports in the upper end of the center column to disperse influent flow into the influent well. Provide the following:
    a. A total of 4 ports.
    b. Appropriately reinforced port openings.
    c. Port dimensions: As indicated on the Drawings.
5. Flange and stiffen the top of the center column for supporting the sludge collector mechanism, the drive mechanism, and the access bridge.
    a. Attach the center column to the drive assembly using bolts.
6. Drain holes: Provide two 2-inch holes at bottom to allow column to drain into the tank.

C. Influent well:
1. Materials:
    a. Structural 304L stainless steel plate and members.
    b. Reinforced with steel stiffening angles where necessary.
2. Design:
    a. Closed-bottom tub concentric with the center column.
    b. Supported around the outside of the center drive cage.
    c. Diffuse influent flow into the clarifier tangentially, evenly, and efficiently without excessive disturbances.
    d. Influent well outlet ports:
        1) Shall direct and control flow into the clarifier.
        2) Dimensions: As indicated on the Drawings.
    e. Dimensions: As indicated on the Drawings.
    f. Provide two 2-inch orifices in the bottom to allow the well to drain as the clarifier is emptying.

D. Flocculating well:
1. Materials:
    a. Structural 304L stainless steel plate and members.
    b. Reinforced with steel stiffening angles where necessary.

2. Design:
    a. Dimensions: As indicated on the Drawings.
    b. Equip with a minimum of 4 baffled slots as indicated on the Drawings to allow for removal of floating material in the well.
    c. Support from center cage using rigid connection.
        1) Other methods of connection such as swinging supports or breakaway supports are not permitted.

E. Center drive cage:
1. Materials:
    a. Structural 304L stainless steel members.
2. Design:
    a. Box truss design.
    b. Design to carry load from the truss arms plus its own dead load.
    c. Fasten center drive cage to spur gear assembly using bolted connection.
    d. Design to support and rotate the truss arm assemblies with the tapered spiral scraper blades, and the surface skimming arm.

F. Sludge collector truss arms:
1. Materials:
    a. Structural 304L stainless steel.
2. Design:
    a. Truss design. Tie rods not permitted.
    b. Design with sufficient structural strength to screed in a layer of grout on the clarifier bottom under its own power.
    c. Maintain width of the truss arm the same as the width of center drive cage to ensure alignment and proper connection.
    d. Rigidly connect truss arm to the center drive cage.
    e. Use the truss arm to support the sludge collection tapered spiral scraper blades, and scum skimmer arms.

G. Tapered spiral scraper blades:
1. General:
    a. Manufacturer shall be solely responsible for the design of the spiral scraper blades.
    b. Number and dimensions of blades shall be based upon sludge transport model results prepared by manufacturer and submitted for review.
    c. Spiral sludge blades indicated on the Drawings are for illustration purposes only, and shall not be construed as design intent.
    d. Additional blades to transport sludge away from center column to withdrawal point shall be provided, if required by manufacturer’s design configuration.
2. Blades:
    a. Materials: Structural 304L stainless steel.
    b. Thickness and stiffeners as required to limit blade deflection.
        1) Taper blades as required to match floor slope.
        2) Top of blade shall be horizontal.
3. Squeegees:
    a. Materials: Brass or stainless steel, spring type, not less than 26 gauge thickness.
    b. Attach squeegees to blades utilizing stainless steel hardware. Squeegees shall be designed to allow 2 inches of vertical adjustment.

H. Scum skimming system: Consisting of a scum skimmer assembly that pushes floating scum to a scum trough for removal. Basic components of skimmer assembly include scum deflector blades and skimmer device.

1. Scum deflector blades:
    a. Material: Structural 304L stainless steel plate.
    b. Designed to collect and push floating scum radially outward toward the circumferential scum baffle.
    c. Extends from the flocculating well to the scum skimmer device.
    d. A central drive mechanism mounted on a center column support and rotates a center cage with 2 truss arm assemblies, including tapered spiral scraper blades and 1 surface skimming arms.
    e. Attach inner end of deflector blade tangentially to the flocculating well where practicable. Otherwise, provide maximum angle of approach of scum deflector blade to the scum in order to drift the scum to circumferential baffle.
2. Scum skimmer device:
    a. Materials: Structural 304L stainless steel plate and members.
    b. Attach to outer end of the scum deflector blade to trap scum for discharge into scum trough.
    c. Size: Full length of the scum trough.
    d. Design:
        1) Maintain continuous contact and proper alignment with scum baffle and inclined scum ramp to positively rake scum to the scum trough.
        2) Use a hinged blade to move entrapped scum up the scum beach to the scum trough.
        3) Provide a replaceable wear block on the outer edge of each scum skimmer device.
    e. Hinged blade:
        1) Adjustable vertically to control the dewatering of scum as it travels up the inclined ramp to the scum trough.
        2) Adjustable vertically over the length to ensure contact with the scum trough even though the trough may not be level.
        3) Capable of being raised and locked out above the water level or held horizontally against the circumferential scum baffle when skimming is not required.
        4) Equipped with replaceable scum skimmer wipers on the bottom inner and outer edges to seal the entrapped scum and water when moving up the inclined approach ramp to the scum trough.
    f. Scum skimmer wipers: Oil resistant neoprene.
    g. Wear block:
        1) Material: Polyvinyl chloride.
        2) Wear block constantly forced against circumferential scum baffle to keep baffle clean using a coiled spring arrangement.
        3) Force between baffle and wear block adjustable between 1 to 5 pounds.
    h. Wear block coiled springs:
        1) Material: Type 18-8 stainless steel.
        2) Enclosed to protect them from the weather.
        3) Spring enclosures:
            a) Material: Welded steel or cast iron housing.
            b) Bronze bushed and grease lubricated for easy movement of hinged blades.

3. Scum trough and scum beach:
    a. Fabricated from 1/4 inch minimum thickness 304L stainless steel plate.
    b. Supported from clarifier wall by structural 304L stainless steel members.
    c. Scum trough:
        1) Width: As indicated on the Drawings.
        2) No internal stiffeners or structural members which obstruct scum flow.
        3) Standard pipe flanged connection for scum discharge pipe. Size as indicated on the Drawings.
    d. Scum beach (inclined approach ramp):
        1) Length: As indicated on the Drawings.
        2) Shaped to contain scum as it is moved up the incline to the trough by the scum skimmer.
4. Skimmer assembly supports:
    a. Material: Structural 304L stainless steel members.
    b. Attached to the sludge collector truss arms. Do not support scum skimmer assembly from the scum baffle.
    c. Space supports, brought up from the truss arm, at not greater than 10 feet on center.
5. Equipment manufacturer shall size and locate counterweights to be installed by the CONTRACTOR.
6. Threaded fasteners: Type 18-8 stainless steel.

I. Center drive mechanism: Provide a center drive mechanism consisting of a primary speed reducer driven by electric motor, through a roller chain using an intermediate gearset consisting of a cylindrical-worm and helical-wormgear, and a low speed gearset consisting of a spur pinion and internal spur gear supported within a cast iron housing by a circular main bearing featuring replaceable bearing race inserts. Center drive mechanisms utilizing housings and internal spur gears featuring integral gothic arch style bearing races are not acceptable.
    1. Gear motor speed reducer:
        a. Type:
            1) Cylindrical-worm or helical-wormgear motor.
            2) Planetary gear units will not be acceptable.
        b. Speed reducer in accordance with AGMA 6013 and 6034.
        c. Service factors: Minimum speed reducer service factor of 2.0 minimum based on continuous running torque.
        d. Connect speed reducer output shaft to drive sprocket of chain drive.
        e. Speed reducer overhung load rating:
            1) Exceed the chain pull (based on continuous running torque) by 1.50 minimum.
        f. Oil bath lubrication:
            1) Lubricant in accordance with AGMA 9005.
            2) Provide oil fill, drain, and oil level indicator devices.
            3) Oil bath protection seal: Felt.
        g. All gears supported by anti-friction bearings.
        h. Lubricant: In accordance with AGMA 9005.
    2. Intermediate gearset:
        a. Type: Cylindrical-worm and wormgear.
        b. Materials:
            1) Worm: Alloy steel, hardened, ground, and polished.
            2) Wormgear: Centrifugally cast bronze.

3) Washers: Hardened steel to prevent embedding of bolt head or nut.
4) Bushings: Bronze.
5) Housing: Cast iron in accordance with ASTM A 48, Class 30 minimum.

c. Load capacity: Rated in accordance with AGMA 6034.
d. Service factor: Minimum of 1.25 based on continuous running torque.
e. Wormgear shaft:
1) Drives pinion of low-speed gearset.
2) Support shaft by anti-friction bearings or combination of anti-friction bearings and bushing.

f. Wormgear: In accordance with AGMA 6022.
g. Worm shaft: Support by anti-friction bearings. If the wormgear is bolted to a drive hub, it shall be piloted for concentricity.
h. Worm and wormgear shaft: Anti-friction bearings shall have ABMA 9, L-10 life of 180,000 hours minimum based upon continuous running torque.
i. Provide oil bath lubrication.
1) Lubricant in accordance with AGMA 9005.
2) Provide oil fill, drain, and oil level indicator devices.

3. Low-speed gearset:
a. Provide low-speed gearset using spur pinion and internal spur gear.
b. Spur pinion shall be:
1) Integral with its shaft or keyed to a shaft.
a) If keys are used, the pinion shall be secured to the shaft with a shrink fit.
b) Set screws will not be acceptable.
2) Welded spur pinion and shafts will not be acceptable.
3) Keyed spur pinions shall have a wall thickness above the keyway equal to 1 tooth whole depth minimum.
a) Keyway and keyseat shall have 0.02-inch minimum inside radii.
b) Keys shall have 0.04 inch minimum chamfer on all edges.
4) Manufactured to have a minimum AGMA Quality Class 8 in accordance with AGMA915-1, 915-2, 2015-1, and 2015-2.

c. Provide full depth teeth in accordance with ISO 53.
1) Stub pitch gear teeth will not be accepted.
2) Undercut gear teeth will not be accepted.

d. Load capacity rated in accordance with AGMA 2001.
e. Power rating based on continuous service and the lower of the:
1) Pitting resistance for the pinion and gear.
2) Bending strength for the pinion and gear.

f. Minimum service factor of 1.25 based on continuous running torque.
g. Overload torque capacity (based on yielding of the pinion or gear teeth) exceeding the momentary peak torque by 1.8 minimum.
h. Internal spur gear:
1) Material: Ductile (nodular) iron in accordance with ASTM A 536 or cast steel in accordance with ASTM A 148, or heat-treated alloy steel.
2) Minimum AGMA Quality Class 6 in accordance with AGMA 915-1, 915-2, 2015-1, and 2015.
3) Internal spur gear bolted to the center drive cage.

i. Turntable base:
   1) Material:
      a) Ductile (nodular) iron in accordance with ASTM A 536 or cast iron in accordance with ASTM A 48, Class 40 minimum.
      b) Fabricated steel bases will not be accepted.
   2) Bolted to the center column to provide support for the internal spur gear, entire rotating collector mechanism, and one end of the access bridge.

j. Raceways, ball bearings, and oil bath:
   1) Raceways and ball bearings:
      a) Raceways: Heat-treated alloy steel.
      b) Ball bearings: Heat-treated alloy steel.
   2) Provide replaceable annular raceways to support vertical and horizontal forces transmitted by ball bearings on turntable base and internal spur gear.
      a) Raceway 40 inches minimum in diameter.
      b) Size the raceways using the following equation:

$$q = 59{,}466 \left(\frac{P}{N * D^2} \right)^{1/3}$$

Where:
q = Contact stress, pounds per square inch (maximum = 300,000 pounds per square inch)
P = Total rotating (hung) load, pounds, including truss arms, center cage, internal spur gear, influent well, flocculating well, skimmers, tapered spiral scraper blades, counterweights, and any other rotating weight.
N = Number of balls.
D = Ball diameter, inches.

      c) Replacement accomplished without removing, jacking, or backing up the access bridge.
   3) Design raceway and ball bearings for ABMA 9, L-10 life of 200,000 hours minimum.
   4) Provide oil bath for turntable base and internal spur gear.
      a) Include felt seal and dust shield protection.
      b) Provide oil fill, oil drain, and oil level indicator devices in readily accessible locations.
      c) Lubricant in accordance with AGMA 9005.

4. Chain drive:
   a. Material:
      1) Sprockets: Steel.
   b. Type: Standard roller chain in accordance with ASME B 29.1M connecting drive sprocket of the gear motor speed reducer to the driven sprocket.
   c. Drive sprocket: Minimum of 12 teeth.
   d. Chain and sprockets enclosure: Enclose roller chain and sprockets in weatherproof fabricated steel guard with service openings.
   e. Chain:
      1) Minimum tensile strength greater than 4 times chain pull based on momentary peak torque.
      2) Power rating exceeding the transmitted power (based on continuous running torque) by 1.50 minimum.

5. Drive motor:
    a. Type: Drive motor shall be a squirrel-cage induction type.
    b. As specified in Section 16222.
    c. Motor characteristics:
        1) Minimum continuous horsepower not less than 1 hp.
        2) Voltage: 480 volts.
        3) Phase: 3.
        4) Frequency: 60 hertz.
        5) Insulation: Class B, moisture resistant.
        6) Service factor: 1.15.
        7) Maximum ambient temperature: 40 degrees Celsius.
        8) Enclosure: TEFC, Class 1, Division 2 compliant.
        9) Synchronous speed: 1,800 revolutions per minute.
    d. Nameplate information: Include all information listed under subparagraph "Motor Characteristics" above.

J. Electrical controls:
1. Local control panel:
    a. Enclosure: NEMA Type 4X.
    b. Mount local control panel near drive mechanism on guardrail as indicated on the Drawings.
2. Electrical wiring as specified in Section 17710.
3. Overload device and alarms:
    a. Torque overload device: Incorporate into drive assembly.
        1) Mechanical overload device shall be actuated by torque from the rotation of the wormgear.
        2) Torque indicator:
            a) Provide a visual torque indicator oriented so that it may be read from the walkway at all times during operation.
            b) Calibrate torque indicator from 0 to 160 percent of the continuous running torque.
        3) Include with the overload device, 2 independently adjustable switches as follows:
            a) Alarm switch: An alarm switch that shall be adjusted to activate an alarm when load reaches 90 percent of the continuous running torque.
            b) Cutout switch: A cutout switch that shall be adjusted to shut off the motor when load reaches 100 percent of the continuous running torque.
            c) Alarm contacts of the maintained type rated at 10 amps continuous pilot duty.
            d) Overload device indicating meter enclosure: Weather proof 304L stainless steel, NEMA Type 7.
        4) Provide electrical supply to overload device as indicated on the Drawings. Include:
            a) Electrical components of overload device compatible with alarm devices.
            b) Other electrical requirements as indicated on the Drawings.

b. Additional protection:
   1) Provide shear pins in the drive assembly for additional protection above the shut-off torque rating.
      a) This additional protection device shall function at approximately 125 percent of continuous running torque.
      b) Shear pins: Corrosion resistant material.
   2) Provide limit switch that indicates breakage of the shear pin due to any circumstance. Shear pin limit switch shall be interlocked with motor controls to prevent mechanism from operating with a broken shear pin.
      a) Materials: Corrosion resistant.
      b) Electrical enclosure: 304L stainless steel NEMA Type 7.

4. Scum Flush Water:
   a. Provide limit switch to open scum trough flush water solenoid valve.
   b. Switch Housing: 304L stainless steel NEMA 7.
5. Equipment identification plates: Provide 16-gauge stainless steel identification plate, securely mounted on equipment in readily visible location, bearing equipment identification tag number.

2.04 CLARIFIER ACCESSORIES

A. Density current baffle:
   1. The baffle system shall consist of a series of baffle panels which are attached to the wall of the clarifier and form an inclined, shelf-like surface around the entire inner periphery of the tank as indicated on the Drawings.
   2. Construct panels of corrosion-resistant, UV-treated fiberglass-reinforced plastic.
      a. For the resin, use an isophthalic polyester with corrosion-resistant properties, 33-402 resin or equivalent, which is typically used in submerged wastewater treatment applications.
      b. Do not use any fillers in the resin except as required for viscosity control, for which, up to 5 percent by weight of a thixotropic agent may be added.
      c. Treat the resin to provide ultraviolet suppression.
   3. Glass reinforcement to consist of chemically bonded surfacing mat and copped strand roving, with the glass contents of the finished laminate to be not less than 30 percent by weight.
   4. The nominal thickness of each baffle panel shall be 3/16 inches minimum.
   5. Attach the panels to the clarifier wall at a reinforced mounting flange and support them at the proper angle with a triangular shaped bracket.
      a. The brackets may be molded as an integral part of each panel, or separate brackets may be supplied.
      b. If separate brackets are supplied, the brackets shall be fabricated of Type 316 stainless steel.
   6. Design the baffle to withstand a buoyant force load equal to the weight of the water displaced from the volume beneath the baffle.
      a. In addition, design the baffle to withstand common wind and snow loads where applicable.
      b. Provide sufficient pitch and width of the angle's working surface of the baffle to divert the flow and create a self-cleaning action of the baffle.
   7. Include provisions to vent gases that may form beneath the baffle through the installation of vents located in the panel.

8. Manufacturer shall furnish certified test reports of the physical and mechanical properties of the product. Each panel shall have the following minimum physical properties:

Tensile Strength	5,000 psi per ASTM D 638
Flexural Strength	16,000 psi per ASTM D 790
Hardness	Barcol 60 per ASTM D 2583

9. Manufacturer shall also furnish certified design calculations and drawings showing details of installation.
10. Install the baffle as indicated on the Drawings and in accordance with the manufacturer’s recommendations.
    a. For attachment of the baffle panels, use concrete expansion anchors with neoprene-backed fender washers, lock washers, and hex nuts.
    b. Use Type 316 stainless steel for all the installation fasteners.

2.05 FINISHES

A. Shop finishing:
   1. Center drive mechanisms: Prime and finish paint before shipping to project site.

B. Field finishing:
   1. For all metal surfaces, except stainless steel or aluminum components, perform surface preparation and coating as specified in Section 09960.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install sludge collector mechanism and clarifier accessories as indicated on the Drawings and in accordance with the manufacturer's installation instructions and recommendations.

B. Field welding:
   1. Field welding is permitted only for the bridge splice.
   2. Use shielded arc welding and conform to requirements of design loads.

C. Guardrail with kickplate: Install on both sides of walkway and around center turntable as specified in Section 05500.

D. Scum skimming system: Install counterweights designed and located by the manufacturer.

E. Center column: Mount center column vertically over influent port at center of basin floor.

3.02 FIELD QUALITY CONTROL

A. Testing, training, and start-up: As specified in Section 01660 and the following requirements below.

B. Tests:
   1. General: Conduct tests in presence of the ENGINEER.
   2. Working under direction of manufacturer's engineer, perform field tests on each mechanism as follows:
      a. Cutout torque test:
         1) Perform cutout torque test prior to placement of grout topping on concrete slab.
         2) The manufacturer shall propose a method of conducting this test and shall verify that the method of testing will not impose stresses in members that exceed allowable stresses.
      b. Adjustments and settings to overload device:
         1) Adjustments and settings: Perform necessary adjustments and settings to overload device to ensure that sludge collector mechanism will sound an alarm and shutdown the drive motor when specified overload conditions occur in clarifier.
         2) Test run: Perform test run following completion of adjustments and settings of overload device to confirm effectiveness of overload device.
      c. Dry test run of equipment:
         1) Special attention: Give attention during dry test run of equipment to operation of scum skimming device.
         2) Settings of skimmer boom to scum box lip and rubber wiping and sealing strips: Set as required to ensure that adequate volume of scum is discharged under normal operating conditions.

C. Required results:
   1. Sludge collector mechanism:
      a. In event mechanism fails to meet field quality control test requirements of this Section, make necessary changes and retest mechanism.
      b. If mechanism remains unable to meet test requirements to satisfaction of the ENGINEER, remove and replace such mechanism with satisfactory mechanism at no additional cost to the OWNER.

D. Manufacturer's field service:
   1. CONTRACTOR to coordinate field service work with the manufacturer's service representative, OWNER, and ENGINEER prior to initiating such work.
   2. Manufacturer's service representative:
      a. Manufacturer is to furnish services of representative experienced in erection and operation of the sludge collector mechanism.
      b. Period of services: The manufacturer shall include in his bid a minimum of five 8-hour days and three trips. The specified durations are the minimum required time on the job site and do not include travel time.
      c. Services are to include the following:
         1) Installation consultation and advice.
         2) Checking and supervision of the collector installation.
         3) Inspection and certification that unit is ready to sweep in grout prior to grouting operation.
         4) Final inspection and adjustments prior to testing.
         5) Supervision of testing.
         6) Instruction of personnel on operation and maintenance of equipment as specified in Section 01660.

END OF SECTION

SECTION 11366A

CLOTH DISK FILTERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Pre-engineered cloth disk filter systems including provisions for sludge wasting, vacuum backwashing, and all appurtenances necessary for a complete and operational modular assembly.
   2. All mechanisms and components that are required to complete a functional cloth disk filter system, including tank assemblies, center tube assemblies with cloth media disks, drive assemblies, backwash/sludge discharge assemblies, automatic valves, instruments, electrical controls, and local control panels for each filter should be furnished by manufacturer.

B. Tag numbers:
   1. Tertiary Filter No. 1 Inlet Valve, 30-EDM-211.
   2. Tertiary Filter No. 1 Solids/Backwash Pump No. 1, 30-PMP-214.
   3. Tertiary Filter No. 1 Solids/Backwash Pump No. 2, 30-PMP-215.
   4. Tertiary Filter No. 1 Solids Valve, 30-VAL-212.
   5. Tertiary Filter No. 1 Backwash Valve No. 1 Thru 5, 30-VAL-213A, 213B, 213C, 213D, and 213E.
   6. Tertiary Filter No. 1 Drive Motor, 30-MTR-210.
   7. Tertiary Filter No. 1 Level Instrument, 30-LE/LIT-210.
   8. Tertiary Filter No. 2 Inlet Valve, 30-EDM-221.
   9. Tertiary Filter No. 2 Solids/Backwash Pump No. 1, 30-PMP-224.
   10. Tertiary Filter No. 2 Solids/Backwash Pump No. 2, 30-PMP-225.
   11. Tertiary Filter No. 2 Solids Valve, 30-VAL-222.
   12. Tertiary Filter No. 2 Backwash Valve No. 1 Thru 5, 30-VAL-223A, 223B, 223C, 223D, and 223E.
   13. Tertiary Filter No. 2 Drive Motor, 30-MTR-220.
   14. Tertiary Filter No. 2 Level Instrument, 30-LE/LIT-220.

C. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01330 - Submittal Procedures.
      c. Section 01600 - Product Requirements.
      d. Section 01612 - Seismic Design Criteria.
      e. Section 01614 - Wind Design Criteria.

f. Section 01660 - Testing, Training, and Commissioning.
g. Section 01740 – Warranties and Bonds.
h. Section 01770 - Closeout Procedures.
i. Section 01782 - Operation and Maintenance Data.
j. Section 05120 - Structural Steel.
k. Section 05500 - Metal Fabrications.
l. Section 09960 - High-Performance Coatings.
m. Section 10400 - Signage.
n. Section 15050 - Common Work Results for Mechanical Equipment.
o. Section 15075 - Equipment Identification.
p. Section 16050 - Common Work Results for Electrical
q. Section 16075 - Electrical Identification.
r. Section 16125 - Fiber Optic Cable and Appurtenances.
s. Section 16134 - Boxes.
t. Section 16222 - Low Voltage Motors up to 500 hp.
u. Section 16412 - Low Voltage Molded Case Circuit Breakers
v. Section 16422 - Motor Starters
w. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
x. Section 17100 - Control Strategies.
y. Section 17101-30 - Specific Control Strategies - Tertiary Filters.
z. Section 17720 - Control Systems - Programmable Logic Controllers Hardware.
aa. Section 17721 - Human Machine Interface Hardware.
bb. Section 17733 - Network Materials and Equipment
cc. Section 17761 - PLC Programming Software.
dd. Section 17765 - Human Machine Interface Software.
ee. Section 17950 - Testing, Calibration, and Commissioning.

1.02 COST OF PRE-NEGOTIATED ITEMS

A. Cost for some of the items in this section of the Specifications has been pre-negotiated with the specified manufacturer and is included in one of the bid items in the bidding sheet. Refer to the bidding sheet and applicable pre-negotiated proposal included in Appendix H for more details. The Contractor shall provide additional items as indicated in the applicable pre-negotiated proposal included in Appendix H, even if they are not included in the Specifications and/or Drawings. The Contractor is very strongly cautioned to carefully review the applicable pre-negotiated proposal, because the pre-negotiated proposal does not include all the items included in the Specifications and Drawings. In addition to the cost indicated for the applicable bid item in the bidding sheet, the Contractor shall include in his bid the costs for the following:
   1. All items not specifically mentioned in the scope of supply of the pre-negotiated proposal, but required per Specifications and Drawings and required to complete the installation to provide an operational system.
   2. All other items indicated in the pre-negotiated proposal to be provided by others, by customer, by Owner, or any other similar designation.
      a. All freight and applicable taxes, unless specifically included in pre-negotiated proposal.
      b. All labor, materials, and all other associated costs not included in the pre-negotiated proposal but required per Specifications and Drawings and required to complete the installation to provide an operational system.

B. Supplier of pre-negotiated items shall not package the pre-negotiated item(s) with any other items or services.

C. Schedule:
   1. The manufacturer has agreed to the following schedule:
      a. Deliver shop drawings 8 weeks following issuance of purchase order by Contractor. Contractor shall perform initial review for 2 weeks and allow 4 additional weeks for Engineer to review submittal.
      b. Vendor shall re-submit shop drawings within 4 weeks of receiving comments on first submittal. The second submittal shall fully address all review comments. Vendor may schedule a meeting prior to resubmittal to resolve all outstanding issues but a schedule extension will not be granted.
      c. Deliver equipment to site 18 weeks following receipt of approved shop drawings.
      d. Deliver draft O&M manuals 14 weeks following receipt of approved shop drawings.
   2. The Contractor shall coordinate with the equipment supplier's delivery schedule to issue a purchase order at such time that equipment delivery will be completed at least 8 weeks in advance of the required date, as indicated in the Contractor's approved construction schedule. In addition, the Contractor shall issue the purchase order no later than September 30, 2014.

D. Liquidated Damages:
   1. The manufacturer has agreed to the following liquidated damages:
      a. $500.00 per day for delays of shop drawings as outlined for the first and second submittals in the schedule above.
      b. $500.00 per day for delays of equipment delivery as outlined in the schedule above.
      c. $500.00 per day for delays of O&M manuals as outlined in the schedule above.
      d. The sum of all liquidated damages shall be capped at 10 percent of the total price for the purchase order.

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM).

B. American National Standards Institute (ANSI).

C. Occupational Safety and Health Act (OSHA).

D. American Society of Mechanical Engineers (ASME).

E. American Gear Manufacturers Association (AGMA).

F. American Institute of Steel Construction (AISC).

G. American Welding Society (AWS).

H. National Fire Protection Association (NFPA).

I. National Electric Code (NEC).

J. National Electrical Manufacturer's Association (NEMA).

K. Underwriters Laboratories (UL).

L. California Water Recycling Criteria (Title 22).

M. California Department of Public Health (CDPH).

N. Steel Structures Painting Council (SSPC).

1.04 SYSTEM DESCRIPTION

A. Process Description:
   1. Secondary Effluent (SE) is pumped from the Filter Influent Pump Station to either or simultaneously to both cloth disk filter units, which permeates from the exterior surface to the interior surface of the filter cloth. Under normal operation, the disks are stationary and fully submerged in SE.
   2. The filtrate, or Filtered Effluent (FE), is collected in the filtrate header and flows through the effluent chamber to the effluent pipe to the disinfection facilities. If for any reason the piping downstream of the filter is obstructed, the liquid level will rise and flow into the overflow chamber.
   3. In addition to removal by filtration, solids are also removed in the cloth disk filter system by sedimentation. The heavier solids settle out before reaching the filter cloth, and an intermittent sludge pump removes the settled solids through a sludge manifold at the bottom of the tank.
   4. As the SE flows through the filters, solids are accumulated on and within the depth of the filter cloth, forming a mat that subsequently provides additional filtration. As the mat is formed, head loss through the cloth increases, causing the liquid level in the tank to rise. At a predetermined liquid level, the backwash cycle is initiated. During backwash, the disks remain submerged while they are rotated at 1 revolution per minute (rpm) by a drive mechanism. While the disks are rotating, backwash water, collected in the filtrate header, is drawn back through the filter cloth through the vacuum suction heads located on either side of each disk. The reversal of flow removes the majority of particles that have accumulated on the surface of, and within, the filter cloth. The frequency of backwash depends on the influent feed characteristics, filtration rate, and amount of particles contained on and within the filter cloth not removed by previous backwash cycles.

B. Design Criteria:
   1. Treatment Capacity:
      a. Total Number of Units: Two (1 duty, 1 standby).
      b. Design flows:
         1) Average annual: 1.2 mgd.
         2) Maximum month: 2.0 mgd.
         3) Peak day: 2.7 mgd.
         4) Peak hour: 2,800 gpm (4.04 mgd).
            a) Maximum Loading rate (one unit in service): 90 percent of manufacturer's maximum permissible flow rate as approved by CDPH for Title 22.
   2. Influent Characteristics:
      a. Maximum Turbidity: 10 NTU. If influent turbidity exceeds 5 NTU for 15 minutes, coagulant shall automatically be added.
      b. Maximum Total Suspended Solids: 20 mg/L.

c. Average Total Suspended Solids: 10 mg/L.
d. Minimum Wastewater Temperature: 20 degrees C.
e. Maximum Wastewater Temperature: 27.7 degrees C.

C. Performance Criteria:
1. Effluent Characteristics:
a. The effluent characteristics from the cloth disk filter units shall meet the following average day limit under stated treatment capacity and influent characteristic conditions:
1) Turbidity:
a) 24-hour average: Maximum 2 NTU.
b) Maximum 5 NTU for 5 percent of a 24-hour period.
c) Maximum 10 NTU at any time.
2) Total Suspended Solids: Less than 5 mg/L daily average.
2. Backwash Characteristics: The Filter System shall be able to operate with the following backwash characteristics:
a. Daily backwash rate shall be less than:
1) 2.2 percent under annual average flow of 1.2 mgd and average influent TSS of 10 mg/l.
2) 2.4 percent under maximum month flow conditions of 2.0 mgd and average influent TSS of 10 mg/l.
3) 3.6 percent under peak hour design flow conditions of 2,800 gpm and maximum influent TSS of 20 mg/l.
b. Frequency of backwash (complete cleaning of all of the disks) shall not occur more frequently than every 45 minutes under annual average flow and average influent TSS conditions.
c. The filter shall be capable of modification such that the instantaneous filter effluent flow immediately following a backwash sequence shall be minimized to the extent practical and not be greater than:
1) Average annual flow (1.2 mgd): The filter effluent flow rate shall not exceed 120 percent of the current feed rate to the filter.
2) Peak hour flow (2,800 gpm): The filter effluent flow rate shall not exceed 107 percent of the current feed rate to the filter.

D. Design Requirements:
1. The Contractor shall furnish all equipment that is required to provide a workable, operational, and complete filter system. The specifications define a minimum system. Changes, if required, shall be per the manufacturer's recommendations, subject to the Engineer's acceptance.
2. Fit in space available for the tertiary filter tanks as indicated on the Drawings.
3. Contractor shall submit certified equipment arrangement and foundation requirement Drawings for approval. Drawings shall show all pertinent layout dimensions and weights for filter units with specific requests (if applicable) for minor changes to Plans to accommodate equipment proposed to be furnished. Changes shall include any applicable piping changes required to align with piping approaching and exiting structure as indicated on the Drawings.
4. All components shall be suitable for outdoor installation, including, but not limited to; controls, wiring and electrical devices, valve operators, materials, piping, and valves.
5. Each equipment item shall be delivered to the job site as an assembled unit (when practical), pumps and valves will be shipped loose, ready for operation after connection of piping, and utilities provided by the Contractor.

E. Prefabrication:
   1. Manufacturer shall coordinate all instrumentation and other device supports to be fabricated with the cloth disk filter system and include these supports on the submittal Drawings to the Engineer.
   2. Submittal shall include preliminary control strategy sequences for PLC as described in Section 17101-30. Final control strategy sequences shall be submitted for acceptance prior to installation.

F. Contractor shall provide supports for piping, instrumentation, and other equipment mounted within, against or adjacent to the cloth disk filter units. Welding, drilling, or tapping of the filter tank will not be allowed.

1.05 SUBMITTALS

A. Product Data:
   1. Submit data as specified in Section 01330 completely describing product, including plan and section views, and a list of all components and materials of construction.

B. Shop Drawings:
   1. Submit detailed specifications and drawings as specified in Section 01330 containing complete piping and flow diagrams of the proposed installation, including dimensions, weights, and complete parts lists. Drawings shall show proposed anchorage of equipment and appurtenances and equipment relationship to other parts of the work including clearances for installation.
   2. List of materials, list of equipment (with model number, size, weight), including a complete list of parts and supplies with current unit prices and sources of supply. List of parts recommended by the manufacturer to be replaced after 1 and 3 year(s) service. List of special tools for each type of equipment furnished including special tools necessary for adjustment, operation, maintenance, and disassembly.
   3. Special shipping, storage and protection, and handling instructions including equipment weights and lifting points, and recommendations for short- and long-term storage.
   4. Functional description of internal and external instrumentation and controls including list of parameters monitored, controlled, or alarmed.
   5. Wiring, control schematics, and control logic diagrams for all electrical and control components furnished.
   6. Control panel elevation drawings showing fabrication and placement of operator interface devices and associated elements.
   7. Completed data sheet (ISA data sheet) for each instrument supplied.
   8. Hardcopy and electronic copy on a CD-ROM of the Tertiary Filter PLC system program.
   9. Hardcopy and electronic copy on a CD-ROM of the HMI program.
   10. Detailed control narrative of the programming that includes:
      a. Operator-adjustable setpoints, their ranges, recommended initial setpoint value.
      b. Diagram depicting sequence of operation.
   11. Loop drawings.
   12. Power and control wiring diagrams, including terminals and numbers.
   13. See Section 17710 for additional submittal requirements.

C. Manufacturer's Installation Instructions:
   1. Installation and checkout instructions including lubrication and initial start-up procedures.
   2. Do not install equipment until all installation instructions have been supplied.

D. Operations and Maintenance Manuals:
   1. As specified in Sections 01782.
   2. Provide schematic, physical wiring diagrams, and any as-built field modifications.
   3. Start-up of the system will not be permitted until O&M manuals have been submitted and approved by the Engineer.

E. Manufacturer's Field Report:
   1. Indicate personnel present and actual tests and start-up procedures that were performed by manufacturer's representative.
   2. Manufacturer’s Certificate of Proper Installation.

F. Seismic Structural Calculations:
   1. Submit seismic structural calculations in conformance with the requirements of Section 01612. The calculations shall be prepared and stamped by a structural engineer registered in the State of California.

G. California Health Laws Related to Recycle Water: Manufacturer shall provide written evidence that the proposed cloth disk filter system furnished for this Project meets or exceeds the requirements of Title 22, California Code of Regulations, Division 4 Environmental Health, Chapter 3 Water Recycling Criteria for Disinfected Tertiary Recycle Water, filtered wastewater. In addition, the manufacturer shall provide all required data, and assist the Owner in obtaining approval for the use of the cloth disk filter system from the State of California Department of Health Services, Division of Drinking Water and Environmental Management, Recycle Water Unit.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. A manufacturer that with 10 or more demonstrated installations that meets all three of the following criteria:
      a. North American permanent installations similar to the specified equipment in municipal wastewater application;
      b. Consistently meets water quality requirements as dictated for Title 22 Disinfected Tertiary Recycled Water (or equivalent);
      c. Have been in service for a minimum of 5 years.
   2. The equipment shall be the product of a recognized manufacturer regularly engaged in the design and manufacturing of cloth media filter units for at least 5 years and who maintains a reasonable stock of parts for this equipment.
   3. The manufacturer shall have obtained written acceptance of the system from the CDPH for the system supplied for this application. A system that has not been issued ‘Conditional Acceptance by CDPH’ prior to bid advertisement will not be accepted.

B. Acceptance Criteria: The manufacturer shall be solely responsible for the equipment supplied by the manufacturer including performance requirements and coordination of equipment installation with the Contractor.

C. All stainless steel components and enclosure panels shall be cleaned, pickled, and passivated as specified in Section 05500.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Provide delivery, storage, handling, and any required periodic maintenance from delivery until start-up in accordance with manufacturer's recommendations, Section 01600, and Section 15050.

1.08 WARRANTY

A. The manufacturer shall provide a written warranty against defect in materials and workmanship. The manufacturer shall warrant the equipment provided by manufacturer to be free from defect in materials and workmanship under normal conditions in accordance with Section 01740.

1.09 MAINTENANCE

A. As specified in Section 15050.

B. Spare Parts: Deliver as specified in Section 01600:
   1. The manufacturer with the equipment, if required for normal operation and maintenance, shall furnish special tools.
   2. The following spare parts shall be provided by the manufacturer:
      a. Filter Cloth Media and Non-Corrosive Support Frame Assemblies: Quantity as required for five disks.
      b. Viton® V-ring effluent port/center tube seal: Quantity of one.
      c. Backwash/sludge valve and actuator: Quantity of two.
      d. Float Switch: Quantity of one.
      e. Backwash Pump: Quantity of one.
      f. Gearbox for Drive Assembly: Quantity of one.

C. Contractor, inspector, and Owner's maintenance representative shall inventory and account for all tools and spare parts delivered to the site. Each party shall sign a turnover agreement. Owner will then take possession and responsibility for items.

PART 2 PRODUCTS

2.01 GENERAL

A. The equipment covered by these Specifications shall call attention to certain features but may not cover all details of the construction of the cloth disk filter system. Ancillary and accessory devices, within the confines of the manufacturer's scope, necessary for the treatment system performance shall be included by the manufacturer whether specified or not.

B. All items specified in this Section shall be furnished by a single manufacturer to provide sole source responsibility for a complete and properly functioning tertiary filter system.

C. The Contractor shall be responsible for any required design modifications to accommodate the tertiary filter tanks including but not limited to the design of any additional piping, pipe supports, controls, and redesign of the structure to accommodate the pipe penetrations. The cost for these changes shall be included in the bid price.

2.02 MANUFACTURER

A. Acceptable Manufacturers:
   1. Aqua-Aerobic Systems, Inc., Rockford, IL, AquaDisk Model ADFSP-54 x 10E-PC, no equal.

2.03 FILTER DISK TANK

A. The manufacturer shall supply:
   1. 2 packaged filters in 304 stainless steel tanks.

B. Tank Construction: Stainless steel, minimum 10-gauge thickness, designed and supplied by the filter manufacturer.

C. Tank Finish: Passivate after fabrication to remove embedded iron, surface rust, and weld burn. After passivation, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and passivation acid, and promote the formation of an oxidized passive layer on the stainless steel surface, which is critical to the long life of the stainless steel.

D. Tanks shall include stainless steel effluent seal plate weldments.

E. Each tank shall be provided with 3-inch drain connections as indicated on the Drawings. Provide one (1) 3-inch manual ball valve for tank drain.

2.04 DRIVE ASSEMBLY

A. The drive assembly shall consist of gearbox, drive sprocket, drive chain, a chain guard.

B. Gearbox: Parallel in-line helical-type, AGMA Class 1 with a 3/4-hp standard duty, 50-degree rise, drive motor rated for 460/3/60. Gearbox shall have a 1.15 service factor.
   1. Gear reducer: Manufacturer shall be Nord or equal.
   2. Motor: Manufacturer shall be by Nord, Baldor, or equal.
      a. Provide motor winding space heaters.
      b. Provide motor temperature switches.

C. Drive Sprocket: Nylon.

D. Chain: Acetal with 304 Stainless Steel link pins.

E. Chain Guard: 304 Stainless Steel.

2.05 CENTER TUBE ASSEMBLY

A. Each center tube assembly shall include a 304 Stainless Steel center tube weldment, driven sprocket, wheel assemblies, and frame and cloth assemblies. Where stainless steel is welded, use low-carbon stainless steel in compliance with Section 05120.

B. Effluent Port Seal: Include a chlorine resistant Viton® V-ring effluent port seal.

C. Drive Sprocket: Multi-segment U.H.M.W. polyethylene.

D. Fasteners: 316 Stainless Steel.

2.06 FILTER CLOTH ASSEMBLIES

A. General:
   1. Each cloth disk assembly shall be comprised of individual segments; each consisting of a cloth media sock supported by an injection molded polypropylene co-polymer frame.
   2. During filtration, the filter assemblies shall operate in a static condition with no moving parts. The filter system shall provide for the collection of filtered solids on the outside of the cloth media surface to allow for the direct contact of cleaning systems. Filtered effluent shall be used for backwash. The filter flow path shall be from the outside of the disk to the inside. Systems with flow paths from the inside to the outside of the disk that collect filtered solids and plastic debris on the interior surfaces of the disk will not be acceptable.

B. Cloth/Frame Assemblies:
   1. Shall be constructed such that each segment is easily removable from the center tube, without special tools, to allow for removal and replacement of the cloth at the point of installation.
   2. Each assembly shall have a minimum of 53.8 square feet of effective submerged filtration area. Effluent filtration area is defined as only the portion of the disk that is submerged during filtration. Any disk area that is not submerged shall not be considered as effective area.
   3. Each disk shall be divided into no more than six segments and shall be easily removable for service.

C. Cloth Media:
   1. Filter cloths shall be of chlorine-resistant polyester (PES) fiber pile construction with polyester backing material having a nominal filtration rating of 10 microns. Filter cloths shall be subject to a free chlorine residual (up to 3.0 mg/L) on a continual basis and up to a 10 mg/L free chlorine residual for brief intermittent events without impacting the warranty. Granular media and screens having structured identical openings shall not be allowed.
   2. The cloth media shall have an active filter depth of 3 to 5 mm to provide additional collisions between solids particles and the media within the media depth, resulting in capture of solids across a broader particle range. The cloth depth shall also provide storage of captured solids, reducing backwash volumes while maintaining an operational head loss. Woven mesh or microstrainer type disk with no filtration depth are not acceptable.

2.07 BACKWASH/SLUDGE DISCHARGE ASSEMBLY

A. General:
   1. The backwash function shall incorporate a pump that draws filter effluent through the cloth, thereby removing accumulated solids from the cloth surface. Because of the frequency of the backwash and misting associated with spray systems, designs that utilize high-pressure spray as the sole means of solids removal will not be acceptable.
   2. Each backwash/sludge discharge assembly shall include a backwash system assembly, an external piping assembly, and two backwash pumps with a throttling gate valve.

B. Backwash System Assembly:
   1. Number: One assembly per filter.
   2. Each assembly includes:
      a. 304 stainless steel backwash shoe supports.
      b. 316 stainless steel springs.
      c. 2 UHMW backwash shoes per disk.
      d. Reinforced PVC flexible hose with stainless steel hose clamps.
      e. (2) 3-inch manual ball valves.
      f. (2) 3-inch manual gate valves.
      g. Vacuum gauges with diaphragm seals and snubbers: 0 to 30 inches mercury, minimum 2.5-inch dial with all stainless steel welded construction, 1/4-inch NPT process connection, 316 stainless steel bourdon tube, Ashcroft or equal.
      h. Pressure gauges with diaphragm seals and snubbers: 0 to 15 psi, minimum 2.5-inch dial with black painted steel construction, 1/4-inch NPT process connection, “C” shaped bronze bourdon tube, Ashcroft or equal.
      i. Vacuum transducers: IFM Effector PX or equal.
   3. Each disk shall be cleaned by a minimum of two backwash shoes. Springs shall be used to maintain the proper tensioning of the backwash shoe against the media surface. Neither the cloth/support assemblies nor the backwash shoes shall include any gridwork overlays or other interferences that would prevent direct contact of the backwash shoes with the cloth fibers.
   4. The backwash shoe shall maintain direct contact with the cloth to ensure effective media cleaning. Each tank shall be provided with an integral solids waste collection manifold.

C. Backwash Pumps:
   1. Manufacturer: Gorman Rupp, model 12B20-B, or equal.
   2. Type: Externally mounted centrifugal pump.
   3. Number: Two per filter.
   4. Pump shall be provided with a 2-hp, standard duty, 50-degree rise, 460-volt, 3-phase, 60-Hz TEFC motor and operate at 1,750 rpm. Motor shall be by Baldor or equal.
      a. Provide Motor Winding Heaters.
      b. Provide Motor Temperature Switches.
   5. Pump shall be rated for 130 gpm at 23 feet TDH.
   6. Pump shall include an internal check valve.

2.08 BACKWASH VALVES, SLUDGE VALVE, AND CONTROL VALVE

A. Backwash Valves:
   1. Quantity: 5 per filter.
   2. Size: 2-inch.
   3. Type: 316 stainless steel ball valve with actuator: Manufacturer standard.
   4. Each valve shall have a 115-volt, 1 phase, 60-cycle OPEN/CLOSE service electric actuator. Valve actuator shall include a compartment heater, with limit switch feedback to the microprocessor in both the OPEN and CLOSE positions.

B. Sludge Valve:
   1. Quantity: 1 per filter.
   2. Size: 2-inch.
   3. Type: 316 stainless steel ball valve with actuator: Manufacturer standard.
   4. Each valve shall have a 115-volt, 1 phase, 60-cycle OPEN/CLOSE service electric actuator. Valve actuator shall include a compartment heater, with limit switch feedback to the microprocessor in both the OPEN and CLOSE positions.

C. Manual Control Gate Valve: Manufacturer Standard.

2.09 ANCHOR BOLTS

A. The manufacturer shall provide anchor bolt calculations per Section 01612.

B. The manufacturer shall provide and anchor bolts for the filters and backwash pumps. Anchor bolts shall be 316 stainless steel and conform to Section 05120. The Contractor shall install the anchor bolts.

2.10 PIPING

A. Contractor shall provide all piping, supports, bracing and fitting as required and as acceptable to the Engineer.

B. Piping for the backwash pumping system, filter influent, filter overflow, and filter outlet shall be as listed in the piping schedule, Section 15052.

C. Contractor shall provide piping, supports, bracing, and fitting as required.

2.11 FINISHES

A. Contractor shall provide field finishes under the provisions of Section 09960.

2.12 ELECTRICAL, INSTRUMENTATION, AND CONTROLS

A. General:
   1. Electrical work shall conform to Section 16050.
   2. Electrical elements identification as provided in Section 16075.
   3. Electrical connections shall provide flexibility to allow full pivot without disconnecting power or cables.

B. Control Panel:

1. The controls shall be incorporated into vendor control panels as indicated on the drawings and in accordance with Section 17710. A vendor control panel (VCP) shall be provided for each filter. The VCPs shall be NEMA 4X of stainless steel Type 316 construction.
    a. Power to each Control Panel shall be through a single 480-volt, 3-phase, 60-Hertz feeder. Provide fine-down transformers and power supplies inside the control panel to power the 120-volt loads and 24-volt DC loads
2. Main overcurrent device shall be a flange-mounted disconnect handle operating a molded case circuit breaker in accordance with Specification Sections 17710 and 16412.
    a. Provide all other VCP Circuit breakers in accordance with Specification Section 16412.
3. Each VCP shall include a programmable logic controller (PLC) that complies with Sections 17720 and 17761.
4. Each VCP shall include a closed circuit air conditioning system, temperature switches, strip heaters, and corrosion inhibiting vapor capsules or strips per Section 17710.
5. Provide Ethernet communications to communicate with the Plant PLC and SCADA systems as indicated on the Drawings. Coordinate data points and addressing with the ICSC.
6. Each VCP shall include a managed Ethernet switch and panel mounted fiber optic patch panel that complies with Section 17733.
7. Each VCP shall include a human machine interface screen that complies with Sections 17721 and 17765. Provide a hinged cover for protection of the operator interface.
8. Each VCP shall include all motor starters, contactors, and overload relays required to operate the filter. The panel shall also include a 460/120 volt control power transformer.
    a. As specified in Section 16422.
9. All instruments and equipment directly mounted to the filter tank shall be factory prewired to the control panel. All conduits shall be conforming to Section 16130. The panel shall be factory mounted directly to the filter unit at the location as shown on the Drawings. The panel shall be lowered to ship the filter. The Contractor shall raise the panel into position in the field.
    a. Interconnecting wiring and conduit from the filter to the backwash pumps shall be provided by the Contractor.
10. Each VCP shall provide the following signals to SCADA via Ethernet connection:
    a. Common Fail.
        1) The alarm shall activate upon any critical system failure and will prompt the Plant PLC to remove flow to the filter.
    b. Drive Motor Running.
    c. Drive Motor Fail.
    d. Drive Motor Overtemp.
    e. Backwash Pump Running.
    f. Backwash Pump Fail.
    g. Backwash Pump Motor Overtemp.
    h. Backwash Cycle Ready
    i. Solids Pump Running.
    j. Solids Pump Fail.
    k. Solids Pump Motor Overtemp.

l. Backwash Valve Status (OPEN/CLOSED).
m. Backwash Valve Fail.
n. Backwash Valve Status (OPEN/CLOSED).
o. Solids Valve Fail.
p. High Backwash Pump Vacuum.
q. Tank Water Level.
r. Filter Mode (Filtering/Backwash/Sludge).
s. Elapsed Time Since Last Backwash.
t. Elapsed Time Since Last Sludge Cycle.
u. Elapsed Time on Drive Motor.
v. Elapsed Time on Backwash Pumps.
w. Total Backwash Time and Cycles.
x. Total Solids Waste Withdrawal Time and Cycles.

C. Each VCP shall allow the following control via the HMI located on the control panel:
1. Sludge setup:
   a. Set pump run time.
   b. Set backwashes between sludge cycles.
   c. Set maximum time between sludge cycles.
   d. Start manual sludge cycle.
2. Backwash setup:
   a. Set minimum time between backwash cycles.
   b. Set maximum time between backwash cycles.
   c. Set backwash time per pair of disks.
   d. Set water level to trigger backwash.
   e. Start manual backwash.
3. System status:
   a. Displays system operating status (current mode).
   b. Displays backwash history.
   c. Displays time since most recent sludge and backwash cycle.
   d. Displays basin water level.
4. Motor and process ETM:
   a. Displays all motor ETM.
   b. Displays all process ETM.
5. Alarm list:
   a. Displays list of all alarms that have not been cleared by the operator.
6. Alarm history.
7. Time defaults.

D. Each VCP shall allow the following control via the HMI located on the control panel:
1. Backwash Mode:
   a. When a Filter System is ready for a backwash cycle, the associated VCP shall issue a BACKWASH READY signal as described above. The Filter VCP shall not initiate a backwash sequence until the VCP receives a backwash permissive signal from the Plant PLC.
2. System setup:
   a. Number of backwash pumps and valves.
   b. Basin level at 4mA and span.
   c. User control of valve actuator feedback.
   d. Sludge cycle minimum water level.
   e. Backwash cycle minimum water level.
   f. Backwash ready notification.

g. Backwash start level.
h. Backwash differential start level.
i. Basin high level alarm.
j. Alarm enable/disable bits.

3. Password protected system setup.

E. Backwash Operation:

1. General:
   a. VCP controls the backwashing sequence of the filter. There are 2 backwash pumps - 2 duty pumps. There are 5 motorized backwash valves and 1 motorized sludge valve. The backwash cycle draws water from the filtered side of the cloth filter to a backwash header connected to the backwash pumps. The reverse flow through the cloth filter dislodges material in the cloth media. During the sludge cycle, the sludge valve opens and sludge is drawn off the bottom of the filter and pumped to waste by the backwash pumps.
2. VCP HAND control:
   a. Each backwash valve can be opened or closed by its respective OPEN-CLOSE-AUTO hand switch. The valve position shall be indicated at the control panel.
   b. The sludge valve can be opened or closed by its respective OPEN-CLOSE-AUTO hand switch. The valve position shall be indicated at the control panel.
   c. The filter can be rotated to the next backwash position by its HAND-OFF-AUTO switch. The drive motor operation shall be indicated at the control panel.
   d. Each backwash pump can be started or stopped by its respective HAND-OFF-AUTO switch. Pump run status and fail alarm shall be indicated at the control panel.
   e. Sludge waste initiate: If the backwash pumps are in AUTO and the sludge waste valve is in AUTO, the pushbutton shall initiate a sludge waste cycle.
   f. Backwash initiate: If all valves and 2 of the backwash pumps are in AUTO, the pushbutton shall initiate a backwash cycle.
3. VCP AUTO control:
   a. All pump and valve hand switches are in AUTO.
   b. The filter unit remains in service during the filter backwash cycle. The backwash initiates based on the first instance of the following conditions:
      1) Water level in the tank exceeds specified level.
      2) Operator-specified time interval elapses.
      3) High-level float switch activates.
   c. When the controls activate a backwash cycle for a given filter, the following sequence takes place:
      1) Backwash Valve No. 1 opens, starting the designated Filter Backwash Pump No. 1 associated with the filter unit being backwashed. The control system will advance the backwash valve sequence until all disks are cleaned.
   d. Sludge waste cycle: From time to time, solids will settle in the bottom of the filter box. These solids must be withdrawn out of the filter. The sludge waste cycle initiates based on the first instance of the following:
      1) Operator-specified time interval elapses.
      2) Operator-specified backwash count elapses.
      3) When the controls activate a sludge waste cycle, the following sequence shall take place:

a) The sludge waste valve shall open.
b) A backwash pump shall start and run for an operator preset time.

4. Power failure recovery:
   a. The VCP will detect an interruption of utility power. The VCP will inhibit all alarms that would affect the programmed operation of the system.
   b. Power failure as indicated by power failure relay VCP inputs:
   c. If in Automatic control prior to the power supply interruption, the VCP will clear all alarms and automatically restart with a time delay.
   d. If in Hand control prior to the power supply interruption, the system will require manual restart in the field.

F. Programming:
   1. The PLC in each VCP shall be programmed by the System Supplier to control the operation of the tertiary filter.
   2. In addition, the system shall be capable of executing the tertiary filter control strategy outlined in Section 17101-30 and operate using inputs provided by, and shall send outputs to, the Plant PLC.

G. Instrumentation:
   1. System Supplier shall furnish the following components as a part of the filtration system.
      a. Pressure gauges: Manufacturer standard supply with diaphragm seals and snubbers.
      b. Level pressure transmitter: Manufacturer standard supply.
      c. High-level float: Manufacturer standard supply.

PART 3 EXECUTION

3.01 EXAMINATION

A. As specified in Section 15050.

3.02 INSTALLATION

A. The cloth disk filter systems shall be installed under the direction of the system supplier in strict conformance with the manufacturer's installation instructions and with favorable review of shop drawings. An authorized representative of the manufacturer shall perform final installation inspection, start-up, calibration, and instruction of operating personnel.

B. The manufacturer shall inspect the installation of all equipment in this Section before start-up to verify that the equipment has been properly installed and operates properly as a system and individually. The Contractor shall coordinate the scheduling of this activity with manufacturer.

C. Installation of all conduit and related components shall adhere to Section 16130 - Conduits.

D. Upon acceptance by the Engineer, alignment of equipment, piping, and accessories may vary from that indicated on the Drawings to suit the equipment furnished without additional cost to the Owner.

E. Make up piping with a sufficient number of unions to permit ready breaking of lines for maintenance.

F. Support and brace plastic pipe to prevent sagging or overstressing of pipe and connections; furthermore, support piping so no item of the piping system transfers load or strain to equipment.

G. Adequately support piping to ensure that the operation of valves will not cause the pipe to show appreciable movement.

H. Perform an end-to-end test with the aid of the Electrical Contractor.

I. Perform system test with the aid of the Contractor.

J. Verify networking communication between the Owner's control system and the filter network.

3.03 FIELD WELDING

A. The stainless steel components and enclosure panels shall be cleaned, pickled, and passivated as specified in Section 05500 for any field-welded surfaces.

3.04 SUPPLIER/MANUFACTURER FIELD SERVICES

A. Coordinate with manufacturer's field representative to ensure proper installation, testing, and start-up of the cloth disk filter units. The Contractor shall coordinate with manufacturer the scheduling of all Field Services activities.

B. The manufacturer's representative shall be present at the job site for whatever period is necessary to ensure proper installation. The Contractor shall coordinate the scheduling of this activity with manufacturer.

C. The manufacturer's representative shall have 5 years experience in the installation of similar systems and provide a list of 10 facilities at which he/she has inspected the installation and testing of similar cloth disk filter units.

D. The manufacturer shall provide the services of a qualified representative to supervise and inspect equipment installation and start-up and training of Owner's plant personnel. Notwithstanding, manufacturers' representatives shall be present at frequent enough intervals to ensure proper installation and testing of the equipment furnished.

Duties/Description	**Minimum Requirements(1)**	
	Man Days (days)	**Trips to Site (No.)**
Assist Contractor and Inspect Work	2	1
PLC Coordination Meeting (Coordination between LCP and SCADA PLC)	1/2	1(2)
Start-Up and Operator Training	4	1
TOTALS	**9**	**3**

Notes:
(1) All days are calendar weekdays.
(2) Coordination meeting may be by phone, as approved by Engineer.

3.05 FIELD QUALITY CONTROL

A. System Tests:
   1. System testing of the entire system to be conducted following installation and cleaning of the equipment.
   2. Testing to be conducted by the Contractor and the manufacturer's representative in the presence of the Engineer to demonstrate that the equipment is capable of performing its specified function in a satisfactory manner without mechanical or electrical defects, binding, or operational difficulties.
   3. Repair visible leaks.
   4. Test and calibrate all controls, switches, automatic valves, and other instrumentation and control equipment associated with the cloth disk filter units specified herein, in accordance with the manufacturer's printed instructions over the full operating range of the equipment.
   5. After equipment, piping, and other necessary incidentals are completed, conduct system and operational testing of the system as specified in Section 01660 and provide a certified test report.
   6. Do not affect warranty of the systems by testing.
   7. Coordinate testing with system testing of other equipment.

B. Field Services:
   1. Provide a factory-trained representative from the manufacturer, after installation, to thoroughly inspect each cloth disk filter unit, place it in operation, and make necessary adjustments.
   2. The services required of the representative shall include installation assistance, safety inspection, preventive maintenance and calibration check.

3.06 DEMONSTRATION AND TRAINING

A. Provide system start-up as specified in Section 01660.

B. Provide operator training at job site by a factory-trained representative in accordance with Section 01660. Operator training to include:
   1. Operations and inspection training.
   2. Safety instruction.
   3. Preventative maintenance instruction.
   4. Calibration and other pertinent services.

C. The Contractor shall coordinate the scheduling of all training activities with manufacturer.

D. When all preceding equipment tests have been satisfactorily performed and when water is available and can be suitably handled, the furnished equipment shall be started. The manufacturer's representative shall supervise the Owner's operating personnel during the start-up period. Start-up operations shall be continued until it is satisfactorily demonstrated that the equipment is suitable for continuous online service.

E. After start-up, the manufacturer shall furnish the service of a competent technical service representative after Contractor's start-up to instruct the Owner's personnel in the operation and maintenance of the equipment.

F. Instruction of personnel in the operation and maintenance of equipment as specified in Section 01660.

3.07 SUPPLIER/MANUFACTURER'S FIELD QUALITY CONTROL SERVICES

A. A qualified representative of both the manufacturer and Contractor shall perform preliminary field-testing, inspection, and checkout of the furnished equipment, following installation. Tests shall be conducted to demonstrate to the Engineer that all system components furnished by the manufacturer are operational, that all connecting piping is leak proof and properly anchored, and that the entire system furnished by the manufacturer is ready for continuous safe operation. The purpose of the checkout shall be to ensure that each individual system component has been correctly installed, shall operate fully in the manner intended, and is ready to perform its function as part of an integrated system when placed in continuous operation.

B. Field Services:
   1. Manufacturer shall provide the services necessary to start-up, test, and operate the system as follows:
      a. Contractor assistance and inspection:
         1) Advice during installation.
         2) Equipment check-up and initial testing.
         3) Loop tests with assistance of the Electrical Contractor.
         4) End-to-end test.
         5) Control system network test.
         6) PLC coordination.
      b. Start-up and operator training:
         1) Start-up assistance.
         2) Supervision of equipment operation at start-up.
         3) Operator training.
   2. Fees, costs, and/or expenses in excess of the scheduled field services, which result from manufacturer assistance as required or requested by the Contractor, as presented in Article 3.04, shall not be incurred by the Owner and are the sole responsibility of the Contractor.

C. Inspection and Testing:
   1. Upon completion of equipment installation by the Contractor, and before equipment testing and start-up, the manufacturer shall inspect the equipment installation and provide the Owner a letter of certification stating that the equipment has been installed in accordance with manufacturer instruction and recommendations.
   2. After all equipment has been completely installed by the installation contractor, each unit shall be tested by the manufacturer and equipment manufacturer as follows:
      a. Proper operation of the furnished equipment.
      b. Operation of programmable controls, electrical panels, indicating lights, pushbuttons, etc., if applicable.
      c. All other related equipment supplied by filter manufacturer.

END OF SECTION

SECTION 11376A

ROTARY-LOBE AERATION BLOWERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Aeration blowers, blower panel, and appurtenances for the Solids Storage tanks.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01600 - Product Requirements.
      b. Section 01612 - Seismic Design Criteria.
      c. Section 01614 - Wind Design Criteria.
      d. Section 01660 - Testing, Training, and Commissioning.
      e. Section 09960 - Coatings.
      f. Section 13446 - Valve and Gate Operators.
      g. Section 15082 - Piping Insulation.
      h. Section 15117 - Specialty Valves.
      i. Section 16222 - Low Voltage Motors up to 500 Horsepower.
      j. Section 17101 - Specific Control Strategies.

1.02 REFERENCES

A. American Iron and Steel Institute (AISI).

B. American National Standards Institute (ANSI).

C. American Petroleum Institute (API):
   1. 617 - Rotary Assembly Dynamic Balancing.

D. American Society of Mechanical Engineers (ASME):
   1. ASME PTC 10 - Performance Test Code - Compressors and Exhausters.

E. American Bearing Manufacturers Association (ANSI/ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

F. Institute of Electrical and Electronics Engineers (IEEE):
   1. 85 - Test Procedure for Airborne Noise Measurements on Rotating Electric Machinery.

1.03 DEFINITIONS

A. Continuous Operation: 24-hour-per-day operation for design life of not less than 20 years, or 175,200 hours.

B. Intermittent Operation: Periodic operation, including starts and stops; including extended periods of time when not in use.

C. Rotary Blower System: The blower unit, including but not limited to: Rotary blower, motor, controls, and appurtenances required to furnish a complete installation as specified herein and as indicated on the plans.

1.04 SYSTEM DESCRIPTION

A. General: Aeration blowers and appurtenances shall include the following items supplied by blower manufacturer:
   1. Rotary Positive Displacement Blower and Motor.
   2. Air intake filters.
   3. Silencers, inlet, discharge, and vent.
   4. Butterfly valves in blowoff circuit.
   5. Check valves.
   6. Relief valves.
   7. Flexible pipe connectors.
   8. Pressure gauges.
   9. Sound Enclosure.
   10. Appurtenances as required.

B. Design Requirements:

Parameter	50-BLO-401, 50-BLO-402, 50-BLO-403
Type of Blower	Rotary lobe, positive displacement
Number of blowers	3
Rated speed	1,800 revolutions per minute, maximum
Rated inlet air flow at rated speed	600 scfm
Inlet filter pressure loss	0.20 pounds per square inch
Rated relative humidity	100% RH
Rated barometer	14.7 psia
Rated Inlet temperature	97° Fahrenheit
Rated discharge pressure	9 psig

   1. Motor: As specified in Section 16222, except as otherwise specified or supplemented below:
      a. Provide winding temperature switches.
      b. Provide Motor Winding Space heater.

Power supply	480 volt, 3 phase, 60 hertz
Horsepower	50
Speed, maximum	1,800
Enclosure	TEFC
Service factor	1.15

2. Drive: The blower shall be V-belt driven with the drive designed for a minimum 140 percent of motor hp, and include an adjustable motor slide base. Sheaves shall be two part, with taper lock style attachment to the shaft. Sheaves shall be dynamically balanced as required by the manufacturer's maximum rim speed. V-belt design shall calculate the forces on the blower input drive shaft and motor so as not to exceed maximum bearing side load. A totally enclosed guard built to OSHA specifications shall be painted safety yellow. In lieu of V-Belt Drive, a direct couple between the blower and drive motor may be acceptable, with no changes to the basic mechanical layout allowed. Direct couple shall be "S-Flex" style, two-piece EPMD with retaining ring (E-Type), with a 1.5 service factor manufactured by Lovejoy or approved equal.
3. Provide controls as indicated on the P&ID Drawings and as specified in Section 17100.

C. Operations Description, Monitoring and Alarms: As indicated on the P&ID Drawings and as specified in Section 17100 and Section 17101.

1.05 SUBMITTALS

A. Product Data and Shop Drawings: Include:
1. Blower panel device layout and material list.
2. Literature and drawings describing equipment performance and construction in sufficient detail, including parts list, dimensions, materials, and details of construction and installation.
3. Schematic electrical wiring diagrams and other data as required for complete system.
4. Certified dimensional data for components, including foundation and anchor bolts and details.
5. Equipment Data:
   a. Blower Information:
      1) Manufacturer.
      2) Model.
      3) Blower speed in revolutions per minute.
      4) Blower site capacity, actual cubic feet per minute.
      5) Discharge pressure, psia.
      6) Horsepower required including loss in V-belt drive.
      7) Weight of blower.
      8) Weight of motor.
      9) Free-field noise level at 3 feet from blower acoustic enclosure.
   b. Motor performance and construction data.
   c. Descriptive brochures and applicable performance and construction data for each item of auxiliary equipment along with their weights.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Minimum 15 years experience in manufacturing similar equipment utilized in water and wastewater treatment plants.
2. Supplies accessories including motor.

3. Assumes responsibility for compatibility of components furnished.
4. Furnishes services of factory representatives with complete knowledge of proper installation, operation and maintenance of equipment to inspect and approve final installation and supervise test runs of equipment.

B. Equipment supplier must be an authorized representative of the blower manufacturer. Verification to be part of shop drawing review.

C. Equipment supplier must have a service facility within 200 miles of job site.

1.07 ENVIRONMENTAL CONDITIONS

A. Blower shall be suitable for continuous service and intermittent operations.

B. Site conditions for determining rated ACFM noted in Article 1.02 Paragraph B Design Requirements.

1.08 SPARE PARTS

A. Furnish one set of special tools with equipment when required for normal operation and maintenance.

B. Spare Parts: Include:
1. 1 complete set of bearings.
2. 4 complete sets of ventilation and air intake filters.
3. 4 lubrication oil filter cartridges.
4. 2 complete sets of gaskets and O-rings.
5. 2 sets of drive belts or direct couplings.

C. Label spare parts as specified in Section 01600 and box for storage.

PART 2 PRODUCTS

2.01 AERATION BLOWERS

A. Manufacturers: One of the following or equal:
1. Roots, series Easy Air X2 package with a Ram WHISPAIR frame.
2. Sutorbilt, equivalent product.

2.02 MATERIALS

A. General:
1. Aeration Blower Package Assembly: Complete with sound attenuating enclosure, blower, drive, inlet and discharge silencers, valves and appurtenances.
2. Blower Rating: As specified above.
3. Rotation direction of blower shall match requirements of piping.

B. Blower and Drive:
1. General:
a. Blower shall deliver oil-free air.
b. Blower and Motor Mounting: On common base.

c. Lifting Provisions: Lifting eyes on blowers, motors and base so each major component or entire unit can be lifted.
d. Piping Connections: 125 pound class flanges meeting ANSI B16.1.

2. Type: Positive displacement rotary blowers using 2 impellers to pressurize a trapped volume of air at a controlled rate prior to exposing it to a discharge pressure.
3. Casing and Head Plates:
   a. Blower Casing: One piece with separate head plates and end covers.
   b. Casing and Head Plates: Made of close-grained, machined cast iron.
   c. End Covers and Head Plates: Reinforced with bosses at penetrations with cast, machined support feet.
   d. Housing: Feedback plenum on the discharge port that bleeds back some of the discharge air to a closed pocket as the rotor tip passes to reduce pulsation and noise.
4. Impellers:
   a. Material: Ductile iron or cast iron, ASTM A48 Class 30B.
   b. Design: Straight, 2-lobe, involute type.
   c. Balance: Statically and dynamically, by removing metal from impeller body.
   d. Operation: Free of rubbing without need for liquid seals or lubrication.
   e. Timing: Positively by a pair of accurately machined, heat treated, alloy steel timing gears. Helical gears shall be machined from hardened alloy steel and bolted to timing hubs. Timing hubs shall be serrated on the inner diameter and placed over matching serrations on the shaft. Timing gears and hubs shall be locked in the axial position by a lock nut to assure no slippage.
   f. Shafts: Alloy steel forgings, pressed into each end of each impeller and pinned.
   g. Impeller Assembly Support: Anti-friction type bearings, sized for a minimum ABMA L-10 life of 100,000 hours.
5. Lubrication:
   a. Positive Oil Seal: Provided at each bearing.
   b. Seal Design: Capable of preventing lubricant from leaking into air stream.
   c. Vent Provisions: Capable of venting impeller side of oil seal to atmosphere while eliminating possible carryover of lubricant into air stream.
   d. Drive-end Bearings: Splash oil lubricated from an oil reservoir in the drive end cover housing.
   e. Timing Gears and Gear-end Bearings: Splash oil lubricated from an oil reservoir in the drive end cover housing.
   f. Blowers Shipment: With openings sealed after injection of rust inhibitor.

2.03 APPURTENANCES

A. Inlet Air Filter/Silencer:
   1. Provide filter/silencer installed at the blower inlet connection inside enclosure.
   2. Galvanized Carbon Steel housing with front access for paper or pleated filter elements and suitable clamps.
   3. MERV rating of 8.99 percent and can achieve removal efficiency of 5-micron particle size and larger.

B. Silencers:
   1. Manufacturers: One of the following or equal:
      a. Burgess-Manning, Model BMSI-L, BMSS-L, or equal.
   2. Construction: Combination multi-chambered reactive/adsorptive type of all welded steel construction with flanged connections with diameter and drilling conforming to ASME B16.1 Class 125.
   3. Discharge Silencer: Furnished with copper wool absorption material.
   4. Silencers Sizing: For design conditions and specifically designed for use with positive displacement blowers, size as indicated on the Drawings unless a larger size is recommended by the manufacturer.
   5. Mounting of Silencers: Inlet, discharge, and vent. Complete support of inlet, discharge, and blowoff silencers is required as part of the package.
   6. Noise attenuation of silencers shall as a minimum, meet the following:

Octave Band Center Frequency, Hertz	Attenuation, dbA
63	12
125	20
250	27
500	30
1,000	31
2,000	29
4,000	25
8,000	21

C. Combination Base: Base shall have combination type discharge silencer. Provide flexible connectors between the blower discharge connection and the discharge silencer inlet connection. The base/discharge silencer shall be manufactured using carbon steel, have plain pipe stub connections and incorporate an oil pan in the design. The base/discharge silencer will have connections for a pressure relief valve, pressure gauge, discharge temperature gauge, mechanical unloading valve and 1/2-inch drain built into the silencer. Packed/absorptive type silencers are not acceptable.

D. Vibration mounts shall be supplied and capable of leveling the blower package to insure proper oil level to increase service and longevity of the equipment. The blower manufacture must insure proper selection for the specific blower system supplied.

E. An 80-dBA or less free field guaranteed noise enclosure should be provided for each blower system. The enclosure shall incorporate inlet and discharge weather hoods. The enclosure outer material must be zinc coated steel with a surface preparation and paint as follows: Powder coat with texture finish 40-100 microns (65 microns average) RAL 5015 blue powder coat process to be proven to pass 500-hour salt spray test satisfactory with no rust evidence. The enclosure must be suitable for outdoor installation, 20 lb. per square foot snow load and 70 mph wind speed. The enclosure shall include a vent system and (3) removable panels for easy access and maintenance. The ventilation fan shall be mounted on blower drive shaft; separately wired electric enclosure fans are not acceptable. The noise

enclosure shall be provided with 1-inch foam and the foam shall comply with UL94-HF 1 for flammability. The noise enclosure shall provide up to 22-dba attenuation, free field.

F. Relief Valve: Spring type, full-nozzle type; sized to relieve full blower capacity with 10 percent accumulation; 10 pounds per square inch gauge set pressure. Relief valve outlet shall be bronze body, screwed or flanged connections per ANSI B16.
   1. Manufacturers: One of the following or equal:
      a. Kunkle Valve Co.

G. Butterfly Valves:
   1. Constructed as specified in Sections 15112, 13446, and 13447.
   2. Lined with 10 mils of epoxy suitable for temperatures to 280 degrees Fahrenheit.
   3. Sealed with EPDM seals suitable for temperatures of 250 degrees Fahrenheit.

H. Check Valves: Dual disc, wafer style with torsion spring induced closure; consisting of following components: manufactured by Val-Matic or equal:
   1. Valve body: Carbon Steel or ASTM A 126 cast iron.
   2. Disc: ASTM B 148-9A, aluminum bronze.
   3. Spring: ASTM A 276, Type 316 stainless steel.
   4. Pins and Thrust Bearings: ASTM A 276 Type 316, stainless steel.
   5. Seals, EPDM rated for minimum 280 degrees Fahrenheit.

I. Pressure Gages: Liquid filled case with minimum 4 inch dial face:
   1. Type on Suction Side of Blower: Vacuum gauge calibrated in inches of water.
   2. Type On Discharge Side of Blower: Pressure gauge calibrated in psig.
   3. Mount gage on the face of noise enclosure.

J. Inlet Filter differential pressure Gages: minimum 4 inch dial face:
   1. Magnehilic type calibrated in inches of water vacuum.
   2. Mount gage on the face of noise enclosure.

K. Temperature Gauges: Liquid filled case with minimum 4 inch dial face:
   1. Type On Discharge Side of Blower: Pressure gauge calibrated in Deg F and Deg C.
   2. Mount gage on the face of noise enclosure.

L. Switches: Provide the following switches mounted on the blower inside of enclosure as part of the package.
   1. High Discharge Air Temperature Switch:
      a. With thermowell, suitable for direct or remote mounting in discharge piping.
      b. Adjustable over range of 80 to 300 degrees Fahrenheit or as recommended by blower manufacturer. Initial setting as recommended by blower manufacturer.
      c. NEMA 4.
   2. High Discharge Air Pressure Switch:
      a. Range as recommended by blower manufacturer: initial setting as recommended by bower manufacturer.
      b. NEMA 4.

3. High Inlet Filter Vacuum Switch:
    a. Range as recommended by blower manufacturer: initial setting as recommended by bower manufacturer.
    b. NEMA 4.
4. Motor Winding Temperature Switch:
    a. Range as recommended by blower manufacturer: initial setting as recommended by bower manufacturer.
    b. NEMA 4.

M. Other Safety Devices and Controls: As recommended by blower manufacturer.

N. Rubber Expansion Joints:
1. Provided at inlet and discharge flanges of blowers.
2. Suitable for pressures up to 15 pounds per square inch gauge and temperature up to 280 degrees Fahrenheit.
3. At discharge joints, provided with control rods to restrict axial pipe movement.
4. Manufacturers: One of the following or equal:
    a. General Rubber, or equal.

O. Discharge Piping and Silencer Insulation: As specified in Section 15082, and as indicated on the Drawings.

P. Provide unloading valves for each blower for proper operation of the system.

Q. Supports and Bracing: As required to support blower, associated equipment and piping, and to prevent excessive or harmful vibration or movement of equipment or piping.

2.04 CONTROLS

A. Provide Blower controls as indicated on the plans and per Sections 17710 and 17101.

2.05 SURFACE PREPARATION AND PAINTING

A. Prepare and shop paint surfaces as specified in Section 09960.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install adequate supports and bracing to support blower, associated equipment and piping, and to prevent excessive or harmful vibration or movement of equipment or piping resulting from operation of the system.

B. Install blower/motor support structure. Properly align and mount blower and motor.

3.02 MANUFACTURER'S FIELD SERVICES

A. Require manufacturer to inspect system before initial testing and start-up and certify that system has been correctly installed and prepared for testing and start-up as specified in this Section and Sections 15050 and 15958.

B. Training: As specified in Section 01660 and as described below:
   1. Require manufacturer's representative to perform the following services in four separate trips (minimum) as described below:
      a. Installation assistance and inspection: One man-day.
         1) Advise/observe the CONTRACTOR on the installation of rotary lube blowers.
         2) Check and verify that installation of the rotary lube blowers is in accordance with the Drawings and manufacturer's installation instructions.
      b. Certification of installation, field testing, and start-up assistance: Two man-days.
      c. Operator Training: Two separate half man-days, one during Testing Phase and one during Commissioning Phase.
      d. Post start-up services: One man-day.
   2. Each man-day consists of 8 working hours.
   3. The specified durations are the minimum required time on the job site and do not include travel time.

C. Require manufacturer's representative to complete all certificates, reports, and forms in Specification Section 01600.

3.03 FIELD TESTING

A. After installation of equipment, approval of installation by manufacturer's representative, and operation equipment for sufficient period to make corrections and adjustments, test aeration blower system in the presence of ENGINEER.

B. During test period, take and record readings of essential data at 30-minute intervals, including but not limited to noise, vibration, oil and air temperature, and operating pressures.

3.04 CORRECTIVE MEASURES

A. When units or system performance or operation fails to meet specifications, take corrective measures, or remove and replace units with acceptable units.

B. Operate equipment for 7-day operating period as specified in Section 01660.

END OF SECTION

SECTION 11376C

SLOW SPEED MECHANICAL AERATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Slow speed, fixed, mechanical surface aerators for use in the oxidation ditches, consisting of a drive motor, gear reducer, coupling, impeller shaft, and an open type, vaned impeller. Two oxidation ditch return flow control gates shall be provided.

B. Equipment Numbers:

Oxidation Ditch No. 1	Aerator	20-AER-091
	Aerator	20-AER-092
	Flow Control Gate	20-GAT-093
Oxidation Ditch No. 2	Aerator	20-AER-101
	Aerator	20-AER-102
	Flow Control Gate	20-GAT-103

C. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01610 - Project Design Criteria.
   b. Section 01660 - Testing, Training, and Commissioning.
   c. Section 09960 - High-Performance Coatings.
   d. Section 15050 - Common Work Results for Mechanical Equipment.
   e. Section 15958 - Mechanical Equipment Testing.
   f. Section 16222 - Low Voltage Motors up to 500 Horsepower.

1.02 REFERENCES

A. American Bearing Manufacturers' Association (ABMA):
1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Gear Manufacturers' Association (AGMA).

C. American Welding Society (AWS).

D. ASTM International (ASTM):
   1. A 36 - Standard Specification for Carbon Structural Steel.
   2. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

E. National Electrical Manufacturers Association (NEMA).

F. Society for Protective Coatings (SSPC):
   1. SP-1 - Solvent Cleaning.
   2. SP-10 - Near-White Blast Cleaning.

1.03 SYSTEM DESCRIPTION

A. Projected Loads:

PROJECTED LOADS – MAXIMUM MONTH VALUES		
Criteria	**Units**	**Values**
Flow	mgd	1.41
5 Day Biochemical Oxygen Demand (BOD)	ppd	4,600
Total Suspended Solids (TSS)	ppd	3,965
Nitrogen (as total N)	mg	60
Wastewater Design Temperature	deg C	20.3

B. Expected Effluent Limits:

Criteria	Units	Values
BOD (est.)	mg/l	10
TSS	mg/l	10
NH3-N	mg/l	<1.0
NO2-N	mg/l	<1.0
TN	mg/l	7.0

C. Oxidation Ditch Design Criteria:

Criteria	Units	Values
Number	ea	2
Total Volume per Basin	MG	1.088
Anoxic Zone	MG	0.224
Aerated Zone	MG	0.864
Hydraulic Detention Time		
Average Day Maximum Month (ADMM)	hrs	31.6

Criteria	Units	Values
Side Water Depth(1)	ft	12.25
Mixed Liquor Suspended Solids (MLSS)		
ADMM	mg/L	3,400
Solids Residence Time (MLSS)		
Average Day Maximum Month (ADMM)	Days	20.54
VFD per Ditch	ea	2
Horsepower/Aerator (maximum)	hp	75
Return Activated Sludge Flow		
Maximum Month	mgd	1.59

Notes:

(1) In storage mode the water in the ditch will rise by 7 inches to a maximum side water depth (SWD) of 12.83 feet. At this time oxygen demand will be a minimum and the system shall keep the solids in suspension.

(2) The motor horsepower for the aerator shall be non-overloading at the maximum SWD.

1.04 PERFORMANCE REQUIREMENTS

A. The aerators, as installed, shall establish and maintain an average liquid velocity of at least 1.0 feet per second in any cross-section of the oxidation ditch which is unaffected by flow disturbance of aerators or turning vanes.
   1. Channel velocity shall be measured using a suitable velocity meter at 16 points in a cross-section of the channel.

B. Operate at the specified controlled variations of mixed liquor level in the oxidation ditchl so that oxygenation and power draw will vary as desired to respond to load variations to the plant.

C. Maintain biological solids in suspension.

D. Develop an oxygen transfer efficiency of no less than 3.5 pounds of oxygen per horsepower hour based on motor output power at standard transfer conditions.

1.05 SUBMITTALS

A. Provide submittals as required in Section 15050.

B. Product data: Include manufacturers' specifications.

C. Provide motor sumbittals as required in Section 16222.

D. Shop drawings:
   1. Include general arrangement drawings and details.
   2. Certified shop and erection drawings showing all-important details of construction, dimensions, anchor bolt locations, and field connections.

3. Descriptive literature, bulletins, and catalogs of the equipment.
4. Installation, operation, and start-up procedures including lubrication requirements.
5. Total weight of the equipment including the weight of the single largest item.
6. A complete bill of materials for all equipment with the O&M manual.

E. Certificates:
1. The equipment manufacturer shall provide a general statement from DHV Raadgevend Ingenieursbureau BV or Landustrie BV that the equipment supplied has successfully been used in oxidation ditches.
2. Certified oxygen transfer and horsepower data demonstrating that the mechanical aerators are capable of meeting the required operating conditions.
3. The aerator manufacturer shall provide a certified installation list with start-up dates on the manufacturers' aeration equipment currently operating in facilities in the United States, with contact names and phone numbers.

F. Calculations: Structural and mechanical, including gear reducers.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. The aerator manufacturer must provide a performance guarantee for proper channel velocities as specified. All costs relative to this review, including basin and structure redesign, shall be borne by the CONTRACTOR. The CONTRACTOR shall not begin construction of the oxidation ditch basin until final aerator approval has been obtained.

C. Manufacturer Qualifications: Manufacturer regularly engaged in manufacturing slow speed mechanical aerators of the size and type specified that have been in successful and continuous operation in United States installations for not less than 5 years.

D. Provide aerators which have been tested by and approved by DHV Raadgevend Ingenieursbureau BV.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDTIONS

A. Environmental requirements: As specified in Section 15050.

1.09 SEQUENCING AND SHEDULING

A. Coordinate Work with restrictions specified in Section 01140.

1.10 WARRANTY

A. As specified in Section 15050.

1.11 MAINTENANCE

A. Special tools: Deliver one set of any special tools required for complete assembly or disassembly of the aerator or return flow gate.

B. Spare Parts: Deliver the following as specified in Seciton 01600:
   1. 1 set motor and gear reducer bearings.
   2. 1 low-flow or oil pressure cutout switch.
   3. 1 flexible motor coupling.
   4. 1 cast iron split flange impeller coupling.
   5. 1 gear reducer, complete, suitable for operation in either direction.

PART 2 PRODUCTS

2.01 AERATORS

A. Manufacturers: One of the following or equal:
   1. Ovivo/Eimco Process Equipment Company, Hubert – B Aerator.
   2. WesTech, Inc, Landy - F Aerator.

2.02 MOTORS AND RELATED EQUIPMENT

A. Motors: As specified in Section 16222 and as follows:
   1. Chemical or severe duty.
      a. Enclouser: TEFC.
      b. Voltage/Hertz/Phase: 460/60/3.
      c. Speed: 1,800 rpm.
      d. Rating: Inverter duty.
      e. NEMA Premium efficient.
      f. P-base or C-face for mounting to the gear reducer.
   2. Motors rated at 40 degrees Celsius ambient with Class F insulation; with service factor of 1.15, complying with the applicable provision of the Standards of NEMA. ABMA 9 and 11 L10 life for bearings, 100,000 hours.
   3. Cast iron construction:
      a. Mount in a vertical position to the gearbox and furnished with a canopy cap (drip cover) and suitable lifting lugs.
      b. Connect motor to gear reducer using of a flexible coupling.
   4. The conduit boxes shall be gasketed with neoprene or equivalent material, so as to prevent moisture from entering the stator through the conduit box.
   5. Drain holes shall be suitably positioned in the lower external surface so that any accumulation of moisture can drain from the complete motor housing.
   6. Ball or roller bearings shall be supplied and shall be grease lubricated.
   7. Grease reservoirs shall be ample and provisions shall be made for regreasing with a lubrication system where grease is flushed through the bearings.
   8. The winding end turns shall be dipped and brushed with a nonhydroscopic coating, the stator bores and rotor cores shall be coated with epoxy paint, and the entire enclosure shall be sealed and have a corrosion-resistant coating as specified in Section 09960 to provide additional protection against moisture and contaminants.
   9. The nameplates shall per Section 16222.

B. Gear reducers:
   1. Helical gear type sized with a minimum service factor of 3.0 times the motor nameplate horsepower rating in accordance with applicable American Gear Manufacturers' Association standards. The minimum ABMA 9 and 11 L10 life for bearings, design life shall be 100,000 hours. The efficiency shall not be less than 92 percent based on the reducer input horsepower.
   2. Designed for vertical output shaft operation and the housing shall be all cast iron construction with provisions for the attachment of suitable lifting devices. Helical meshes are acceptable. Worm-gearing shall not be used. Pinion and gear materials shall be left to the discretion of the manufacturer, provided they are rated according to appropriate AGMA durability and strength requirements. The helical gear teeth shall be machined and then surface-hardened. Pinion teeth shall be machined, case carburized, and then ground. All shafts shall be supported on tapered roller or double spherical roller bearings. The gearbox housing shall be sealed and have a corrosion-resistant coating as specified in Section 09960 to provide maximum protection against moisture and contaminants.
   3. Each gear reducer shall be mounted on a steel baseplate or mounting bars with steel bolts. The baseplate or mounting bars shall be mounted on 4 zinc-plated jack studs inserted in the platform structure and adequately designed to withstand all normal operating loads. The jack studs shall have the capability to provide a total vertical adjustment of 6 inches.

C. Gear reducer lubrication system:
   1. Integral mechanical oil pump lubrication: All gear meshes shall be oil lubricated and all bearings can be oil or grease lubricated except for the lower take-off shaft bearing, which shall be grease lubricated. A dry well shall prevent oil from escaping around the output shaft and a lip-type oil seal shall be used to prevent lubricant leakage down the output shaft. Baffled moisture-resistant breathers shall be installed. Housing shall be provided with an oil level sight glass or dipstick and an accessible oil drain.
   2. Reducers employing oil pump lubrication shall be provided with a low oil pressure cut-out switch externally accessible and available for connection to the motor starter control circuit in the MCC to allow the control to stop the aerator drive motor in the event of a loss of lubrication. A second contact developed in the starter circuit shall be connected to the alarm circuit at the remote base in the MCC control section.

D. Impellers and couplings:
   1. Each impeller shall be an open-vane type with 8 equally spaced blades and constructed of 1/4-inch minimum steel plate.
      a. The impeller shaft shall be of sufficient size and thickness to safely withstand the torque and hydraulic side forces imposed on the aerator impeller.
      b. The impeller blades, supports, and pipe shaft shall be an integral, shop-welded unit requiring no field assembly or welding.
   2. The impeller shall operate at a maximum speed of 32 revolutions per minute.
      a. The impeller shall present a minimum amount of edge perpendicular to the flow to prevent any attachment of solid materials.
      b. The design shall preclude the use of impeller shrouds or stabilizing rings.

3. The impeller shaft flange shall be attached to the gear reducer by an adapter shaft connected to rigid cast iron split flange type coupling.
    a. A retainer plate shall be provided for mounting to the end of the gear reducer output shaft to provide protection against disengagement of the coupling from the reducer output shaft.
    b. The flange, coupling, and impeller shall be assembled with ASTM A 325 high strength bolts.
4. All structural steel used in the fabrication of the aerator shall be in accordance with ASTM A 36.
    a. All shop welding shall be in accordance with the latest standards of AWS.
    b. Fabricated assemblies shall be shipped in convenient sections as permitted by carrier installations.

E. Motor heat protection device:
1. Each motor shall be equipped with a thermostatic heat protection device to protect the motor from overheating during operation and 1 temperature switch contact rated for direct connection in the motor starter control circuit in the MCC.
2. The units shall immediately stop the aerator drive motor in the event of excessive heat buildup.
3. A second heat device temperature switch contact shall be connected to the remote base in the MCC for an alarm.

F. Motor space heater: Each motor shall be equipped with a suitably-sized space heater to keep condensation from forming when the motor is not running.
1. The space heater shall operate on control voltage and switched at the MCC.

G. Coatings:
1. Unless otherwise indicated on the Drawings, all ungalvanized fabricated iron and steel surfaces shall receive a shop-cleaned surface preparation equivalent to SSPC SP-10 immediately prior to shop-priming. Shop-priming shall consist of 1 coat to provide 1.5 mils dry film thickness.
    a. Primer:
        1) Manufacturers: One of the following or equal:
            a) Tnemec, 37-77 Chem Prime.
            b) Carboline 150.
2. Motors and gear reducers shall receive a minimum shop-cleaned surface preparation equivalent to SSPC SP-1 immediately prior to shop-priming.
    a. Shop-priming shall consist of a coating that is compatible with the field coating as specified in Section 09960.

2.03 RETURN FLOW CONTROL GATE

A. Description
1. There shall be furnished one flow control gate per oxidation ditch suitable for installation in the oxidation ditch basin on the concrete wall of the bypass channel as shown on the contract plan drawings. Each mechanism shall be of the handwheel driven gear drive type, with 112.5-degree travel in forward and reverse direction. This flow control gate and the mechanical surface aerators shall be supplied by the same manufacturer in order to ensure uniformity of responsibility for the performance of the anoxic/aerobic system.

2. The equipment furnished for each gate mechanism shall include: stand, gear reducer, rotating shaft, positioning plate/arm and lock pin, guide bearings, flow vane, stops, fasteners, and anchor bolts.
3. Except where specifically indicated otherwise, all plates and structural members designated for submerged service shall be 1/4-inch minimum thickness and reinforced as required. Stainless steel Type 303 anchor bolts and 304 fasteners with necessary hex nuts and washers, shall be provided for all parts of the gate assembly.
4. Fabricated assembles shall be shipped fully assembled except for attachment of the gear reducer, stand, shaft, and guide bearings. The unit shall be designed to allow adjustment for concrete tolerances of ± 1/2 inch. The unit shall be erected and lubricated in strict accordance with instructions from the manufacturer.

B. Product:
1. Wormgear Reducer:
   a. The worm gear operator shall be of heavy-duty construction, totally enclosed in a cast iron housing. The housing shall be designed so that all gears and bearings are grease packed and factory sealed to prevent condensate formation. The gear shall be designed to operate under the full load as applied from the rotating gate. The reducer shall be equipped with a 20-inch steel hand wheel and require no more than 25 revolutions to rotate the gate a full 112.5 degrees in one direction. The gear reducer shall be of the worm gear type design and have the ability to backdrive without locking of the worm.
2. Gate Component:
   a. The reducer mechanism shall be fitted to the gate shaft with a sleeve and key for ease of assembly and disassembly. The reducer shall be supported on a steel stand that is anchored to the concrete floor or side wall by cinch Type 303 stainless steel anchors. The stand shall be of proper height to allow the operator a convenient grip on the handle for clockwise or counter clockwise turning.
3. Rotating Gate Assembly:
   a. Each gate shall be constructed from 1/4-inch steel plate properly stiffened with rib extensions and end flares. Each gate shall include a revolving shaft assembly fixed between three guide bearings mounted to the floor and stand. The floor bearing shall be a thrust type alignment bearing, supporting the entire weight of the unit. The upper guide bearing shall be an integral part of the support stand and shall be mounted just below the worm gear reducer. The center guide bearing, if required by the shaft length, shall be mounted just above the water surface on the lower part of the shaft and shall be field aligned after installation of all other components, assuring proper rotational capability. The revolving shaft shall be supported at each end in such a manner that a slight vertical or horizontal misalignment shall not interfere with the smooth operation of the gate. The shaft shall revolve from the turning of the gear unit. The gate shall include a position lock, lock pin with retention chain and a wall stop bracket, complete with Type 303 stainless steel wall anchors.
4. Painting and Surface Preparation:
   a. Unless otherwise noted, all ungalvanized fabricated iron and steel surfaces shall receive a shop-cleaned surface preparation equivalent to SSPC-SP-10 immediately prior to shop-priming. Shop-priming shall

consist of one coat of Tnemec 161-1211 Epoxoline primer or equal to 3.0 to 5.0 mils DFT. Touch-up and finish painting shall not be the responsibility of the equipment manufacturer.

b. Gear reducers shall be furnished with manufacturer’s standard enamel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's installation instructions.

B. Require the services of an approved manufacturer's representative to supervise the erection, starting, operating, testing, and to instruct the operating personnel on the operation of the equipment. Include a minimum of 3 days.

C. Field coating as specified in Section 09960.

3.02 FIELD TESTING

A. Aerators shall be tested at Level 4 in the field as described in Section 15958 at intervals of 30 minutes, including but not limited to vibration bearing temperature, revolutions per minute, and amperage draw. All field testing shall be conducted and paid for by the CONTRACTOR unless otherwise noted.

B. After the equipment furnished under the Contract has been installed and placed in operation, it will be tested by and at the expense of the OWNER at the earliest practicable date to determine whether the CONTRACTOR's guarantees and the requirements of these Specifications have been fulfilled.
   1. The acceptance tests will be conducted by the OWNER, but the CONTRACTOR will be given opportunity to verify all observations and computations.
   2. The ENGINEER shall represent the OWNER in all matters pertaining to acceptance testing and scheduling training of OWNER's personnel.

C. Provide the services of a qualified factory representative to perform tests of the installation to verify that the aeration equipment operates within acceptable vibration severity limits and to determine baseline vibration spectra for future use in identifying maintenance actions.
   1. Perform tests in the presence of the ENGINEER using a dual channel, spectrum analyzer.
   2. The manufacturer shall also be responsible for correcting vibrations that exceed 0.11 inch per second.
   3. Submit a report with spectral plots to the ENGINEER documenting test results and recommended corrective measures.

D. At the OWNER's option and written request, the CONTRACTOR shall, within 6 months of start-up of the aerators, employ the services of an independent laboratory to perform full-scale tests of channel velocity and oxygen transfer efficiency, in the presence of the CONTRACTOR.
   1. The cost of these tests, if required, will be paid by the OWNER.

E. If the results do not meet the required performance, CONTRACTOR shall have 20 days to propose changes that meet the approval of the OWNER, and 60 days to make these changes, at no cost to the OWNER.
   1. The system shall then be retested at CONTRACTOR's expense.
   2. If the system again fails to meet the required performance, CONTRACTOR shall replace the aeration equipment with that of another manufacturer that will perform.

3.03 TRAINING

A. Schedule training for aeration equipment in advance.
   1. Submit training schedule upon equipment delivery.
   2. Base training schedule upon the projected installation schedule at that time.

B. Train operational staff as specified in Section 01660.

END OF SECTION

SECTION 11378

SLUDGE STORAGE TANK AERATION DIFFUSER SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Scope:
   1. This specification shall govern all work necessary to design, furnish, install, and place into initial operation the medium bubble aeration system for the sludge storage tanks/basins as described in detail herein and as shown on the Plans.
   2. The equipment furnished under this Specification shall consist of but not be limited to all “in-tank/basin” air supply piping, air control valves, air headers, diffuser drop assemblies, supports, anchorage and fasteners as necessary to form a complete aeration system.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR’s responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR’s Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.
      b. Section 01740 - Warranties and Bonds
      c. Section 01782 - Operation and Maintenance Data.

1.02 GENERAL REQUIREMENTS

A. It is the intent of this Specification to require individual air diffusers and drop pipes that are capable of being cleaned without draining the basins. In addition, the aeration system shall include only above-water orificing that allows cleaning of the drop pipe and diffuser from the top. It is the intent of this specification to require air diffuser equipment designed to meet the air flow distribution and oxygen transfer requirements of the aerated system at all air flows from design to maximum as specified, to completely mix the basin contents and to require little or no maintenance to continuously meet these requirements. The aeration equipment must have a history of efficient operation and be free from clogging, excessive backpressure and/or any structural failure, when applied to service conditions similar to those indicated for this project.

1.03 ACCEPTABLE MANUFACTURERS

A. The medium bubble aeration equipment shall be manufactured by Ovivo USA, LLC.

B. ENGINEER's approved equivalent: Other manufacturers may propose similar equipment meeting these specifications provided that written prior approval is granted by the ENGINEER in the form of an addendum to these specifications issued to plan holders prior to bid opening. Requests for approval must be submitted in writing to the ENGINEER no later than 15 days prior to the bid opening. Alternate diffuser, upper deflector, and orifice assembly designs will be evaluated by the ENGINEER prior to bid date. In no event will the ENGINEER accept as "equal" an air drop assembly system less than equal with regard to clogging, oxygen transfer, power consumption, materials of construction, or ease of switching or replacing orifices. The request for approval must be complete and shall contain at least the following information.

1. A statement of compliance with the manufacturer's qualification requirements described above and the quality assurance requirements below and a list of qualified projects including the OWNER and ENGINEER reference information (address and telephone number) for each qualified project.
2. A description of all proposed equipment items. Materials and coatings shall be included with the description.
3. Equipment layout drawings with dimensions and component sizing. AutoCAD drawings on disk shall be included.
4. A certification by the equipment manufacturer that the basin contents will be adequately mixed throughout the basin depth at the power input levels proposed.
5. Operating data from the continuously operating wastewater treatment plants and testimonials from operating personnel. The data and testimonials shall include the maintenance history of the equipment including frequency of cleaning and labor and materials required for cleaning.

1.04 QUALITY ASSURANCE

A. Standardization: To ensure compatibility, all equipment items furnished under this Specification shall be furnished by a single manufacturer who shall be responsible for the adequacy of design.

B. Experience: The aeration equipment shall be furnished by a manufacturer engaged in the production of the specified type of engineered air diffusion equipment for a minimum of 10 years. The manufacturer shall have furnished similar equipment for at least 20 other installations performing similar duty, including process, capacity, submergence and environment.

C. Manufacturer’s quality control: All fabrication shall be carefully inspected at the site of fabrication by factory inspectors who shall use whatever means are necessary, including shop assembly, to ensure the proper fit of all field connections and compliance with all material and fabrication requirements of the specifications.

D. Manufacturer's warranty: All parts of the air supply, individual drop pipe, and diffuser assembly shall have a 2-year warranty against mechanical failure beginning at the date specified in Section 01740.

E. Coordination: The contract documents provide details of a complete equipment installation for the purpose specified. It shall be the CONTRACTOR's responsibility to coordinate all the details required for a complete operating system such as

protective coatings and electrical requirements as well as provide all work needed to properly install, adjust, and place in operation a complete working system.

1.05 SUBMITTAL REQUIREMENTS

A. Submit as required per Section 01330 and herein.

B. The CONTRACTOR shall provide to the ENGINEER a schedule for equipment submittal, review, delivery, installation and start-up.
   1. Equipment schedule.

C. Approval for equipment installation and incorporation into this project will be made only after the receipt and examination of equipment submittals, as described below. The following shall be provided, as a minimum:
   1. A letter of qualification shall be provided if the manufacturer is recommending any deviations from the contract Plans and Specifications. Reasons for such requests shall be fully justified, with illustrative drawings when appropriate.
   2. Instructions on receiving, storage, handling, and installation of equipment.
   3. Material specifications describing the size, type, and quality of individual items to be provided. Catalog cut sheets shall be provided when appropriate.
   4. Equipment description for each component explaining scope of supply.
   5. Shop drawings with all dimensions showing the location of embedded items and piping. Shop drawings shall clearly and completely depict all equipment.
   6. Structural calculations of support system, signed and stamped by a California registered structural engineer.
   7. Design calculation of process air requirements based on design criteria provided.
   8. Design and layout of the air distribution piping and diffuser system.

D. Installation, operation, and maintenance manuals shall be provided in accordance with Section 01782. The manuals shall be provided prior to delivery of equipment and updated as necessary during installation. The CONTRACTOR shall not accept delivery of any equipment without the operation and maintenance manual onsite. The following shall be provided, as a minimum:
   1. Name, address, and phone number of the nearest competent service organization who can supply parts and service. If this is not the manufacturer's own service department, then furnish a letter certifying that the named organization is authorized to represent the manufacturer and to perform warranty service.
   2. Complete descriptive literature and drawings of all material furnished including "as-built" wiring diagrams of all electrical equipment, "as-built" erection drawings providing up-to-date information on the actual fabrication and erection of the equipment, and documentation of any field modifications made during installation, start-up, and testing.
   3. Installation, operation, and maintenance brochures from the original manufacturers of all mechanical components such as valves, pipe couplings, gear reducers, bearings, etc. incorporated into the completed installation.
   4. All required assembly, installation, alignment, leveling, adjustment, start-up and testing instructions.
   5. All required operating instructions.
   6. All required maintenance instructions, including routine maintenance and lubrication schedules.

E. The equipment manufacturer shall provide a field certification report stating that equipment is properly installed and ready for operation. The field certification report shall be based on an actual jobsite assessment of the installed equipment.

1.06 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Preparation for shipment: All pieces shall be delivered in the largest pieces practical for field assembly by the CONTRACTOR. Individual pieces shall be permanently tagged with welded erection marks or stainless steel tags cross-referenced with information on the manufacturer's erection and assembly drawings. Mechanical and electrical components shall be protected from the weather and suitably packaged to facilitate handling and storage. All mechanical and electrical equipment shall be kept thoroughly dry at all times and shall be stored indoors.

B. Storage of equipment: All equipment stored on the job shall be protected and maintained in accordance with the manufacturer's recommendations. Electrical equipment must be stored in weatherproof, ventilated enclosures. Structural materials may be stored outdoors on pallets or other wooden supports providing for the proper support and drainage. Equipment shall not be allowed to contact the ground directly.

C. Offsite storage: The equipment manufacturer shall maintain storage facilities for completed equipment such that, in the event that proper storage facilities are not available on the jobsite, the manufacturer and CONTRACTOR will have the option of storing finished goods off site for delivery to the project within 2 weeks' notice from the CONTRACTOR.

PART 2 PRODUCTS

2.01 PROCESS DESIGN REQUIREMENTS

A. The aeration equipment shall be designed based on the following criteria: CONTRACTOR shall verify the following dimensions as per the plans as these are approximate dimensions.
   1. Number of basins: 2.
   2. Basin dimensions: 22-feet wide by 44-feet long by 18-feet high.
   3. Basin side water depth: 15 feet.
   4. Floor slope: As indicated on plans.
   5. Design airflow: 550 cfm each tank.
   6. Maximum blower discharge pressure: 9 psig.

B. Site conditions:
   1. Elevation: 88 ft ASL.
   2. Maximum air temperature: 130 degrees F.
   3. Minimum water temperature: 40 degrees F.

2.02 GENERAL REQUIREMENTS

A. Design: The equipment manufacturer shall be responsible for determining the layout based on the basin drawings, the size and number of all diffusers, air drops, shear tubes, draft tubes, baffles, and other equipment required for the specified airflow ranges indicated below, subject to approval of the ENGINEER.

B. Structural steel fabrication: Except where specifically stated otherwise, all structural members, piping, and support system shall be Type 304 stainless steel. Minimum thickness shall be as required by the design structural calculations. Pieces shall be fabricated in maximum sizes suitable for shipping. The equipment shall be designed and fabricated per ASTM A-143, A-384, and A-385 for bolt-together field assembly. All welding shall conform to the latest AWS Standards and shall be performed by certified welders. All welding shall use a minimum of 3/16-inch fillets and shall completely seal all mating surfaces. Skip welding will not be allowed. All field connections shall be bolted connections designed to resist all static, live, and erection loads. Field-welded assembly will not be allowed.

C. All fabricated steel components shall be Type 304 stainless steel.

D. Anchorage and fasteners: All anchors shall be Type 316 stainless steel with Type 316 stainless steel nuts and washers. All fasteners attached to stainless steel shall be Type 316 stainless steel. All other fasteners shall be hot dip galvanized. The equipment manufacturer shall furnish all anchor bolts, nuts, washers, and gaskets necessary for the equipment furnished, as well as any templates required for setting the anchorage. The CONTRACTOR shall place the anchorage in accordance with the certified prints supplied by the equipment manufacturer. All anchor bolts shall be set with proper projection.

2.03 AERATION EQUIPMENT

A. The aeration system shall be able to properly distribute design airflow to all diffusers at design airflow incompliance with the air supply pressure requirement.
   1. The equipment manufacturer shall demonstrate uniform air delivery to all diffusers at design airflow in compliance with the air supply pressure requirement.
   2. The equipment manufacturer shall guarantee that the increase in diffuser backpressure at the design airflow specified shall not exceed 0.1 psig after 1 year of operation and 0.2 psig after 5 years of operation.
   3. The equipment manufacturer shall demonstrate compliance with the air supply pressure requirement and provide baseline data for the increase in diffuser backpressure requirement.

B. Air supply piping shall be sized so that the velocity in the pipe at 150 percent of the design airflow is less than or equal to the following values:

Pipe Size	Velocity, fpm
1" - 3"	1,800
4" - 10"	3,000
12" - 24"	4,000
> 24"	6,500

   1. Piping smaller than 8-inch diameter shall be fabricated from Schedule 40, Type 304 stainless steel.
   2. Couplings for air piping shall be Type 304 stainless steel.
   3. Gaskets for air piping couplings shall be Viton with a temperature rating of 350 degrees F or higher.
   4. Air distribution headers shall be furnished with threaded Type 304 stainless steel couplings welded at each air drop location.

C. Orificing shall be sized by the equipment manufacturer to provide balanced air distribution for proper mixing and aeration.
   1. All orificing shall be interchangeable without draining the tank contents.
   2. To ensure structural integrity the orifice must be removable without disassembly of any rigid piping.
   3. Orifice sizing shall provide at least 3 inches of water column head loss at minimum conditions.
   4. No air diffusion equipment using underwater orificing or restricting devices such as couplings to provide male to female to male connections to the Type 304 stainless steel drop pipes will be accepted.
   5. The orifice assembly shall be molded of high-temperature, black-pigmented, glass-reinforced nylon suitable for extended outdoor application in extreme heat and wastewater environments.
   6. The orifice assembly shall screw into the top of the adapter and shall be easily removable for positive cleaning of the drop pipe and diffuser.

D. An individual air drop shall be furnished for each air diffuser assembly.
   1. Each drop shall be supported by the orifice-tee assembly attached to the air supply and by a lower drop support.
   2. Drop pipes with lengths in excess of 20 feet 0 inches shall include 2 lower drop supports.
   3. Individual air drops shall be positively and securely fixed in place at the proper elevation and must be capable of being individually and positively cleaned from above the water surface without being removed.

E. MS diffuser assemblies: Individual air drop assemblies each consisting of an easily replaceable above-water air control orifice, orifice adapter piece, drop pipe, vibration dampening clamp, and non clogging air diffuser shall be furnished. The use of dissimilar metals in the air drop assembly will not be allowed. No diffuser utilizing small underwater orifices for either bubble formation or air distribution will be permitted.
   1. 2-inch diffusers: The individual air drop diffusers shall be pressure injection molded, black-pigmented ABS plastic having a high-temperature tolerance range of 220 degrees F to 245 degrees F. Each diffuser shall be constructed with a full 2-inch inlet diameter, vertical, hollow section extending from the inlet through the bottom-most point of the diffuser to provide for minimum pressure losses and positive cleaning of the airway throughout its length.
   2. Air drops: Each 1-inch air drop shall be 1.315 inches O.D. Schedule 10, Type 304 stainless steel tubing. Each 2-inch air drop shall be 2.375 inches O.D. Schedule 40, Type 304 stainless steel welded-seam pipe. The connection between the drop pie and the diffuser shall be male threads on the drop pipe to female threads on the diffuser.
   3. Air drop supports: Each air drop pipe shall be rigidly secured in place by the orifice adapter piece and a lower support mounted on the energy recovery baffle. The lower support clip shall be fabricated from a minimum 3-inch by 3-inch by 1/4-inch Type 304 stainless steel angle. A vibration-resistant clamping block shall be used molded from black-pigmented filled polypropylene.

F. Butterfly air control valves: Butterfly valves shall be of the flanged body style for air service as noted on the plans. All valves shall be suitable for use with ANSI 125- or 150-pound flanges. Bodies shall be Type 304 stainless steel. Valves shall be

available with field interchangeable manual or powered actuators, as required. Valves 8 inches and smaller shall have 10 position levers. All manually actuated valves 10 inches and larger shall be operated using a handwheel gear actuator. Operating shaft to be supported axially and radially at input end by permanently lubricated bronze thrust and sleeve bearings. Valves shall be as manufactured by DeZurik, or equal, and be furnished by the aeration manufacturer.

G. Aeration system supports: Design of the supports for the aeration system shall be the responsibility of the equipment manufacturer.
   1. All supports shall be minimum 1/4-inch thick Type 304 stainless steel.
   2. Lower drop pipe supports shall include a polypropylene clamp block with minimum 10-gauge stainless steel backing plate.

H. Anchorage and fasteners:
   1. All anchors shall be minimum 1/2-inch, Type 316 stainless steel with Type 316 stainless steel nuts and washers.
   2. All fasteners attached to stainless steel shall be Type 316 stainless steel.
   3. All submerged fasteners shall be Type 316 stainless steel.
   4. All other fasteners shall be Type 316 stainless steel.

I. Protective coatings:
   1. Mechanical components, such as valves, gear reducers and bearings, shall be furnished with the original manufacturer's standard finish.
   2. Coat equipment per Section 09960.

PART 3 EXECUTION

3.01 PREPARATION

A. Inspect all concrete and piping and determine that all dimensions and elevations relating to the equipment are correct. All modifications to cured concrete require approval of the ENGINEER.

B. The CONTRACTOR shall have sufficient copies of the equipment manufacturer's installation, operation, and maintenance manuals onsite prior to installation.

3.02 INSTALLATION

A. The CONTRACTOR shall install all equipment in accordance with the manufacturer's written instructions and as directed during onsite inspection by the manufacturer's representative.

B. Deviations from the manufacturer's written or verbal instructions shall be subject to approval of the ENGINEER.

3.03 FIELD TESTING

A. Prior to start-up, the CONTRACTOR shall test all valves, switches, and gauges for proper setting and operation.

B. Check assembly alignment.

C. Ensure all equipment is properly lubricated.

3.04 TESTING AND START-UP SERVICES

A. The manufacturer shall provide the services of a field service representative to inspect the equipment installation and place the equipment into initial operation.

B. The field service representative shall instruct operating personnel in the proper operation and maintenance of the equipment.

C. A minimum of three 8-hour days and 2 trips to the jobsite shall be provided.

END OF SECTION

SECTION 11380

DEWATERING SCREW PRESS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: A dewatering system including two dewatering screw presses and all auxiliary equipment to make a complete dewatering system including, air compressor if required, polymer injection ring and mixing valve or flocculation tank with mixer, and with drivers and features specified in this Section and scheduled below. All dewatering equipment shall be provided by a single manufacturer. The dewatering system shall be capable of dewatering waste activated sludge or thickened waste activated sludge (WAS or TWAS).

B. Tag Numbers.
   1. Dewatering Screw Press No. 1: 51-PRE-431.
   2. Dewatering Screw Press No. 2: 51-PRE-432.
   3. Air Compressor No. 1: 51-ARC-431.
   4. Air Compressor No. 2: 51-ARC-432.

C. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01140 - Work Restrictions.
      b. Section 01330 - Submittal Procedures.
      c. Section 01600 - Product Requirements.
      d. Section 01612 - Seismic Design Criteria.
      e. Section 01660 - Testing, Training, and Commissioning.
      f. Section 01740 - Warranties and Bonds.
      g. Section 01782 - Operation and Maintenance Data.
      h. Section 05500 - Metal Fabrications.
      i. Section 09960 - Coatings.
      j. Section 14555 - Shaftless Screw Conveyors.
      k. Section 15050 - Common Work Results for Mechanical Equipment.
      l. Section 15958 - Mechanical Equipment Testing.
      m. Section 16050 - Common Work Results for Electrical.
      n. Section 16075 - Electrical Identification.
      o. Section 16134 - Boxes.
      p. Section 16222 - Low Voltage Motors up to 500 Horsepower.
      q. Section 16412 - Low Voltage Molded Case Circuit Breakers.
      r. Section 16422 - Motor Starters.

s. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
t. Section 17101-51 - Specific Control Strategies - Dewatering.
u. Section 17710 - Control Systems - Panels, Enclosures, and Panel Components.
v. Section 17720 - Control Systems - Programmable Logic Controllers Hardware.
w. Section 17721 - Control Systems - Human Machine Interface Hardware.
x. Section 17733 - Control Systems - Network Materials and Equipment.
y. Section 17761 - Control Systems - PLC Programming Software.
z. Section 17765 – Control Systems - Human Machine Interface Software.
aa. Section 17950 - Testing, Calibration, and Commissioning.

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA).

B. American Gear Manufacturers Association (AGMA).

C. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).

D. Institute of Electrical and Electronics Engineers, Inc. (IEEE).

1.03 SCREW PRESS DESCRIPTION

A. Screw press system shall be capable of dewatering thickened waste activated sludge with the characteristics and to the performance standards described below.

B. Dewatering screw press with components as specified in this Section and shown on the Drawings or as required for a complete and functional screw press system, including but not limited to:
1. Screw press with all 304 stainless steel wetted parts.
2. Sludge inlet headbox or inlet chamber.
3. Sludge inlet flange with location and size as shown on Drawings.
4. Filtrate outlet flange with location and size as shown on the Drawings.
5. Washwater manifolds with locations and sizes as shown on the Drawings.
6. Spray nozzle bars and spray nozzles at all required wash locations.
7. Screen drum or screen basket.
8. Screw brushes if required.
9. Speed reducer.
10. Motor coupling.
11. Coupling guards.
12. Stainless steel machinery base or stainless steel equipment support legs.
13. Back pressure cone if required.
14. Pressure transducer-type level element with indicating transmitter and high level probe switch if required.
15. Pressure instruments and indicating transmitters where required.
16. Equipment motors.
17. Anchorage/seismic support calculations.

C. Design requirements:
   1. Screw press minimum performance requirements:
      a. Minimum cake dryness: 15 percent TS.
      b. Maximum polymer demand: 35 lb/DT.
      c. Minimum capture rate: 95 percent.
   2. Design loading and sludge characteristics: Meet the preceding performance requirements for the following conditions:

Type of Sludge	Waste Activated Sludge
Feed Solids, percent total solids (TS)	0.6 – 2.0 percent
Volatile Solids Content, percent TS	60 – 75 percent
Design Capacity(1) dry ton TS/24 hr day at 0.6% solids	3.7
Design Capacity(1) dry ton TS/24 hr day at 2% solids	8.4
Temperature, degrees F	60 - 105 degrees
pH	6.5 - 7.5
Notes: (1) Meet design capacity at 60 percent of maximum speed.	

D. Motor characteristics: As described in this Section.

1.04 SUBMITTALS

A. Submit in accordance with Section 01330 and Section 15050.

B. Motor data as specified in Section 16222.

C. Instrumentation and control data as specified in Section 17100.

D. Product data:
   1. Submit data completely describing product including plan and section views, and listings of all components and materials of construction.
   2. Submit surface preparation and finishes to be applied to all equipment.

E. Shop drawings:
   1. Complete manufacturer fabrication/assembly drawings stamped by a registered Engineer.
   2. Certified drawings showing dimensions, weights, loading information, and location of all components. Include details on interconnecting piping, supports, and control panel.
   3. Wiring, control schematics, and control logic diagrams for all electrical and control components furnished.
   4. Manufacturer's Drawings shall be coordinated with the Contract Drawings, including equipment numbers and piping designations.
   5. List of Recommended Spare Parts with price information.
   6. List of special tools required for installation and servicing equipment.

F. Calculations: As specified in Section 15050 and Section 01612, and including the following to support structural adequacy of the screw press, and all associated equipment by a registered professional structural engineer in the State of California.
   1. Structural anchor points to concrete foundation.
   2. Seismic loads on frame and anchor bolts.

G. Resume of Technician to perform screw press adjustments, inspections, observations of test operations, supervision of functional and performance testing, and training.

H. Training Course Outline.

I. Operating and Maintenance Manuals: As specified in Sections 15050 and 01782. Include complete lubrication, maintenance, and operation instructions, including initial start-up instructions, and unloading and handling methods.

J. Manufacturer's references as required in Article 1.05.

K. Quality Control Submittals:
   1. Special shipping storage, protection, and handling instructions.
   2. Manufacturer's Installation Instructions.
   3. Factory Test Results.

1.05 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Manufacturer qualifications:
   1. Minimum 20 years of experience in construction and manufacturing of dewatering screw presses.
   2. Submit evidence of satisfactory operation of dewatering screw presses with minimum throughput of 400 lb/hr in at least 20 separate municipal wastewater applications in the United States.
   3. Provide 5 references from operating installations in the United States meeting the following requirements:
      a. Be in municipal wastewater application.
      b. Be for waste activated, thickened waste activated or digested sludge dewatering .
      c. Years in service: Minimum 5 years.
      d. Have the same manufacturer as proposed for this project.
      e. Minimum screw press solids throughput of 400 lb/hr at 2-percent influent solids.
      f. Reference information shall include treatment plant name and location, contact name for personnel at treatment plant, contact telephone number, date of installation, date of start-up, model number of unit installed, number of units installed, and type of sludge being treated.
      g. OWNER reserves the right to contact any installation that owns equipment manufactured by the proposed alternative manufacturer to evaluate equipment performance and manufacturer's services.
   4. Multiple equipment units at a plant shall be considered as one installation toward meeting the experience requirements.
   5. Manufacturer shall provide a signed affidavit stating conformance with these requirements.

6. OWNER reserves the right to reject alternative equipment upon:
   a. Failure to prove conformance with specifications.
   b. Poor references for equipment performance and/or manufacturer's services.

C. The stainless steel components and enclosure panels shall be passivated after fabrication to remove embedded iron, surface rust, and weld burn. After passivation, the equipment must be washed with a high-pressure wash of cold water to remove any remaining surface debris and passivation acid, and promote the formation of an oxidized passive layer on the stainless steel surface, which is critical to the long life of the stainless steel. No stainless steel components may be fabricated or assembled in a factory where carbon steel products are also fabricated, in order to prevent contamination by rust.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050. CONTRACTOR shall unload, store, and handle the equipment per the manufacturer's instructions.

1.07 WARRANTY

A. Warranty period shall extend for a minimum of 24 months from the date specified in Section 01740.

B. Warranty shall include all parts, labor, and coatings to repair or replace equipment that fails during warranty period. Defects or corrosion occurring within warranty period shall be repaired or replaced by the manufacturer at no cost to OWNER.

1.08 PROJECT CONDITIONS

A. Environmental requirements: As specified in Section 15050.

B. Deliver screw press as completely assembled as practical to minimize field assembly. CONTRACTOR shall be responsible for unloading and any necessary field assembly. CONTRACTOR shall contact manufacturer for screw press field assembly requirements during bid.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate work with restrictions as specified in Section 01140.

1.10 MAINTENANCE

A. As specified in Section 15050.

B. Special tools: Provide standard manufacturer supplied toolbox with all special tools needed to assemble and disassemble the screw press.

PART 2 PRODUCTS

2.01 MANUFACTURER

A. Manufacturer: One of the following, modified as necessary to meet the Specification requirements:
   1. FKC Co., LTD, Model BHX - 1100 x 6000L.
   2. Huber Technology Incorporated, Model RoS3 Q800.
   3. Or equal.
   4. ENGINEER is not aware of any “equal” manufacturer.

B. Contract Drawings are based on the Huber ROTAMAT® RoS3 Q800. If CONTRACTOR wishes to furnish equipment by other manufacturer that meets all Specification requirements, then all costs associated with modifications to adapt the facilities as designed to accommodate proposed equipment shall be borne by CONTRACTOR. This shall include all design, procurement, and installation costs for any necessary structural, mechanical, electrical, instrumentation and control, and any other changes required for a complete and satisfactory installation, including ENGINEER's cost for redesign.

2.02 MATERIALS

A. Stainless steel: Type 304, unless otherwise indicated.

B. Drive unit: As scheduled.

C. Stainless steel base or stainless steel equipment supports.

D. Anchor bolts and miscellaneous hardware, including bolts, nuts, washers, and fastener clips: Type 316 stainless steel.

2.03 HOUSING

A. Housing shall be rigid Type 304 stainless steel weldment, supported by a stainless steel base or stainless steel equipment supports.

B. The whole dewatering section and basket area shall be easily accessible through inspection lids mounted via two hinges on the side of the machine or side covers. Equipment covers or lids shall be Type 304 stainless steel. Side covers if provided shall be easily removable by a single person.

C. Sludge feed connections and filtrate discharge connections shall be Type 304 stainless steel flanged meeting ANSI/ASME B 16.1, Class 125, or ANSI/ASME B 16.5, Class 150; provide higher pressure class as required to meet Design Working Pressure. Feed and filtrate connections shall be sized as shown on the Drawings.

D. Press shall have Type 304 stainless steel discharge box with hinged lid or sludge discharge chute. Dimensions as indicated on the Drawings.

E. Housing shall be designed for noise reduction, to act as a protective guard and to provide a complete enclosure for odor containment.

F. Include 304 stainless steel foul air connections suitable for flexible duct connections with clamps for size shown on the Drawings.

G. Headbox, if provided, shall be provided with pressure transducer level element and high-level float switch. Include all hardware to allow field assembly in to the headbox.

H. A sludge inlet chamber if used shall be provided with a pressure probe. Include all hardware to allow field assembly in to the inlet chamber.

I. A pneumatic actuated cone, if used, will serve to adjust the pressure in the pressure zone and shall be provided at the discharge end of the screening basket.

J. Spray water supply shall be designed for a flow and pressure required by the manufacturer. If multiple wash water connection points are required, pressure-reducing valves shall be used to adjust the pressure to the manufacturer's requirements.

2.04 DRIVE SYSTEM

A. General: Drive system shall consist of an electric motor suitable to use with a variable speed drive system as required to provide full load capacity and also to withstand the full starting torque of the system. VFD shall be provided by the manufacturer as part of the Screw Press Vendor Control Panel.

B. Screw speed shall be electronically controlled by means of a VFD in an enclosure as specified in Section 16050.
   1. The maximum screw speed shall be 0.9 rpm or lower.
   2. Dewatering units with screw speeds higher than 0.9 rpm shall not be accepted.
   3. The unit shall meet the design capacity at 0.55 rpm or lower.

C. Speed reducer:
   1. Provide speed reducer rated for uniform shock load classification with a Sumitomo Cyclo® reducer service factor of 1.0.
   2. Speed reducer gear ratio shall be supplied to meet design capacities at 60 percent of the maximum speed.
   3. As specified in Section 15050.
   4. Speed reducer shall be Sumitomo Cyclo® Reducer or equal.

D. Shaft couplings: As specified in Section 15050.

E. Shaft Seals shall be Musashi double lip spring-loaded Nitrite oil seal or equal.

F. Bearings:
   1. As specified in Section 15050.
   2. Screw press shall be designed so that the entire rotating assembly is supported by an inlet bearing and the Sumitomo Cyclo® Reducer. Each bearing shall be a grease lubricated ball or spherical roller type bearing. Bearing shall be conservatively designed to withstand all stresses of the service specified. Main bearings shall have a minimum B-10 life rating of 500,000 hours at standard operating speeds.
   3. Bearings for the screw shall be anti-friction with grease lubrication.

G. Flexible connectors for the drive motor and screw press junction boxes shall be furnished by the installing CONTRACTOR such that all local electrical codes are met.

H. Motor:
   1. Provide inverter rated motor with temperature switches in accordance with Sections 16222 and 15050.
   2. Minimum motor requirements of 5.0 horsepower (480 volt/3 phase).

2.05 SCREW ASSEMBLY

A. A single screw shall be provided for each dewatering unit. Units with multiple screw assemblies shall not be accepted.

B. Screw shaft: Stainless steel, Type 304 with Teflon® coating.

C. Helical flight welded to screw shell: Stainless steel Type 304.

D. The screw supported in the head by a radial bearing.

E. If brushes are provided for the helical screw flights, they shall be of wear-resistant plastic material. The brush will be held in place by stainless steel clamps and bolts that can be easily removed.

2.06 SCREEN ASSEMBLY

A. Type 304 stainless steel panels with punched holes or wedge wire screens shall be used.

B. If wedge wire baskets are used, the wedge sections of the three different baskets shall have bar spacing from 0.5 mm to 0.1 mm. The overall basket length shall be 13 feet 1-1/2 inch. The basket diameter shall be 31-1/2 inch.

C. A dewatering drum with moving rings shall not be accepted.

2.07 FLOCCULATION TANK (IF REQUIRED)

A. Flocculation tank wetted parts and supports shall be constructed of Type 304 stainless steel throughout.

B. Flocculation tank shall be designed for a retention time of 5 to 8 minutes under the normal design flow rate. The inlet of the tank shall be located at the bottom of the tank and conditioned sludge shall overflow from the discharge pipe located near the top of the tank. Provide 6-inch overflow and discharge connections.

C. Flocculation tank shall be supplied complete with an agitator. The agitator drive shall be an SEW Eurodrive Varimot® speed reducer/mechanical variator or equal. Agitator speed shall be adjusted manually at the flocculation tank.

D. Flocculation tank, agitator, and agitator drive shall be designed to handle the entire flow capacity range of the screw press.

E. Provide motor in accordance with Section 16222. Motor shall be a minimum 1 hp, 480 volt/3-phase unit.

F. Provide split flocculation tank cover with a hinged inspection port. Include a 4-inch vent connection on the fixed portion of the cover.

2.08 POLYMER MIXING VALVE (IF REQUIRED)

A. A mixing valve with adjustable weight shall be provided downstream of the polymer injection ring. The mixing valve shall be designed and sized to ensure optimum mixing conditions and creation of the right size and strength of flocs.

B. The location of the mixing valve shall provide a minimum of 40 seconds retention time between the mixing valve and the dewatering screw press inlet.

C. Screw press manufacturer shall determine during testing which of the three possible injection points optimize dewatering. Polymer injection and mixing valve shall be installed at this point for each screw press and spool pieces shall be installed in the remaining locations.

D. The CONTRACTOR shall provide temporary polymer piping, valves, and fittings up to the polymer injection ring at each mixing valve location during testing at no additional cost to the OWNER.

E. The CONTRACTOR shall provide temporary supports for the polymer piping and mixing valve at each testing location at no additional cost to the OWNER.

F. The CONTRACTOR shall provide polymer piping, valves, and fittings at the final selected location of the mixing valve, along with all necessary supports at no additional cost to the OWNER.

2.09 AIR COMPRESSORS (IF REQUIRED)

A. Manufacturers: One of the following or equal:
   1. Quincy.
   2. Ingersoll Rand.

B. Type: The air compressors shall be portable, reciprocating, single stage, V-belt driven compressor mounted on a horizontal air receiver, meeting the following design requirements:

CHARACTERISTICS	
Displacement Capacity, cfm	4.0 – 5.5
Operating Pressure Range, psi	90 - 135
Tank Volume, gal	13
Motor Horsepower, hp each	2
Motor Speed, rpm	3450

C. Compressor unit, including crankshaft, cylinders, flywheel, and motor shall be single stage, and shall be air cooled, splash lube, completely sealed against dirt, and providing a large oil sump.
   1. A finned, multi-tube intercooler and aftercooler shall be provided and shall include a safety valve to prevent over pressurization.
      a. A dry-type 10 micron filter silencer shall be provided on the air inlet.
   2. A low oil level switch shall be provided to automatically stop the compressor if the oil level gets too low.
   3. An air-cooled aftercooler shall lower the discharge air temperature to within 25 degrees Fahrenheit of the ambient air temperature.
   4. Compressor bearings shall be oil lubricated.
   5. Each compressor shall be driven by an electric motor integral with the compressor.
   6. All control equipment for each compressor shall be furnished as required for a complete installation, requiring only field connection of the electrical power supply and alarm output signals.

D. Receiver:
   1. Air receiver shall be ASME, National Board coded, and tested to 1.5 times the design working pressure of 135 pounds per square inch.
   2. Receiver shall be provided with pressure gauge, safety valve, and automatic condensate drain trap.
   3. All taps shall be National Pipe Thread threaded.
   4. The receivers shall include a portability kit with steel wheels ball bearings and no-flat solid tires for easy transport.

E. Motor:
   1. Compressor motor: 120 VAC, 1 phase, 60 hertz, TEFC, 1.15 service factor, severe duty, energy efficient, with self-lubricated ball bearings.
   2. Designed, manufactured, and tested in accordance with NEMA MG-1.
   3. Provide in accordance with Section 16222.

2.10 EQUIPMENT GUARDS

A. Provide equipment safety guards as specified in Section 15050.

2.11 ANCHOR BOLTS

A. Anchor bolts shall be Type 316 stainless steel sized by screw press manufacturer and supplied by the CONTRACTOR.

B. Design in accordance with Section 01612.

2.12 VIBRATION ISOLATORS

A. As specified in Section 15050 and as recommended and provided by manufacturer.

2.13 NAMEPLATES

A. Non-electrical nameplates: Per Section 15050.

B. Electrical nameplates and identification:
   1. As specified in Section 16075.

2.14 INSTRUMENTATION AND CONTROLS

A. Control panels:
   1. The manufacturer shall provide a control panel for each of the dewatering screw presses to operate as described in Section 17100-51 and as shown on the Drawings.
   2. Control panels shall be provided in accordance with Section 17710.
   3. Power to each control panel shall be through a single 480-volt, 3-phase, 60-Hertz feeder. Provide control power transformers and power supplies inside the control panel to power the 120-volt loads and 24-volt DC loads
   4. Main overcurrent device shall be a flange-mounted disconnect handle operating a molded case circuit breaker in accordance with Sections 17710 and 16412.
      a. Provide all other VCP circuit breakers in accordance with Section 16412.
   5. Provide a variable frequency drive (VFD) including over-current and overheat protection in accordance with Section 16262 for the screw press main drive.
   6. Provide a programmable logic controller (PLC) that complies with Sections 17720 and 17761.
   7. Provide a human machine interface screen that complies with Sections 17721 and 17765. Provide a hinged cover for protection of the operator interface.
   8. Provide a managed Ethernet switch that complies with Section 17733.
   9. Each VCP shall include a closed circuit air conditioning system, temperature switches, strip heaters, and corrosion inhibiting vapor capsules or strips per Section 17710.
   10. Automatic control for the pneumatic pressure cone if provided with the unit.
   11. Control panels shall be factory wired and pre-tested.
   12. Each VCP shall have the following control devices:
      a. Screw Motor Hand-Off-Auto selector switch.
      b. Screw Motor Forward-Off-Reverse selector switch.
      c. Initiate pushbutton to allow starting of a washing sequence when the local controls are utilized.
      d. Alarm RESET Pushbutton.
      e. Floc Tank Mixer (if provided) Hand-Off-Auto selector switch.
      f. Compressed air solenoid valve Hand-Off-Auto selector switch (for each compressed air valve provided).
      g. E-Stop pushbutton to stop all motors and solenoids.
   13. Each VCP shall include the following pilot lights for the screw press:
      a. Screw press:
         1) Power On.
         2) Screw Press Running Dewatering Mode.
         3) Washwater Solenoid Valve On.
         4) Compressed Air Solenoid Valve On.
         5) Screw Press Running Washing Mode.
         6) Floc Tank Mixer (if provided) Running.
         7) Motor Fault.
         8) Motor High Current.
         9) Motor High Temperature.
         10) High Inlet Pressure.
         11) Low Air Pressure.
      b. Screw press headbox (if provided):
         1) Headbox High Level.

c. Flocculation tank mixer (if provided):
    1) Power On.
    2) Flocculation Mixer Running.
    3) Motor Fault.
    4) High Temperature.

14. Each VCP shall provide the following signals to SCADA via Ethernet connection.
    a. System in LOCAL.
    b. System in REMOTE.
    c. System E-STOP Alarm.
    d. System Fail.
    e. Wash Cycle Ready.
    f. Wash Cycle Active.
    g. Dewatering Mode Ready.
    h. Dewatering Mode Active.
    i. Screw Press:
        1) Screw Press Running.
        2) Floc Tank Mixer (if provided) Running.
        3) Motor Fault.
        4) Motor High Current.
        5) Motor High Temperature.
        6) High Inlet Pressure.
        7) Inlet Pressure Indication.
        8) Screw Motor Speed Indication.
        9) Low Air Pressure.
    j. Screw Press Headbox (if provided):
        1) Headbox High Level.
    k. Flocculation Tank Mixer (if provided):
        1) Power On.
        2) Flocculation Mixer Running.
        3) Flocculation Mixer Running.
        4) Motor Fault.
        5) High Temperature.
15. Each VCP shall receive the following signals from SCADA via an Ethernet connection:
    a. System REMOTE START DEWATERING MODE.
    b. System REMOTE START WASHING MODE.
    c. System REMOTE STOP.

B. Emergency stop local control panel:
    1. Provide an emergency stop local control panel for each screw press. The E-Stop shall provide the operator with the provision to stop all motors and solenoids in the event of an emergency. The local control panel will be located adjacent to the screw press unit as indicated on the Drawings. The enclosure shall meet the requirements of section 16050. The local control panel shall consist of the following components:
        a. One red mushroom-head emergency stop button to stop the screw press.

C. Programming:
    1. The PLC in each VCP shall be programmed by the manufacturer to control the operation of the associated screw press. The system shall be capable of

executing the control strategy outlined in Section 17101-51, operate using inputs provided by the plant PLC, and send outputs the Plant PLC.

D. Screw press manufacturer shall provide programming support and start-up services. Manufacturer is responsible to direct all programming changes required to meet the system performance standards.

E. Screw press manufacturer shall provide flange-mounted pressure sensing type level indicating transmitter as follows if sludge inlet head box is provided:
   1. Manufacturers: One of the following or equal:
      a. Rosemount.
      b. Fischer and Porter.
      c. Leeds and Northrup.
      d. Foxboro.
   2. Level indicating transmitters: Pressure sensing, 24 volt direct current 2 wire type with the following:
      a. 3-inch ANSI B16.5, Class 150 carbon steel mounting flange.
      b. 1/2 inch National Pipe Tread pressure or reference connection.
      c. No mechanical fulcrum points.
      d. Electronic span.
      e. Zero adjustments.
      f. Adjustable damping feature.
      g. Positive overrange protection.
      h. Field adjusted zero elevation or suppression.
      i. 3-valve manifold.
   3. Transmitters housings: Per the requirements of section 16050.Operation temperature range of from 0 to 175 degrees Fahrenheit with relative humidity of 0 to 100 percent.
   4. Wetted material: Cadmium-plated carbon steel, stainless steel, or other corrosion-resistant materials, compatible with process fluid.
   5. Accuracy: Within 0.25 percent of span with repeatability of 0.10 percent.
   6. Output: 4 to 20 milliampere direct current without need for external load adjustments.
   7. Calibrate transmitters to required range.
   8. Provide flange on headbox for mounting the level element.

F. Fixed mount conductance type probe switch - by screw press manufacturer if sludge inlet headbox is provided.
   1. Manufacturers, products: One of the following or equal:
      a. Omega LVC511.
      b. equivalent product.
   2. Life expectancy: Minimum 30 years.
   3. Provide accessories (304 stainless steel), as required, to mount the float switch in the headbox.

G. Pressure switch - by screw press manufacturer if pneumatic discharge cone is provided:
   1. Manufacturers: One of the following or equal:
      a. Ashcroft Static O-Ring.
      b. Mercoid Control.
   2. Components: Pressure sensing mechanism and switch enclosed in housing per the requirements of section 16050.

3. Connections:
   a. Conduit: National Pipe Thread.
   b. Process: 1/2-inch National Pipe Thread, male.
4. Pulsation dampeners: Stainless steel.
5. Type: Diaphragm or bourdon tube or per manufacturer with wetted parts compatible with process fluid with housing for two times process system pressure:
   a. Material of construction and other requirements: Type 316 stainless steel top housing, bottom housing, and bolt assemblies.
6. Switch range: Factory set.
7. Setpoint: Adjustable with approximate setpoint calibrated in engineering units.
8. Type: Fixed deadband, or per manufacturer.
9. Switching mechanism type: Snap acting, with double-pole, double-throw contacts rated at 10 amperes, 120-volts AC, 60 Hertz unless otherwise specified.
10. Provide a flange and accessories (304 stainless steel), as required, to mount the pressure switch in the manufacturer recommended location.

H. Screw press manufacturer shall provide a pressure indicating transmitter if required for the screw press inlet chamber as follows:
1. Manufacturers: One of the following or equal:
   a. Foxboro.
   b. Rosemount.
2. Process pressure indicating transmitters: Provided with microprocessor electronic circuitry and process suitable wetted parts.
3. Type: Loop powered 2-wire, 24 volts DC.
4. Housing: Per section 16050. Operating temperature from 0 to 220 degrees F and relative humidity of 0 to 100 percent.
5. Overrange Protection: To maximum process line pressure.
6. Accuracy: Within 0.10 percent of calibrated span including combined effects of linearity, hysteresis, and repeatability.
7. Rangeability: 10 to 1 with negligible effect on accuracy from static atmospheric pressure changes and 0 to 100 degrees C.
8. Transmitter output: 4 to 20 milliampere direct current into 650-ohm load without need for external load adjustments.
9. Adjustments: Electronic zero and span, and elevated or suppressed zero as required by application.
10. Components: Include process shutoff valves as specified in Section 17100-51 and shown on the Drawings, bleed valves, and mounting brackets.
11. Local indicators: Scaled in Engineering units, calibrated to required range.
12. Provide a flange and accessories (316 Stainless steel), as required to mount the pressure probe in the sludge inlet chamber.

2.15 FINISHES

A. Coating as specified in Section 09960.

2.16 SOURCE QUALITY CONTROL

A. Provide advance notice of field testing as specified in Section 15958.

B. Performance, Noise, and Vibration Test Level 1 as specified in Section 15958.

C. Motor Factory Test as specified in Section 16222.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and as specified in Section 15050.

B. CONTRACTOR shall provide all hardware and accessories required for installation.

C. Manufacturer’s field services:
   1. Include the following:
      a. Pre-installation meeting: One trip with two days service.
      b. Inspection and functional/operational testing: One trip with 5 days service.
      c. Performance testing/training: One trip with 5 days service.
   2. Additional trips resulting from failed tests shall be the sole responsibility of the manufacturer.

D. Install access platform provided by manufacturer per manufacturer’s instructions.

3.02 EQUIPMENT START-UP AND TESTING

A. Perform start-up and functional testing as specified in Section 01660 for entire dewatering system, with all units operating in AUTO mode. CONTRACTOR shall complete all electrical/instrumentation and loop testing prior to functional performance testing.

B. Provide Major Certificate of Proper Installation as specified in Section 01660.

C. Operational test:
   1. General performance test: Level 2 as specified in Section 15958.
   2. Vibration test: Level 1 as specified in Section 15958.
   3. Noise test: None required.
   4. Functional/operational tests may be performed in the same trip. Perform in accordance with Section 01660.

D. Guaranteed performance testing:
   1. Include the minimum number of trips and duration of service as previously indicated. Additional services and trips shall be provided at no cost to OWNER or CONTRACTOR, as necessary to demonstrate compliance with performance standards.
   2. Include demonstration that dewatering system meets minimum specified performance requirements of this Specification.
   3. Manufacturer’s representative shall supervise all performance testing and be solely responsible for operating dewatering and ancillary equipment (e.g., sludge and polymer feed systems). OWNER shall furnish personnel to assist in operating equipment and take samples. Manufacturer shall provide certified test reports.
   4. After adjustments are made to achieve operating requirements, dewatering system will be operated at design conditions to demonstrate consistent

performance. Samples of feed, filtrate, and cake shall be collected by ENGINEER's appointed representative or OWNER and evaluated by a certified independent testing laboratory and/or the by OWNER. Test will be deemed successful if average test results meet or exceed those specified.

5. Sample testing and analysis costs shall be the responsibility of the OWNER.
6. Polymer shall be as selected by the manufacturer and supplied by the OWNER for testing.
7. Data collected during each test run used to complete guaranteed performance testing shall include, as a minimum:
    a. Run number.
    b. Date.
    c. Time.
    d. Feed sludge percent total solids, percent TS (daily composite).
    e. Feed sludge percent volatile solids, percent VS (daily composite).
    f. Sludge feed rate, gpm.
    g. Polymer name.
    h. Polymer percent active, percent.
    i. Polymer density, lb/gal.
    j. Polymer feed rate (neat), gph.
    k. Screw press speed, rpm.
    l. Amperage draw by the screw press drive, amps.
    m. Screw press filtrate percent total suspended solids, percent TSS.
    n. Cake percent total solids, percent TS.
8. Provide calculated values for the following:
    a. Solids throughput, lbs TS/hr.
    b. Polymer dosage, active lb/dry ton TS.
    c. Solids recovery (capture), %, calculated as follows:
        1) Capture %=cake %TS*(feed %TS-filtrate %TSS)/(feed %TS*(cake %TS-filtrate %TSS))*100. Begin sampling after 30 minutes of steady state run time.
9. Solids concentrations will be determined using “Standard Methods.”
10. Guaranteed Performance Test Runs:
    a. Test runs shall consist of two 5-hour steady-state runs performed on two consecutive days. Maintain the minimum design solids throughput of 3.7 DT per day at 0.6-percent inlet solids for one steady state run and 8.4 DT per day at 2.0-percent inlet solids for the other steady-state run operating at 60 percent of the maximum screw press speed or less.
    b. All test data and values and previously described and required to demonstrate compliance shall be recorded at the start of each run and every hour thereafter. The averaged results for each sample shall meet or exceed the minimum and guaranteed performance standards.
    c. The units shall be operated in AUTO mode at all times during the Guaranteed Performance Test runs.
    d. Should installed equipment fail to meet specified minimum performance requirements, manufacturer shall make all necessary changes to the equipment and/or operation within 30 days at no cost to OWNER. Equipment shall be retested using the same procedure indicated above. If after the second test, equipment still does not meet minimum performance requirements and/or guaranteed performance standards, damages will be assessed and/or equipment replaced. If assessed, damages will be based upon a 20-year life cycle present worth value of additional sludge disposal and/or polymer cost at a 5 percent interest rate. Damages will be based

upon current operating costs and sludge disposal/dewatering quantities. Damages will be limited to the total purchase order cost for all goods and services provided by the screw press manufacturer.

e. It is agreed by manufacturer that screw press dewatering system will meet every item of performance criteria as specified prior to acceptance by the OWNER.

11. Manufacturer shall prepare and submit a written report documenting the above listed test data.
12. Provide a computer spreadsheet compatible with Microsoft® Excel (latest version) with the above listed test data.

E. Witnessing: All field testing shall be witnessed by the ENGINEER; provide advanced notice of field testing as specified in Sections 01660 and 15958.

F. A representative of the screw press manufacturer shall be provided for the following:
1. To inspect the equipment and installation.
2. To make any field adjustments to ensure proper equipment operation.
3. To furnish affidavit stating that the dewatering system has been tested and is ready for installation as specified in Section 01660.
4. To inspect start-up.

G. Manufacturer shall inspect system before initial start-up and certify that system has been correctly installed and prepared for start-up as specified in this section and Sections 15050 and 15958.

H. Training:
1. Provide operator training for at least 2 days on-site by factory-trained representative. Operator training to include:
a. Operations and inspection training.
b. Safety instruction.
c. Preventative maintenance instruction.
d. Calibration and other pertinent services.
2. Provide additional training during the Commissioning Phase as specified in Section 01660.

END OF SECTION

SECTION 11395

PRE-ENGINEERED BIOFILTER ODOR CONTROL SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. The work specified herein shall include designing, furnishing, and installing all equipment and materials necessary to provide the OWNER with an operational dual-stage Biofilter Odor Control System. The CONTRACTOR shall be responsible for providing the complete system that shall include, but not be limited to fiberglass reinforced plastic (FRP) vessels, nozzles, two independent stages of treatment media, moisture controls, nutrient supply system, nutrient dosing system, and all necessary accessories.

B. The biofilter system shall be suitable for installation in an NFPA 820 Class 1 Division 2 Group D hazardous duty location.

C. The biofilter system specified herein shall be a portion of a complete odor treatment train. Many portions of the complete odor treatment train including, exhaust fan, and ductwork and dampers, and control system are specified elsewhere, and are not included in this Section.

D. Electrical requirements: See section 16050 and DIVISION 16, Electrical Requirements, which contains information and requirements that apply to the work specified herein and are mandatory for this project.

E. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 – Submittal Procedures.
      b. Section 01660 - Testing, Training, and Commissioning.
      c. Section 01740 - Warranties and Bonds.
      d. Section 06608 - Fiberglass Reinforced Plastic.
      e. Section 09960 - High-Performance Coatings.
      f. Section 15050 - Common Work Results for Mechanical Equipment.
      g. DIVISION 16.

1.02 REFERENCES

A. PS 15-69: National Bureau of Standards Voluntary Product Standard "Custom contact molded Reinforced Polyester Chemical Resistant Process Equipment."

B. ASTM International (ASTM):
   1. ASTM D-883: "Definition of Terms Relating to Plastics."
   2. ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."
   3. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."
   4. ASTM D-4097-01: "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks."

C. National Fire Protection Association (NFPA):
   1. The system and its components shall meet the requirements of NFPA 820 and other relevant codes and standards.

1.03 SUBMITTALS

A. General: Provide Shop Drawings, samples, administrative, quality control, and contract closeout submittals in accordance with the requirements of Section 01330, SUBMITTALS, and as listed below.

B. Provide shop drawings and samples as follows:
   1. Detailed structural and mechanical layout drawings showing system fabrication, dimensions, size, and locations of connections to other work.
   2. Complete design calculations for the media support system and structural members. The design and structural calculations shall be sealed by a registered structural Professional Engineer in California.
   3. Manufacturer’s catalog information, descriptive literature, specifications, and identification of materials of construction.
   4. Provide process calculations showing that the media as provided will meet the required performance criteria.
   5. Manufacturer’s Information on the biofilter media, such as:
      a. Pressure drop data through media.
      b. Biofiltration media physical characteristics, including:
         1) Media volume.
         2) Media depth.
         3) Residence time.
      c. Information on expected settling rates of the media per year.
      d. System biofilter pressure drop calculations.
      e. Operating data from previous installations to substantiate media performance claims.
   6. External utility requirements.
   7. Complete instrumentation, control, logic, and power wiring diagrams in sufficient detail to allow installation of the instrumentation, controls, and electrical components.
   8. Coating systems: Including manufacturer's descriptive technical catalog literature and Specifications.
   9. Field-testing plan for meeting system performance requirements.

C. Provide quality control submittals as follows:
   1. Operations and maintenance data.
   2. Manufacturer’s Certification of Compliance that the factory finish system is identical to the requirements specified herein.
   3. Manufacturer’s Certificate of Proper Installation.

4. Manufacturer's training program.
5. Equipment Testing and Field Start-Up Report.

1.04 QUALIFICATIONS

A. The biofilter system manufacturer/supplier shall be one recognized and established in the design, production, and manufacturing of biological odor control systems. The biofilter system manufacturer/supplier shall have at least 10 years of experience in design and fabrication of similar systems as demonstrated by a list of at least five successful installations of comparable size, with references. References must include valid names and phone contact numbers that can be verified.

B. Any manufacturer whose main business is FRP manufacturing shall not be accepted as a supplier of the complete system.

C. The biofilter system supplier must be able to provide the OWNER with training and monitoring support service during the first 2 years of operation.

D. The system responsibility shall be as specified in Article 2.04.

1.05 WARRANTY

A. Warrant specified performance and all system components for 2 years from the date specified in Section 01740.

B. Warrant the biofilter vessels for 5 years from the date specified in Section 01740 for defects in material and resistance to the H_2S and ambient environment specified.

C. Performance guarantee: The biofilter manufacturer shall guarantee the performance of the system for 2 years from the date specified in Section 01740. If, within the 2-year guarantee period, the system fails to meet the performance H_2S concentration as specified below, the biofilter manufacturer shall make all corrective actions necessary to maintain the system performance at no additional cost to the OWNER. The corrective actions shall include replacing parts of the biofilter, making adjustments to the operating components of the scrubber, and replacing the entire scrubber system and all associated components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, components, and accessories specified in this Section shall be products of the following:
1. Daniel Company.
2. Global Environmental Solutions, Inc.

2.02 DESIGN CRITERIA

A. Foul air removed from the facility will have an average and peak concentration of H_2S and design airflow rate as listed in the following table:

Peak Inlet H_2S (ppm)	100
Average Inlet H_2S (ppm)	25
Total System Airflow Rate (cfm)	550
Number of Units	2
Diameter of Each Vessel	6.5 feet
Maximum Height of Each Unit	Not to exceed as shown on the plans
Minimum First-Stage Media Depth	3 feet
Minimum Second-Stage Media Depth	5.5 feet
Maximum Pressure Drop Across Each Vessel Unit	5 inch WC
Average H_2S Removal Efficiency	Greater than or equal to 99 percent or outlet H_2S less than or equal to 0.3 ppmv, whichever is higher
Average Odor Removal	Greater than or equal to 90 percent or outlet odor concentration less than or equal to 600 OU(D/T), whichever is higher
Maximum Temperature (degrees F)	105

2.03 PROCESS DESCRIPTION

A. The process contains two separate layers. The first layer consists of an inorganic porous substrate, to support a thin film sulfur oxidizing bacteria for the removal of H_2S. The second layer consists of a mix of organic materials for the removal of organic VOC compounds (e.g., methyl mercaptans, dimethyl disulfide, etc.). The system is an upflow vapor-phase design providing integrated sections:
   1. Nutrient/humidification.
   2. Air distribution.
   3. Inorganic media.
   4. Organic media.

2.04 SYSTEM RESPONSIBILITY

A. It is the intent of the Specifications to have the entire odor control system, including the pre-engineered biofilter unit, provided by a single Odor Control System Supplier in order to achieve single-source warranty and process performance responsibility, as well as to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's services. The Odor Control System Supplier shall be responsible for furnishing the system as specified herein, for delivery to site, assistance with installation, start-up, testing, and for warranty of the system design and performance.

2.05 FRP PACKAGED DUAL-STAGE BIOFILTER SYSTEM

A. General:
   1. The gas treatment system shall be a once-through biologically active odor removal system of unitary construction. The system shall consist of a humidifier and two biological gas conditioning/treatment stages in series in a single FRP round vessel unit as shown on the plans. After humidification, the first stage shall facilitate biological oxidation of odor compounds absorbed by the liquid on the inorganic media. Each stage media section shall include a spray header with nozzles to distribute liquid evenly over the media. The complete treatment vessels shall be fabricated of premium-grade vinyl ester FRP.
   2. The air shall enter the vessels and goes upward through the first treatment stage inorganic lava rock media. This stage shall provide absorption of odors from the air stream.
   3. The second treatment stage shall contain blended or synthetic organic media. This stage shall provide absorption of odors from the air stream. The overall biofilter vessel shall not exceed the maximum dimensions shown on the Drawings. The system shall have a maximum height as shown on the plans.
   4. Access manways shall be provided to allow access to the system internals.
   5. The system shall be included with all piping, valves, and internals. The material of construction of internals shall be as follows:
      a. Media support: HDPE and FRP.
      b. Liquid distributor: CPVC.
      c. Spray nozzles: CPVC.
      d. Humidifier nozzles: 316 SS or PVC.

B. Material of Construction:
   1. The vessels and accessories shall be FRP contact molded, manufactured in accordance with NBS PS 15-69, ASTM D 4097 for contact molding. Any material of construction other than FRP with premium-grade vinyl-ester resin will not be allowed.
   2. Resin used in the system liner shall be a premium fire-retardant vinyl-ester type such as Hetron™ 922FR by Ashland Chemicals, Derakane™ by Dow Chemical, or approved equal. The resin shall be reinforced with an inner veil of a suitable synthetic organic fiber such as Nexus 111-00010.
   3. Miscellaneous:
      a. Stainless steel: Unless otherwise specified, all fasteners and metal attachments such as anchors, brackets, etc., shall be ANSI 316SS.
      b. Gaskets: Unless otherwise specified, all gaskets shall be EPDM.

C. Fabrication:
   1. General: Fabrication shall be in accordance with Section 06608 and NBS PS 15-69, ASTM D 3299 and ASTM D-4097. The more stringent requirements shall apply. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat. All voids to be filled with a resin paste. The exterior shall be surface coated with gel coat containing ultraviolet light inhibitors.

2.06 MEDIA

A. Manufacturers:
   1. Global Environmental Solutions, Inc.
   2. Biorem.

B. The first treatment stage shall consist of lava rock as the inorganic media for the primary removal of H_2S. The second stage shall be either blended organic media or synthetic media for the removal of reduced sulfur compounds and VOCs.

C. First Stage Media - Inorganic Crater-Max® Media:
   1. The Crater-Max® media used in the biofilter shall be supplied by Global Environmental Solutions, Inc., no equal, and shall serve as part of the ecosystem for the growth of acidithiobacillus microorganisms. The Crater-Max® media shall also contain the necessary iron content that, in a low pH environment, will create a chemistry of iron ions to support a colony of acidithiobacillus ferroxidans microorganisms. The media shall be of the type to eliminate any eventual treatment efficiency losses over time due to channeling and compacting. Provide 0.25 cubic feet of sample for review by ENGINEER.
   2. The inorganic media shall have a proven reliability record for biological growth with a minimum of 500,000 cubic feet installed over a 5-year period, with at least five separate projects, based on actual installations in a low pH sulfuric acid application without degradation.
   3. The media shall be treated, crushed; using no aggregate larger than 3 inches in diameter, ensuring a uniform surface area of a minimum of 10,000 square feet per cubic foot of media.
   4. The media shall then be screened and cleaned to size and meet the following specifications:
      a. Unit Weight (Jigging Method)/% Voids (ASTM C29):

Dry Unit Weight (pcf)	50.8
Percentage Voids	45.2
Saturated Surface Dry (SSD) Unit Weight (pcf)	59.1
Percentage Voids	36.3

      b. Specific Gravity/% Adsorption (ASTM C127):

Specific Gravity (Oven Dry Basis)	1.486
Specific Gravity SSD (Saturated Surface Dry)	1.705
Percentage Adsorption	14.7

      c. Durability Index (Cal 229):

Timeline of Determination From Line of Sediment (min)	180.0
Sediment Height Reading (in)	0.1
Durability Index	96.0

      d. Screening and Grading (ASTM C136):

Sieve Size	**Percentage Passing**
3 inches	100
2 1/2 inches	100

Sieve Size	Percentage Passing
2 feet	96.0
1 1/2 inches	77.5
1 inch	16.5
3/4 inch	2.3
1/2 inch	0
3/8 inch	0
No. 4	0

D. Second Stage Alternative 1 - Organic FIBER-MAX™ Media:
   1. The FIBER-MAX™ media is a fibrous cellular substrate material manufactured only from trees and large tree branches. No yard/construction/demolition waste or commercial wood-based materials shall be used. No eucalyptus, cedar, redwood, or any other trees having a known inhibitor or germicidal effect on microorganisms shall be used. No foreign material – i.e., metal, plastic, or other inorganic material such as soil fines, trash, paper, etc., shall be allowed.
   2. The media shall be as manufactured by Global Environmental Solutions, Inc.
   3. The media shall have a proven reliability record for biological growth with a minimum of 500,000 cubic feet installed.
   4. Media Composition:
      a. The fibrous cellular materials to be used in the biofilter media shall be chip or abraded to supply an air-filled pore space of 35 to 55 percent with ample surface area for microorganisms to reside. The media shall be cleaned and screened so that leaves, needles, grass, and other undesirable materials shall be limited to less than 0.5 percent of the total media weight. The media sizing shall consist of natural shredded wood with the particle sized to the following:
         1) Less than 1 inch: 5 percent (± 2 percent).
         2) 1 to 3 inches: 20 percent (± 2 percent).
         3) 3 to 6 inches: 60 percent (± 2 percent).
         4) Over 6 inches: 15 percent (± 2 percent).
   5. Media Analysis:
      a. As part of the biofilter media quality assurance and quality control procedures, the biofilter media is analyzed for unwanted contaminates and conditions. The biofilter media shall be tested to meet the following parameters:
         1) SP: 1/2 inch or less per foot.
         2) pH: 6.0 to 8.0.
         3) Soluble Salts: less than 5.0 mS/cm.
         4) Sodium: less than 100 mg/kg.
         5) Potassium: less than 50 mg/kg.
         6) Lead: less than 10 mg/kg.
         7) Copper: less than 40 mg/kg.
         8) Zinc: less than 40 mg/kg.
         9) Mercury: less than 0.1 mg/kg.
         10) Arsenic: less than 0.2 mg/kg.

E. Second Stage Alternative 2 - Engineered synthetic media:
   1. Composition: The media shall be Biorem XLD high-performance engineered biofiltration media specifically designed for biosolids applications where the removal of high odor, low H_2S, and reduced sulfur compounds are critical.

2.07 MEDIA WARRANTY

A. The media supplier shall warrantee the media from decomposition and reduced efficiency for a period of 20 years for the first stage media and 10 years for the second stage media. The standard warranty manufacturer shall be modified as required and submitted for review and acceptance. The warrantyshall commence after the date specified in Section 01740.

2.08 ACCESSORIES

A. Air inlets, air outlets, spray nozzles and headers, media support, each media stage differential pressure gauges, drains, access manways, and all connections, whether shown or not on the Drawings, shall be provided by the odor control supplier/manufacturer. Tie-down lugs shall be integrally molded into the walls of the vessels. All external bolts shall be 316 SS and designed for the specified loads. Interior fasteners shall be of corrosion-resistant materials such as PVC or FRP.

B. Neoprene pad: A 1/4-inch thick neoprene rubber sheet must be placed underneath the biofilter vessel.

C. One water-control cabinet shall be provided which control the irrigation and nutrient supply system. The water-control cabinet shall be weatherproof and constructed from an FRP cabinet with all internal piping SCH 80 CPVC. The cabinet shall be freestanding with Type 316 SS support designed by the biofilter supplier. The cabinet shall, as a minimum, contain the following components and as shown on the Drawings.
   1. Pressure-reducing valves.
   2. Irrigation solenoid valves.
   3. Irrigation system pressure gauge.
   4. Manual valves shall be PVC diaphragm type.
   5. Rotameters.

D. Water distribution system: The first and second media stages shall each be equipped with an independent water-distribution system. The systems shall be designed to irrigate the media beds with complete and even coverage.

E. Nutrient addition: A nutrient non-electric Dosmatic pump metering system shall be provided. Nutrients supplied as a coating to the support media shall not be allowed. The system and piping shall be sized by odor system supplier.

F. Nutrient reservoir: A nutrient reservoir with 30-gallon capacity shall be provided. The nutrient reservoir shall be HDPE and provided by the odor control system supplier.

G. Piping: All makeup water and drain piping shall be SCH 80 PVC. The CONTRACTOR shall insulate and heat trace all external piping as required by climatic conditions.

2.09 CONTROLS

A. The biofilter manufacturer/supplier shall provide one PLC-based control panel to have the logic and controls for the following components or capabilities to handle all odor vessels:
   1. Irrigation valves that will open and close based on adjustable timing cycles.
   2. Push-to-test button for water valves.
   3. Timer relay for on/off control of water valves.

B. The control panel enclosure shall be of fiberglass construction. The panel and all instrument devices shall be NEMA rated according to the requirements in section 16050. The panel shall be factory tested to full operation with all other components prior to shipment.

2.10 SOURCE QUALITY CONTROL

A. Factory test: Perform manufacturer's standard test on equipment. Provide an independent FRP Quality Assurance Inspection report as follows:
   1. Visual inspection to the requirements of ASTM D2563.
   2. Barcol Hardness measurements in accordance with ASTM D2583.
   3. Acetone sensitivity test for all internal secondary bonds.
   4. Glass content by ignition loss on three cutouts in accordance with ASTM D2584.

PART 3 EXECUTION

3.01 EXAMINATION

A. Refer to Section 15050.

3.02 FIELD FINISHING (AND/OR CORROSION PROTECTION)

A. Field touch up in accordance with Section 09960.

B. Damage to pigmented gel coat and/or exterior laminate on any FRP component shall be repaired in accordance with equipment fabricator's recommendations. Exposed surfaces will be restored to a uniform texture and color-matched appearance. Color shall be as selected by the OWNER.

3.03 INSTALLATION

A. General: Follow manufacturer's written instructions for installation and adjustment of components.

B. Media Installation Criteria:
   1. Prior to shipment, media shall be wetted to achieve a moisture content between 40- and 60 percent then mixed with 3-percent nutrient Solutions supplied by Global Environmental Solutions, Inc. Gro-Max®. The mixture shall be placed directly into the biofilter bed immediately upon arrival at the site. The CONTRACTOR will not be allowed to store the mixture on site for any period of time. The CONTRACTOR shall include in his bid an additional 6 inches of

medial bed depth to be installed over the depths shown on the Drawings to allow for compaction of the medial over time.

2. Perform smoothing by hand.
3. The media shall be kept moist at all times after installation. Use irrigation system.

C. Sprinklers: Support sprinkler risers to permit operation without vibrations or movement of the head and piping.

D. FRP fans and duct: Airflow to each biofilter cell shall be dynamically balanced in accordance with ASTM D-4167. Field balancing shall be done by the CONTRACTOR.

3.04 FIELD TEST AND START-UP

A. Manufacturer's Services:
   1. A manufacturer's representative for the equipment specified herein shall be present at the jobsite and/or classroom designated by the OWNER for the minimum man-days listed for the following services and herein, travel time excluded.
      a. Provide 1 man-day for installation assistance, inspection, and certification of the installation.
      b. Provide 1 man-day for pre-start-up classroom or jobsite training, and start-up assistance training of the OWNER's personnel.
      c. Start-up services and training of OWNER's personnel shall be at such times as requested by the OWNER. A minimum of 2 trips will be required.
   2. Provide additional training during the Commissioning Phase as specified in Section 01660.

B. Functional testing:
   1. Test all system components for proper adjustment and operation in both the manual and automatic operating modes.
   2. Allow the biofilter irrigation system to operate for a 48-hour period with the moisture control system in AUTO mode and make adjustments as necessary for proper moisture system operation.
   3. All testing, adjusting, and balancing of the fans shall have been completed and approved.

C. Performance testing:
   1. The performance test shall be conducted while the sources being controlled are operational. The biofilter vessels shall have been fully functional and receiving odorous air for a minimum of 30 consecutive days prior to commencing the testing.
   2. Inlet and outlet concentrations of H_2S, ammonia, amines, total reduced sulfides, and total odor used to determine performance for the control test and operational test shall be measured using an inner scan meter or Odalog. Ammonia and amine concentration shall be measured using Gastec or Draeger Tubes, and associated pump. Total reduced sulfide concentrations shall be measured by collecting in Tedlar bags, shipped to a laboratory, and tested for 20 reduced sulfur compounds. Total odor concentration shall be measured in Tedlar bags, shipped to a laboratory, and tested according to dilution-to-threshold (D/T) and make recognition-to-threshold (R/T) test.

3. The test shall be conducted over an 8-hour period with sampling and data measurements being evenly distributed on all biofilter cells.
4. Record water flow rates, pressure drop across each media section, total system pressure drop, media moisture content/humidity, air temperature, inlet and outlet H_2S, Inlet and outlet D/T and any other parameters recommended by the Odor System Supplier.

3.05 SERVICE AGREEMENT

A. The CONTRACTOR shall provide a 1-year Service Agreement provided by the media manufacturer. The 1-year Service Agreement shall begin 1 year after start-up and shall include 2 semi-annual visits to the site. The media manufacturer shall provide the following services during the visits:
   1. System review:
      a. Check operational/maintenance log(s).
      b. Refresher training of operators on proper operation and maintenance of the biofilter.
      c. Inspect irrigation nozzles; clean and adjust as necessary. Spray patterns verified for complete coverage of media as designed.
      d. Media inspection.
      e. Sample testing of H_2S removal.
   2. The service visit shall be completed in 1 full day, and a trip report shall be sent to the OWNER within 2 weeks of the visit.

END OF SECTION

SECTION 11452

RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Residential appliances.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01770 - Closeout Procedures.

1.02 REFERENCES

A. Underwriters laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Product data.

B. Manufacturer's installation instructions.

C. Operation and maintenance data.

D. Warranties.

1.04 QUALITY ASSURANCE

A. Regulatory requirements: Products shall be listed by UL.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver manufacturer's original containers with seals unbroken and labeled with manufacturer's model and serial number to job site.

B. Store appliances in original, unopened packaging.

C. Warehouse appliances until designated spaces for appliances are constructed and finished.
   1. Unpack appliances in designated spaces.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Kitchen dishwasher (undercounter):
   1. Manufacturers: The following or equal:
      a. General Electric, GLDA696MSS-Stainless steel.
   2. Physical dimensions:
      a. ADA-compliant by fitting under a 34-inch countertop.
      b. Height adjustable legs to fit under a standard 36-inch counter height.
   3. Construction:
      a. Washer cabinet, interior and exterior door panels, interior surfaces, wash arms, and high pressure tubes shall be stainless steel.
      b. Washer chamber shall be equipped with upper and lower revolving spray wash arms.
      c. Sound absorbing insulation shall be provided at door, service panel, top, and sides.
      d. Racking:
         1) Constructed of nylon.
         2) Upper rack, lower rack, utility shelves, and silverware basket.
   4. Controls: Electronic controls with touchpad; 4 distinct cycles consisting of rinse only, light wash, normal wash, and heavy wash.
   5. Other features:
      a. 100-percent triple water filtration.
   6. Power: single-phase, 115 VAC.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide proper clearances.

3.02 CLEANING

A. Clean area after completion of construction as specified in Section 01770.

B. Remove excess materials, equipment, and debris upon completion of installation.

C. Replace defective appliances with new.

3.03 PROTECTION

A. Protect installed appliances from damage and contamination until final acceptance.

END OF SECTION

SECTION 11510

SAFETY EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: The following safety equipment:
   1. First aid kit.
   2. Life preserver kit.

1.02 REFERENCES

A. California Occupational Safety and Health Administration (Cal-OSHA).

B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. Shop drawings.

B. Product data:
   1. Submit manufacturer's product literature information for products specified.
   2. Manufacturer's installation instructions.

C. Samples.

D. Operation and maintenance data.

E. Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Show evidence that the firm has been engaged in producing such materials and products for at least 5 years and that the product submitted has a satisfactory performance record of at least 5 years.

B. Installer qualifications: Installer shall have 3 years experience in installing these materials for similar projects and shall be approved by the manufacturer prior to bidding of the project.

C. Regulatory requirements: As applicable, equipment of this Section shall comply with requirements of public agencies of the state of California including OSHA, Cal-OSHA, and the U.S. Coast Guard.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver to the job site in manufacturer's original containers.

B. Delivery: After wet operations in building are completed.

C. Storage and protection: Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

D. Keep materials dry until ready for use.

E. Keep packages of material off the ground, under cover, and away from sweating walls and other damp surfaces.

F. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

PART 2 PRODUCTS

2.01 FIRST AID KIT

A. Manufacturers: One of the following or equal:
   1. VWR Scientific, 56613-216.
   2. Fire Safety Source, 223UFAO.

B. Features/characteristics:
   1. Prefinished, wall-mounted metal cabinet.
   2. Standard medical supplies capable of serving up to 25 people.
   3. Meets OSHA requirements.

2.02 LIFE PRESERVER KIT

A. Cheyenne Life Ring Cabinet or equivalent:
   1. 30-inch diameter life ring (USCG approved).
   2. 90-foot rope.
   3. UV/weatherproof cabinet with T-handle and weather gasket.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturers' recommendations.

B. Install fixed equipment in accordance with manufacturer's instructions.

C. Replace any equipment found defective with new.

D. First aid kits:
   1. Conspicuously install 1 wall-mounted first aid kit in each of the following locations:
      a. Administration Building.
      b. Maintenance Building.
      c. Dewatering Building.
      d. Electrical Building.
      e. Chemical Facility.

E. Life ring kits:
   1. Furnish and install life ring kits as follows. Location as directed by Engineer unless otherwise indicated on Drawings.
      a. Oxidation ditch: Quantity of 6.
      b. Sludge storage tank: Quantity of 4.
      c. Secondary clarifiers (for each clarifier):
         1) Catwalk: Quantity of 1.
         2) Perimeter: Quantity of 2.
      d. REW ponds (for each pond, as indicated on Drawings):
         1) Inlet: Quantity of 1.
         2) Outlet: Quantity of 1.

END OF SECTION

SECTION 11610

FIXED LABORATORY EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Laboratory equipment, including the following:
   1. Glassware washers and vacuum pumps.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 11620 - Laboratory Fume Hoods.
      b. Section 15050 - Common Work Results for Mechanical Equipment.
      c. Section 16050 - Common Work Results for Electrical.

1.02 SUBMITTALS

A. Product data: Submit manufacturers' product literature information for products specified. Include drawings and wiring diagrams.

B. Shop drawings: Include built-in equipment and mechanical and electrical rough-ins.
   1. Indicate equipment to be installed in specified casework; include anchor and placement dimensions and tolerances, clearances required, and other information required for installation.

C. Manufacturer's installation instructions.

D. Operating and maintenance information: Include repair information.

1.03 QUALITY ASSURANCE

A. Manufacturer qualifications: Show evidence that the firm has been engaged in producing such material for at least 5 years and that the product submitted has a satisfactory performance record of at least 5 years.

B. Installer qualifications: Installer shall have 3 years experience in installing these materials for similar projects and shall be approved by the manufacturer prior to bidding of the project.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver to the job site in manufacturer's original containers.

B. Delivery: After wet operations in building are completed.

C. Storage and protection: Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

D. Keep materials dry until ready for use.
   1. Keep packages of material off the ground, under cover, and away from sweating walls and other damp surfaces.

E. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products equaling or exceeding quality requirements of the specified product as manufactured by the following companies are acceptable:
   1. VWR Scientific.
   2. Hamilton Industries.
   3. Bradley Corporation.
   4. Whirlpool.
   5. Jordon.
   6. Gast.
   7. Fischer Scientific.
   8. Scientific Products.
   9. Kewaunee Scientific Equipment Corp.
   10. Haws.
   11. Better Built Machinery Corp.
   12. H. Thomas.
   13. Heinicke Pulsonic Hurricane.
   14. Frigidaire.
   15. Lab-Line.
   16. Labconco.
   17. Airco Regulator.
   18. Perkin-Elmer Regulator.
   19. Matheson.

2.02 EQUIPMENT

A. Glassware washer (under counter):
   1. Manufacturers: One of the following or equal:
      a. Miele Professional, Model No. G7804.
   2. Construction:
      a. Exterior: Stainless steel.
      b. Interior: stainless steel.
      c. Wash cabinets: Stainless steel.

3. Minimum capacity per load:
   a. 39 narrow necked flasks.
   b. 116 pipettes.
   c. 1,600 test tubes.
4. Controls: Front panel, solid state pushbutton controls (short, medium, long, drain, pre-rinse).
5. Other features:
   a. 4-fold filter system: flat filter, coarse filter, glass shard filter, and micro-fine filter.
   b. Pump capacity: 150 gpm.
   c. Water softener.
6. Electrical service required: 208 VAC.
7. Accessories:
   a. Dual level combination cleaning package:
      1) Standard upper and lower baskets.
      2) Upper and lower injector baskets for a total of 67 injectors.
      3) Two mesh baskets.
      4) Two inserts for beakers.

B. Vacuum pump:
   1. As indicated on the Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fixed laboratory equipment in accordance with manufacturer's instructions.

B. Coordinate delivery and installation of equipment with laboratory casework.

C. Plumbing and mechanical work shall be as specified in Section 15050.

D. Electrical connections and distribution shall be as specified in Section 16050.

3.02 PROTECTION

A. Repair or replace defective equipment with new.

END OF SECTION

SECTION 11620

LABORATORY FUME HOODS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Low Constant Volume (LCV) laboratory fume hoods.

B. Related Sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01410 - Code Requirements.
   b. Section 12349 - Laboratory Service Fittings.
   c. Section 15050 - Common Work Results for Mechanical Equipment.
   d. Section 15400 - Plumbing Fixtures and Equipment.
   e. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
1. 110-1995 - Method of Testing Performance of Laboratory Fume Hoods.

B. ASTM International (ASTM):
1. A 1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
2. E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Underwriters' Laboratories, Inc. (UL):
1. 723 - Test for Surface Burning Characteristics of Building Materials.

1.03 SYSTEM DESCRIPTION

A. Design requirements:
1. General: Fume hoods shall function as ventilated, enclosed work spaces designed to capture, confine, and exhaust fumes, vapors, and particulate matter produced or generated within the enclosure.
2. Design:
   a. Fume hoods shall be an LCV fume hood with a flush-sill airfoil design to ensure maximum operating efficiency and energy conservation.
   b. Unit width: 4 feet.

B. Performace Requirements:

1. An LCV fume hood shall have the following characteristics:

   a. The fume hood sash shall be a dual synchronized system with the upper vertical frameless sash being a 1/4-inch thick laminated safety glass member and the lower sash beign a framed combination sash with 22-inch high by 1/4-inch thick laminated safety glass horizontal sliders.

   b. The sliders shall be sized to yield the maximum openings and volume in ft^3/min (CFM) detailed in the chart below:

Bench Hood Size	Horiz. Max Width	Horiz FPM	Vert. Working Height	Vert. FPM	CFM
4'	15"	98	10"	81	225
5'	18"	102	10"	78	280
6'	22"	104	10"	79	350
8'	30"	106	10"	75	485

2. Test Method:

   a. The hood shall be tested per the ASHRAE Standard 110-1995 by qualified personnel supplied by the CONTRACTOR.

      1) Hood shall be tested with a face velocity of 100 FPM through right, left, and center horizontal sash openings, and with a face velocity of 80 FPM per Table 1.03.B.1.b at a 10-inch vertical opening right, left, and center. The hood shall have a performance rating in the static portion of ASHRAE 110-1995 (Section 7.1-7.10) of 4.0 AM 0.01 or better wherein:
      4.0 = tracer gas release in liters/minute
      AM = as manufactured
      0.01 = level of control of tracer gas in parts per million (ppm)

      2) The hood shall have a maximum perimeter reading (Section 7.11) of 0.01 PPM or less. The hood shall have a maximum sash movement value (Section 7.12) of 0.05 PPM or less.

1.04 SUBMITTALS

A. Product data: Include drawings and wiring diagrams.

B. Shop drawings: Include built-in equipment and mechanical and electrical rough-ins.

C. Manufacturer's Data: Submit manufacturer's data and installation instructions. Provide data indicating compliance with ASHRAE Standard 110.1995.

D. Operating and maintenance information: Include repair information.

1.05 QUALITY ASSURANCE

A. The laboratory LCV fume hood manufacturer shall provide fume hood work tops and casework all manufactured or shipped from the same geographic location to assure proper staging, shipment and single source responsibility.

B. General Performance: Provide certification that fume hoods meet the performance requirements described in Article 1.03 Paragraph B.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver to the job site in manufacturer's original containers.

B. Delivery: After wet operations in building are completed.

C. Storage and protection: Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

D. Keep materials dry until ready for use. Keep packages of material off the ground, under cover, and away from sweating walls and other damp surfaces.

E. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide the following or equal:
   1. Kewaunee Scientific Equipment Corp.
      a. Model: DYNAMIC BARRIER.

2.02 MATERIALS

A. Fume Hood Superstructure Frame:
   1. A free-standing rigid frame structure of steel angle shall be provided to support exterior panels and interior liner and baffle panels. To allow for maintenance and replacements, the interior liner panels shall be removable without disassembly of the frame structure and outer steel panels. Likewise, the exterior steel panels shall be removable without disassembly of the frame structure and inner liner panels. Fume hoods that require disassembly of the superstructure for liner replacement are not acceptable.

B. Fume Hood Interior Walls:
   1. Double wall ends, not more than 4 inches wide, shall be provided to maximize interior working area. The area between the double wall ends shall be closed to house the remote control valves. The front vertical facia section shall have a full 135-degree 1-inch radius at the front leading edge to provide a streamlined section and ensure smooth even flow of air into the hood. The vertical facias shall contain the required service controls, electrical switches, and receptacles. The hood interior end panels and sash track shall be flush with the facia to prevent eddy currents and back flow of air.

C. Fume Hood Airfoil:
   1. A streamlined airfoil shall be integral at the bottom of the hood opening on bench and distillation hoods. This foil shall be mounted flush to the work top and direct an air stream across the work surface to prevent back flow of air. The foil shall be of 12-gauge steel to resist denting and flexing. Walk-in hoods shall have a stop located at the bottom of the sash track that will ensure a nominal 3/8-inch opening between the bottom of the sash and the floor.

D. Fume Hood Top Panel: The top front panel shall be of the same material as the exterior facia.

E. Fume Hood Baffles:
   1. A stable, non-adjustable baffle system with three fixed horizontal slots shall be provided to aid in distributing the flow of air into and through the hood. The baffle shall be spaced out 2-1/4 inches from the back liner. The baffle shall be removable for cleaning.

F. Fume Hood Duct Collar:
   1. An 8-inch diameter polyethylene bell-mouthed duct collar shall be located in the top of the hood plenum chamber. Coated common steel duct collars are not acceptable.Access to fixture valves concealed in wall provided by exterior removable access panels, gasketed access panels on the inside liner walls, or through removable front posts.

G. Fume Hood Lighting:
   1. A one-tube, energy-efficient, T-5 fluorescent light fixture of the size given below shall be provided in the hood roof. Illumination at 13 inches above the worksurface shall be at least 100 foot-candles.

Hood Size, Ft.	Nominal Fixture Length, Ft
4	3
5	4
6	4
8	3 (2 Fixtures)

   2. The light fixtures shall be isolated from the hood interior by a 1/4-inch thick tempered glass panel sealed from the hood cavity. Fixture shall be UL labeled.

H. Fume Hood Dual Vertical Combo Sash: A two panel vertical/combination sash system shall be supplied with the following features:
   1. A bottom framed section with eccentrically sized 22-inch high 1/4-inch thick laminated safety glass horizontal sashes allowing the maximum openings set forth in Article 1.03 Paragraph B.1.b.
   2. A top single vertical sash panel of 1/4-inch laminated safety glass.
   3. Both sashes described above shall move in a manner such that only the bottommost sash need be touched to move the entire system. Entire system shall operate on two separate counterweights.
   4. Vertical defeatable sash stops set at vertical openings of 0 and 10 inches.
   5. An aerodynamic tear drop-shaped lower sash handle with an interior projection past the sash plane of 1.5 inches.
   6. Warning signage as follows:
      a. 0-inch defeatable sash stop: "Close horizontal sash panels before raising."
      b. 10-inch defeatable sash stop: "No experiments to be run above this line."
      c. On lower sash rail of upper panel: "Close horizontal sash panels." This sign is to be revealed when the lower sash is raised above the lower sash stop position.

I. Fume Hood Plumbing Services:
   1. Plumbing services shall consist of remote control valves as selected located within the end panels, controlled by extension rods projecting through the

control panels of the hood, with color coded plastic handles. Interior fitting for gases and water shall be nylon panel flanges and angle serrated hose connectors, color coded. Interior fittings for distilled water shall consist of a bronze tin lined, white color-coded, panel flange and angle serrated hose connector. Interior fittings for steam shall consist of a cast bronze flange and angle serrated hose connector with a chemical resistant metallic bronze finish. Water goosenecks shall be cast bronze with a chemical resistant metallic bronze finish. All plumbing fittings shall be factory installed and piped between the valve and the outlet. Inlet piping shall have a single-point connection for each valve provided and carried to a point 1 inch above the fume hood roof or 1 inch above the worktop rear corner depending on the rough-in locations shown in the drawings. Points of final service connection by other trades shall be at the stub provided by the fume hood manufacturer.

J. Fume Hood Electrical Services:
   1. The hood superstructure shall be pre-wired and contain a UL 3101 label certifying acceptable wire gauge, connections, fixtures and wire color coding. Wiring electrical services shall consist of two duplex receptacles and a light switch. The duplex receptacles shall be 20 Amp., 125 volt AC, and 3-wire polarized grounded with ground fault interruption. The receptacles shall be of specification grade, side wired only, to insure a positive connection. The light switch shall be 20 Amp., 125 volt AC, and 3-wire polarized grounded. Wiring shall terminate in one 6- by 6- by 4-inch service junction box located on the fume hood roof. Final wiring and circuit dedication shall be by others.

K. Service Channels:
   1. Fully enclosed service channels shall be provided on each fume hood side wall creating cord and service line access from the hood interior to the exterior front facia immediately below the duplex outlets. The channel shall have cross-sectional dimensions of 1-1/2 by 3 inches and be designed for smooth cord and service line pass-through.

L. Hood Work Surface: Epoxy Resin:
   1. Hood worksurface shall be 1-1/4-inch thick molded epoxy resin made in the form of a watertight pan, not less than 3/8 inch deep to contain spillage with a 6-inch wide safety ledge across the front edge. Top shall be manufactured at the same manufacturing location as the fume hood to assure proper cutout alignment and coordinated shipping. A cup drain flush with the recessed worksurface shall be provided. The worksurface and cup drain shall be available in either black or grey.

M. Access Opening:
   1. The interior end liner panels shall be furnished with an opening that provides access to the service piping and valves to facilitate installation and maintenance. The openings shall be covered with a removable KMER panel with rounded corners. Panels that require tools to remove are not acceptable. The panel shall provide an overlapping seal on all edges.

N. Fume Hood Finish:
   1. After the component parts have been completely welded together and before finishing, they shall be given a pre-paint treatment to provide excellent adhesion of the finish system to the steel and to aid in the prevention of

corrosion. Physical and chemical cleaning of the steel shall be accomplished by washing with an alkaline cleaner, followed by a spray treatment with a complex metallic phosphate solution to provide a uniform fine grained crystalline phosphate surface that shall provide both an excellent bond for the finish and enhance the protection provided by the finish against humidity and corrosive chemicals.

2. After the phosphate treatment, the steel shall be dried and all steel surfaces shall be coated with a chemical and corrosion-resistant, environmentally friendly, electrostatically applied powder coat finish. All components shall be individually painted, ensuring that no area be vulnerable to corrosion due to lack of paint coverage. The coating shall then be cured by baking at elevated temperatures to provide maximum properties of corrosion and wear resistance.
3. The completed finish system in standard colors shall meet the performance test requirements specified under PERFORMANCE TEST RESULTS.

O. Performance Test Results (Chemical Spot Tests):
1. Testing Procedure: Chemical spot tests for non-volatile chemicals shall be made by applying 5 drops of each reagent to the surface to be tested and covering with a 1-1/4-inch diameter watch glass, convex side down to confine the reagent. Spot tests of volatile chemicals shall be tested by placing a cotton ball saturated with reagent on the surface to be tested and covering with an inverted 2-ounce wide-mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period, and at a temperature of 77 degrees F ±3 degrees F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, the reagents shall be flushed from the surface with water, and the surface scrubbed with a soft bristle brush under running water, rinsed and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.
2. Test Evaluation: Evaluation shall be based on the following rating system.
   a. Level 0 – No detectable change.
   b. Level 1 – Slight change in color or gloss.
   c. Level 2 – Slight surface etching or severe staining.
   d. Level 3 – Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.
   e. After testing, panel shall show no more than three (3) Level 3 conditions.
3. Test Reagents:

Test No. Chemical Reagent	Test Method
1. Acetate, Amyl	Cotton ball & bottle
2. Acetate, Ethyl	Cotton ball & bottle
3. Acetic Acid, 98%	Watch glass
4. Acetone	Cotton ball & bottle
5. Acid Dichromate, 5%	Watch glass
6. Alcohol, Butyl	Cotton ball & bottle
7. Alcohol, Ethyl	Cotton ball & bottle

Test No. Chemical Reagent	Test Method
8. Alcohol, Methyl	Cotton ball & bottle
9. Ammonium Hydroxide, 28%	Watch glass
10. Benzene	Cotton ball & bottle
11. Carbon Tetrachloride	Cotton ball & bottle
12. Chloroform	Cotton ball & bottle
13. Chromic Acid, 60%	Watch glass
14. Cresol	Cotton ball & bottle
15. Dichlor Acetic Acid	Cotton ball & bottle
16. Dimethylformanide	Cotton ball & bottle
17. Dioxane	Cotton ball & bottle
18. Ethyl Ether	Cotton ball & bottle
19. Formaldehyde, 37%	Cotton ball & bottle
20. Formic Acid, 90%	Watch glass
21. Furfural	Cotton ball & bottle
22. Gasoline	Cotton ball & bottle
23. Hydrochloric Acid, 37%	Watch glass
24. Hydrofluoric Acid, 48%	Watch glass
25. Hydrogen Peroxide, 3%	Watch glass
26. Iodine, Tincture of	Watch glass
27. Methyl Ethyl Ketone	Cotton ball & bottle
28. Methylene Cloride	Cotton ball & bottle
29. Mono Chlorobenzene	Cotton ball & bottle
30. Naphthalene	Cotton ball & bottle
31. Nitric Acid, 20%	Watch glass
32. Nitric Acid, 30%	Watch glass
33. Nitric Acid, 70%	Watch glass
34. Phenol, 90%	Cotton ball & bottle
35. Phosphoric Acid, 85%	Watch glass
36. Silver Nitrate, Saturated	Watch glass
37. Sodium Hydroxide, 10%	Watch glass
38. Sodium Hydroxide, 20%	Watch glass
39. Sodium Hydroxide, 40%	Watch glass
40. Sodium Hydroxide, Flake	Watch glass

Test No. Chemical Reagent	Test Method
41. Sodium Sulfide, Saturated	Watch glass
42. Sulfuric Acid, 33%	Watch glass
43. Sulfuric Acid, 77%	Watch glass
44. Sulfuric Acid, 96%	Watch glass
45. Sulfuric Acid, 77% and Nitric Acid, 70%, equal parts	Watch glass
46. Toluene	Cotton ball & bottle
47. Trichloroethylene	Cotton ball & bottle
48. Xylene	Cotton ball & bottle
49. Zinc Chloride, Saturated	Watch glass
* Where concentrations are indicated, percentages are by weight.	

P. Fume Hood Dimensions:
   1. Double wall end panel thickness shall not exceed 4 inches. Interior clear working height shall be not less than 41-3/4 inches. Interior depth from the back of the sash to the front of the rear baffle shall not be less than 25-1/4 inches. The sash opening shall be not less than 37 inches in height above the worksurface on bench hoods.

Q. Fume Hood Liners: KMER Epoxy Resin Lining or equal:
   1. KMER epoxy resin liner shall be the manufacturing standard for liners in this specification. To ensure proper punching and coordination with remaining pieces of assembled fume hood superstructure, this liner material must be manufactured at the same geographic location and the fume hood superstructure. Interior liner panels shall be 1/4-inch thick epoxy resin sheets of a neutral color. Interior liner panels shall be fastened using stainless steel screws with plastic covered heads. Flame spread of material as measured by ASTM E84 shall be 6.2 or less.
   2. Fiberglass reinforced plastics or polyesters shall not be acceptable substitute liner materials for epoxy resin.

R. Liner Tests – Chemical Spot Tests – 24 Hours:
   1. Chemical spot test shall be made by applying 10 drops (approximately 1/2 cc) of each reagent to the surface to be tested. Each reagent (except those marked **) shall be covered with a 1-1/2-inch diameter watch glass, convex side down to confine the reagent. Spot tests of volatile solvents marked ** shall be tested as follows: A 1-inch or larger ball of cotton shall be saturated with the solvent and placed on the surfaces to be tested. The cotton ball shall then be covered by an inverted 2-ounce, wide-mouth bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire 24-hour test period and at a temperature of 77 degrees F + 3 degrees F.
   2. At the end of the test period, the reagents shall be flushed from the surfaces with water and the surface scrubbed with a soft bristle brush under running water, rinsed, and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Spots where dyes

have dried shall be cleaned with a cotton swab soaked in alcohol to remove the surface dye. The test panel shall then be evaluated immediately after drying.

3. Ratings/Legends:

Results	KMER[1]	Glass Reinforced Polyester	Stainless Steel 304	Stainless Steel 316	Reinforced Phenolic Resin
1. Acetic Acid 98%	A	B	B	B	A
2. Acetone[3]	A	D	A	A	A
3. Acid Dichromate	A	A	A	A	A
4. Ammonium Hydroxide[3] 28%	A	A	B	B	A
5. Amyl Acetate[3]	A	A	A	A	A
6. Benzene[3]	A	A	A	A	A
7. Butyl Alcohol[3]	A	A	A	A	A
8. Carbon Tetrachloride[3]	A	A	A	A	A
9. Chloroform[3]	A	D	A	A	A
10. Chromic Acid 60%	B	B	C	C	A
11. Cresol	A	A	A	A	A
12. Dichloroacetic Acid	A	D	B	A	A
13. Dimethylformamide	A	A	A	A	A
14. Dioxane[3]	A	A	A	A	A
15. Ethyl Acetate[3]	A	A	A	A	A
16. Ethyl Ether[3]	A	A	A	A	A
17. Ethyl Alcohol[3]	A	A	A	A	A
18. Formaldehyde	A	A	A	A	A
19. Formic Acid 90%	A	A	A	A	A
20. Furfural[3]	B	B	A	A	C
21. Gasoline[3]	A	A	A	A	A
22. Hydrochloric Acid 37%	A	A	B	B	A
23. Hydrofluoric Acid 48%	B	D	D	D	A
24. Hydrogen Peroxide 30%	A	A	A	A	A
25. Methyl Ethyl Ketone[3]	A	A	A	A	A
26. Methyl Alcohol[3]	A	A	A	A	A
27. Methylene Chloride[3]	A	D	A	A	A
28. Monochlorobenzene[3]	A	A	A	A	A

Results	KMER[1]	Glass Reinforced Polyester	Stainless Steel 304	Stainless Steel 316	Reinforced Phenolic Resin
29. Naphthalene[3]	A	A	A	A	A
30. Nitric Acid 20%	B	A	B	A	A
31. Nitric Acid 30%	B	A	B	A	A
32. Nitric Acid 70%	B	D	B	A	A
33. Phenol[3] 85%	A	C	A	A	A
34. Phosphoric Acid 85%	A	A	B	A	A
35. Silver Nitrate	B	C	A	A	C
36. Sodium Hydroxide 40%	A	D	A	A	A
37. Sodium Hydroxide 20%	A	D	A	A	A
38. Sodium Hydroxide 10%	A	D	A	A	A
39. Sodium Hydroxide FlakE	A	B	A	A	A
40. Sodium Sulfide	A	B	A	A	A
41. Sulfuric Acid 77%	A	A	C	A	A
42. Sulfuric Acid 96%	C	D	C	A	C
43. Sulfuric Acid 33%	A	A	C	A	A
44. Tincture of Iodine	A	C	B	B	A
45. Toluene[3]	A	A	A	A	A
46. Trichlorethylene[3]	A	A	A	A	A
47. Xylene[3]	A	A	A	A	A
48. Zinc Chloride	A	A	B	A	A
49. Nitric 70%/Sulfuric Acid 77%[2]					

Legend:
A = No effect or slight change in gloss
B = Slight change in gloss or color
C = Slight etching or severe staining
D = Swelling, pitting, or severe etching

Notes:
(1) KMER = Kewaunee Modified Epoxy Resin
(2) Equal parts of Nitric Acid 70% and Sulfuric Acid 77%.
(3) Indicates these solvents tested with cotton and jar method.

S. Fume Hood Bypass System:
   1. All bypass air shall pass through a horizontal perforated 304 stainless steel grille located between the interior top front liner panel and the operating plane of the top sash member.
   2. Laboratory air shall always be the source of bypass air. The front soffet panel, if used, shall be louvered to permit this air flow.

T. Fume Hood Base Cabinets: Standard Steel:
   1. Base units under hoods shall be fabricated of cold rolled prime grade roller leveled furniture steel. Gauges of steel used in construction shall be 18 gauge except as follows:
      a. Corner gussets for leveling bolts and apron corner braces, 12 gauge.
      b. Hinge reinforcements, 14 gauge.
      c. Top and intermediate front horizontal rails, apron rails and reinforcement gussets, 16 gauge.
      d. Door assemblies and adjustable shelves, 20 gauge.
      e. Performance of the painted surfaces shall match that of the fume hood outer panels.

U. Filters and Housings:
   1. Where called for, a filter housing shall be provided above the hoods. The housing shall contain an absolute filter (99.97 percent efficient for 0.3 micron particles) and a furnace type prefilter. The housing shall form a rigid, self-supporting assembly and have a gasketed front cover to allow replacement of the filters without disturbing the ductwork. The filter housing shall be fabricated of cold rolled steel with a chemical resistant finish.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install fume hoods, plumb, level, rigid, securely anchored to building and adjacent furniture in proper location, in accordance with manufacturer's instructions and the approved shop drawings. Provide filler panels between top of hood and ceiling. Securely attach access panels but provide for easy removal and secure reattachment. Do not install any damaged units.

B. Coordinate delivery and installation of equipment with laboratory casework.

C. Plumbing and mechanical work shall be as specified in Sections 15050 and 15400.

D. Electrical connections and distribution shall be as specified in Section 16050.

3.02 FIELD QUALITY CONTROL

A. Fume Hood Manufacturer shall field test a random sample of 20 percent of the installed units using ANSI/ASHRAE 110-1995 to control levels of Al 0.01 ppm and SME 0.05ppm or better.

B. Project substantial completion shall be withheld until all required fume hood certification letters, tests, and reports have been submitted to and approved by the Architect.

3.03 PROTECTION

A. Provide reasonable protective measures to prevent casework and equipment from being exposed to other construction activity.

B. Advise OWNER and/or his representative of procedures and precautions for protection of material, installed laboratory casework and fixtures from damage by work of other trades.

END OF SECTION

SECTION 11635

AUTOMATIC SAMPLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Automatic samplers and accessories.
   1. Tag numbers:
      a. 10-COS-011 - Influent Automatic Sampler.
      b. 50-COS-126 - Sludge Automatic Sampler.
      c. 31-COS-247 - Effluent Automatic Sampler.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.
      b. Section 01740 - Warranties and Bonds.
      c. Section 01782 - Operation and Maintenance Data.
      d. Section 15050 - Basic Mechanical Materials and Methods.

1.02 SYSTEM DESCRIPTION

A. Automatic sequential/composite sampler unit, complete with weatherproof insulated fiberglass enclosure, integral programmable controllers, and accessories.

B. Unit shall be designed for use in highly corrosive environments and shall be corrosion resistant.

C. Unit shall have a dedicated pump.

1.03 SUBMITTALS

A. Submittals shall be as specified in Sections 01330 and 15050.

B. Shop drawings:
   1. Detail drawings or manufacturer's literature to indicate compliance with the specified requirements.
   2. Dimensional drawings.

C. Product Data.

D. Operation and Maintenance Manuals per Section 01782.

E. Warranties.

1.04 WARRANTY

A. The automatic sampler manufacturer shall guarantee that the materials and/or the workmanship of the equipment supplied be free of defects in accordance with Section 01740.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Hach Sigma, Model 900MAX AWR.
   2. Teledyne ISCO, equivalent model.
   3. Manning, equivalent model.

2.02 AUTOMATIC SAMPLER

A. Enclosure:
   1. The sampling units shall have a weatherproof-insulated fiberglass enclosure.
   2. Sampler shall be capable of operating in an ambient temperature range that encompasses 32 to 120 degrees Fahrenheit.

B. Sampler shall be capable of both sequential and composite sampling.
   1. Sampler shall be configured for composite sampling.

C. The samples shall be automatically composited in a minimum 5-gallon polyethylene container located in a refrigerated compartment maintained between 0 and 4 degrees Celsius.

D. Controls:
   1. The sampler shall operate on a flow proportional basis paced by 4 to 20 mA signal.
   2. The sampler shall have a standard 4-20mA input compatible with most flowmeters without additional interfacing.
   3. The thermal system shall be controlled digitally with a microprocessor.

E. Sampling intervals: Capable of taking samples at intervals selectable in single increments from 1 to 9,999 flow pulses or timed intervals selectable in 1 minute intervals up to at least 5,999 minutes between consecutive uniform time intervals.

F. Sample volume: Selectable in 1.0-milliliter increments from 10 milliliters to 9,990 milliliters.

G. A positive purge shall be provided before and after each sampling to prevent clogging and cross-connection.

H. Suction lift: Sampler shall be capable of drawing a sample to a minimum vertical height of 26 feet.

I. Pump:
   1. Peristaltic type.
   2. Pumping rate: Minimum pumping rate shall be 2.0 feet per second through 5/8-inch inside diameter tubing at 15 feet of vertical lift.

J. Power: 120 volt, single-phase, 60 Hertz.

2.03 ACCESSORIES

A. Provide 1 set of the following for each sampler furnished:
   1. 1 spare sample tube.
   2. 10 feet of spare pump tubing.
   3. 1 spare strainer.
   4. 24 extra 1,000-ml polyethylene bottles with rack.
   5. 1 extra 5-gallon polyethylene container.
   6. 1 protective enclosure, Model 6989 by Hach Sigma or equivalent
      a. Constructed of FRP.
      b. Minimum height of 70 inches.
      c. Equipment with a lockable hinged door.
      d. Capable of internal lighting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide, store and install automatic samplers in accordance with the recommendations of the manufacturer.

B. Install each sampler in its protective enclosure, whether the enclosure is shown on the Drawings or not.

END OF SECTION

SECTION 12346

LABORATORY WORK SURFACES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Laboratory work surfaces, including:
   1. Molded epoxy.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 15050 - Common Work Results for Mechanical Equipment.
      b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. American Plywood Association (APA).

B. Architectural Woodwork Institute (AWI).

C. ASTM International (ASTM):
   1. D 570 - Standard Test Method for Water Absorption of Plastics.
   2. D 695 - Standard Test Method for Compressive Properties of Rigid Plastics.
   3. D 785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.
   4. D 790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D. National Electrical Manufacturer's Association (NEMA):
   1. LD 3 - High Pressure Decorative Laminates (HPDL).

1.03 SUBMITTALS

A. Product data.

B. Shop drawings:
   1. Include dimensions, features of construction, performance characteristics, materials, and installation instructions.
   2. Show materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory lists, hardware, hardware location, and schedule of finishes.

C. Samples: Complete range of manufacturer's standard, solid, chemical resistant plastic laminate colors for selection.

D. Special samples:
   1. Full-size sample of proposed cabinet work.
   2. Approved sample will be standard against which work will be evaluated.
   3. Approved sample may be part of Work.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Completion of minimum 10 comparable installations within last 5 years.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Wrap and crate finished components and assemblies at factory to prevent damage or marring of assemblies or surfaces during shipping and handling.

B. Deliver materials to site, unload, and store in designated locations.
   1. Coordinate size of access and route to place of installation.

1.06 PROJECT CONDITIONS

A. Field measurements: Verify field measurements prior to preparing shop drawings.

B. Move in equipment when finishes are completed.

C. Maintain room temperature of at least 65 degrees Fahrenheit for 72 hours before equipment installation begins, and continuously after installation.

PART 2 PRODUCTS

2.01 MOLDED EPOXY WORK SURFACE AND SINKS

A. Manufacturer: One of the following or equal:
   1. Kewaunee Scientific Equipment Corporation, Stateville, NC.

B. Material: Kewaunee “Kemresin,” especially compounded, uniformly mixed and cured modified epoxy resin with following physical properties:
   1. Flexural strength: 15,000 pounds per square inch when tested in accordance with ASTM D 790.
   2. Compressive strength: 35,000 pounds per square inch when tested in accordance with ASTM D 695.
   3. Hardness, Rockwell M: 100 when tested in accordance with ASTM D 785.
   4. Water absorption, percent by weight:
      a. 24 hours: 0.02 when tested in accordance with ASTM D 570.
      b. 7 days: 0.04 when tested in accordance with ASTM D 570.
      c. 2-hour boil: 0.04 when tested in accordance with ASTM D 570.
   5. Specific gravity: 1.97.
   6. Tensile strength: 8,500 pounds per square inch.

C. Fabrication: Mold laboratory work tops to the following sizes and configuration:
   1. 1-inch thick top with exposed edges rounded with 1/4-inch radius, drip grooves on underside of exposed edges.
   2. Curbs/backsplashes: 3/4-inch thick integral 4-inch high curbs with coved juncture between tops and curbs at 3/4-inch radius for standard 24- and 31-inch wide tops, or 1-inch thick curbs bonded to top with square joint.
   3. Sink cutouts: Without saw marks, top edge rounded to 1/8-inch radius and corners rounded to 3/4-inch radius.
   4. Fabricate tops in largest practical sections, minimizing number of joints.

D. Sinks:
   1. Sinks shall have coved inside corners and the bottom pitched to the drain outlet.
   2. Sinks shall be provided with lead stoppers and overflow stoppers. Sink size shall be as indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before installation, check building dimensions and rough-in of services.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Insulate areas between dissimilar metals to prevent electrolysis.

C. Sequence installation and erection to ensure mechanical and electrical connections are effected in an orderly and expeditious manner.

D. Cut, fit, and patch work as necessary, coordinating work fully.

E. Monitor connection of services as specified in Sections 15050 and 16050.

F. Fill joints between molded epoxy countertop sections and between sink and countertop, with acid, alkali, and solvent-resistant material compatible with top to form a smooth integral surface.
   1. Sink installation shall be watertight.

G. Tolerances:
   1. Flatness shall be 1/16-inch for each 48-inch span.
   2. Location of cutouts and drillings shall be within 1/16 inch.
   3. Size of cutouts and drillings shall be within 1/16 inch.

3.03 ADJUSTING AND CLEANING

A. Test, clean, and adjust equipment and apparatus to ensure proper working order and conditions.

B. Do not sand or excessively fill tops to meet tolerances.

END OF SECTION

SECTION 12349

LABORATORY SERVICE FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Water faucets and valves for use at laboratory casework.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 15050 - Common Work Results for Mechanical Equipment.

1.02 REFERENCES

A. National Electrical Code (NEC).

1.03 SUBMITTALS

A. Product data: Include dimensions, features of construction, performance characteristics, and materials.

B. Manufacturer's installation instructions.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Wrap and box finished components and assemblies to prevent damage or marring of assemblies or surfaces during shipping and handling.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Service fittings: One of the following or equal:
   1. Kewaunee Scientific Equipment Corp., Statesville, NC.
   2. Hamilton Manufacturing Co.
   3. St. Charles Manufacturing Co.

2.02 MATERIALS

A. Faucets and valve bodies shall be cast bronze with minimum copper content of 85 percent.
   1. Deionized water faucets and bodies shall be polyvinyl chloride lined.

B. Fittings shall be chromium plated unless otherwise specified.

C. Color index buttons of colored plastic with indented letters.

2.03 WATER FAUCETS

A. Combination hot and cold, with removable and replaceable unit containing all parts subject to wear, compression type valves, swivel type gooseneck outlets equipped with vacuum breakers, and serrated nozzles.

B. Identification: Provide colored index buttons, red for hot water and green for cold water. Model numbers as indicated on the Drawings.

2.04 DEIONIZED WATER FAUCETS

A. Single handle valve shall be chromium-plated cast bronze with the interior tin-lined and shall be the self-closing type.
   1. Model numbers as indicated on the Drawings.

B. Identification: Handles shall be furnished with colored index buttons; white for deionized water.

2.05 HOSE COCKS

A. Gas, air, and vacuum services:
   1. Ground key valve hose cocks for gas, air, and vacuum services shall have forged brass bodies and forged brass tapered plugs with broad flat handles having a minimum length of 2 inches beyond the index.
   2. Model numbers as indicated on the Drawings.

B. Valve bodies shall be individually lapped, ground, and sealed.
   1. The retaining spring shall be made of beryllium copper and shall be the dirt-resistant cup type.
   2. Worm-type springs will not be acceptable.

C. Identification: Handles shall be furnished with colored index buttons:
   1. Blue: For gas.
   2. Orange: For air.
   3. Yellow: For vacuum.

2.06 ELECTRICAL FITTINGS

A. Receptacles: Electrical fittings shall contain 20 amp, 120 volt AC, 3-wire polarized grounded receptacles or 20 amp, 250 volt AC, 2 pole, 3-wire grounded receptacle unless otherwise specified.

B. Pedestal boxes shall be of aluminum metallic finish with stainless steel flush plates.

C. All electrical items furnished under this Section shall meet the requirements of the NEC.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before installation, check that laboratory counters have been factory drilled to accept fitting.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Cut, fit, and patch work as necessary, coordinating work fully with other trades involved.
   1. Monitor connection of mechanical services as specified in Section 15050.

3.03 ADJUSTING AND CLEANING

A. Test, clean, and adjust equipment to ensure proper working order and free from leaks.

END OF SECTION

SECTION 12352

LABORATORY WOOD CASEWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Laboratory wood casework fabricated to manufacturer's standard sizes and configurations.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 15050 - Common Work Results for Mechanical Equipment.
      b. Section 16050 - Common Work Results for Electrical.

1.02 SUBMITTALS

A. Product data: Include dimensions, features of construction, performance characteristics, and materials.

B. Shop drawings: Include floor plans and elevations of assembled casework.

C. Sample:
   1. Full-size sample of proposed cabinetwork.
   2. Accepted sample will be standard against which work will be evaluated.
   3. Accepted sample may be part of Work.

D. Manufacturer's installation instructions.

1.03 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

B. Installer qualifications: Manufacturer-approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Wrap and crate finished components and assemblies to prevent damage or marring of assemblies or surfaces during shipping and handling.

B. Deliver materials to site, unload, and store in designated locations.
   1. Coordinate size of access and route to place of installation.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Move in equipment when finishes are completed.

B. Maintain room temperature of at least 65 degrees Fahrenheit for 72 hours before equipment installation begins, and continuously after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Laboratory casework: One of the following or equal:
   1. Kewaunee Scientific Equipment Corp., Statesville, NC, Model Numbers indicated on the Drawings.

2.02 WOOD

A. Exposed solid wood: Appalachian Red Oak, clear, with color and graining in conformance with standards of Scientific Laboratory Equipment Industry.

B. Conceal solid wood: Hardwood, any species acceptable to manufacturer.

C. Exposed plywood: Consisting of 1/16-inch thick Poplar crossbands, 1/24-inch thick plain sliced, Select, Grade 1, Oak on exposed front face, and 1/24-inch thick sound Oak on back face and with Oak veneer banding on exposed edges.

D. Concealed plywood: Douglas Fir, APA AB, 3-ply for 1/4-inch thick, 5-ply for 1/2-, 3/4-, and 1-inch thick, bonded with exterior grade, phenol formaldehyde adhesive.

E. Fiberboard: Black tempered welded, smooth-faced hardboard, with tensile strength of 4,500 pounds per square inch, shear strength of 3,700 pounds per square inch, and average modulus of rupture of 9,600 pounds per square inch.

F. Hardboard: Minimum 3/16 inches thick with single print on one side.

2.03 GLASS

A. Glass for framed hinged doors:
   1. For framed doors: Minimum 1/8-inch thick float glass.
   2. For hazardous locations: Minimum 7/32-inch thick laminated float glass.

B. Glass shielding fluorescent lights in fume hoods: Minimum 7/32-inch thick laminated tempered float glass.

2.04 HARDWARE

A. Drawer and door pulls: Aluminum with comfortable hand grip, attached to doors or drawers with machine screws on 4-inch centers, with clear, air-dry lacquer finish. Install 2 pulls for drawers wider than 24 inches.

B. Hinges: Chromium plated steel; 5 knuckle institutional heavy-duty type with straight wings, unless offset hinges are required; 2-1/2 inches high; mounted with flathead screws, capable of withstanding weights up to 150 pounds.

C. Locks: Two sets of 4 tumblers locking in opposite splines, operated by cam action without springs, keyable by registered locksmiths only, with finish to match exposed surface of other cabinet trim.

D. Magnetic latches for swinging doors: Enclosed in plastic cases and operating on plated steel strike plate screwed to door.

E. Elbow catches for left hand doors of double door cases where locks are used: Cadmium-plated steel.

F. Drawer stops: Cadmium or chrome-plated steel, mounted on inside back of each drawer, capable of preventing accidental removal of drawer.

G. Label holders: Self-adhering aluminum with satin finish to hold 2-1/2-inch by 1-1/8-inch cards.

H. Number plates: Self-adhering aluminum with indented black lettering as directed.

I. Padlock hasps: Stainless steel or chrome-plated brass, capable or preventing damage to cabinets by padlocks.

J. Leveling devices: 1/2-inch diameter bolts threaded through 1/2-inch tee nut securely screwed to bottom of table or base cabinet legs, or to 1-5/8-inch U-shaped, 12 gauge metal bracket with cadmium-plated steel leveling bolts with hexagonal heads mounted at 4 bottom corners of base cabinets; accessible through cupboard bottoms and drawer openings when installed on base cabinets.

K. Support struts to support drain troughs and other abnormal loads: Two 16-gauge channel uprights fastened top and bottom by 2 adjustable U-shaped spreaders, each 1/8 inch by 1-1/2 inch by length indicated on the Drawings, finished with black acid resistant enamel.

L. Floor glides for movable open-leg tables: Non-marring material at least 1-1/2-inch diameter capable of preventing indenting of composition flooring, with minimum 5/8-inch height adjustment.

M. Shelf standards and support clips:
   1. Mounted on interior of cabinets and cases to provide shelf adjustment on 1/2-inch centers.
   2. Provide additional standard and bracket at center of shelves longer than 48 inches.

2.05 LEG SHOES AND BASE MOLDING

A. Leg shoes: Pliable, 2-1/2 inches high, black vinyl.

B. Base molding: Pliable, 4 inches high, black vinyl, with adhesive backing.

C. Base molding for exposed corners: Pliable, 4 inches high, black vinyl clips, with minimum 2-inch legs, with adhesive backing.

2.06 RODS, ROD SOCKETS, AND CLAMPS

A. Upright rod, cross rods, and ring support rods: 1/2- or 3/4-inch diameter Anodized Duralumin.

B. Rod sockets: Chrome-plated brass, secured through table tops with lock nut and spring washer.

C. Rod clamps: Capable of securely holding rod assembly in any position.

2.07 ACCESSORIES

A. None.

2.08 MOISTURE CONTENT OF WOOD PRIOR TO AND DURING FABRICATION

A. Air-dry wood, then kiln dry wood to moisture content of 4-1/2 percent at fabrication facility, then temper wood to moisture content of 6 percent, and maintain wood at 6 percent during fabrication.

2.09 FABRICATION OF BASE CABINETS WITH SWINGING DOORS AND DRAWERS

A. Fabricate cabinets with solid ends and backs, flush overlap doors and drawers, astragal strip between double swinging doors, and fully enclosed toe space.

B. Wood components:
   1. Top horizontal front and rear member: 1-3/4-inch by 3/4-inch solid wood.
   2. Top horizontal side: 2-inch by 3/4-inch solid wood.
   3. Top horizontal center mullion: 2-1/2-inch by 3/4-solid wood.
   4. Intermediate horizontal front member: 1-3/4-inch by 3/4-inch solid wood.
   5. Intermediate horizontal side: 2-inch by 3/4-inch solid wood.
   6. Intermediate horizontal rear: 1-3/4-inch by 3/4-inch solid wood.
   7. Intermediate horizontal center mullion: 2-1/2-inch by 3/4-inch solid wood.
   8. Bottom panel: 3/4-inch plywood.
   9. Cupboard bottoms: 3/4-inch plywood.
   10. Lock shelf panels: 1/8-inch fiberboard.
   11. Shelves: 3/4-inch plywood.

C. Glue end panels to top and intermediate horizontal frames and plywood bottoms through blind mortise and tenon joints.
   1. Secure joints with countersunk wood screws.
   2. Rabbit cabinet backs into end panels.

D. Install hand removable backs where access to plumbing is required.

E. Install cupboard bottoms.

F. Install lock shelf panels when locks are keyed differently.

G. Provide removable half-width base cabinet shelves.

H. Provide fully enclosed 2-1/2-inch deep by 4-inch high toe space as integral part of cabinet.

I. Install hardware.

2.10 FABRICATION OF DRAWERS

A. Wood components:
   1. Fronts: 3/4-inch plywood with solid core.
   2. Sides and backs: 1/2-inch plywood.
   3. Bottoms: 1/8-inch fiberboard.

B. Size fronts to overlap openings to assure dust proofing of cabinet interior.
   1. Machine sand sides.

C. Mortise, tenon, and glue together drawer sides and fronts under 3 inches in depth, or assemble sides to front with appropriate joinery.

D. Set bottoms into 1/4-inch deep grooves on front, rear, and sides.

E. Install hardware.

2.11 FABRICATION OF DRAWER KEELS

A. Use straight-grained hardwood members for upper and lower keels.

B. Glue and securely fasten upper members to drawer bottoms, and lower members to cabinet horizontal frames.

C. For drawers up to 24 inches wide, provide 1 pair of keels.

D. For drawers over 24 inches wide, provide 2 pairs of keels.

E. Chamfer 1-1/8-inch wide upper member on 30-degree angles to fit 2-inch wide mating lower member.
   1. Rout lower member to receive lock shelf panels.

F. Fabricate keel members for smooth operation.

2.12 FABRICATION OF COUNTER MOUNTED OR WALL HUNG SWINGING DOOR CASES

A. Fabricate counter-mounted or wall-hung swinging door cases in accordance with requirements for swinging door cases, except size doors to overlap openings; and hang 48-inch high and higher doors with 3 hinges or doors up to 48 inches high with 2 hinges.

2.13 METAL SUPPORT SYSTEMS FOR WOOD CASEWORK

A. Fabricate cases and cabinets for cantilever or suspended mounting from support core structure.

B. Include necessary latching bolt mechanisms or other special features necessary for type of support system.

C. Fabricate units so that unit and latching bolt mechanism will carry normal loads without excessive defection, and so that units are readily mounted or removed from support core.

D. Fabricate units so that units are completely finished at front and both ends to allow location in any position in assembly.

2.14 FINISHING

A. Smoothly sand case and cabinet surfaces to remove loose fibers, scratch marks, and abrasions.
   1. Remove dust thoroughly with compressed air.

B. Apply finishes under controlled atmospheric conditions. Cure finish in modern humidified oven at 140 degrees Fahrenheit and 30 percent relative humidity.

C. Finish interior surfaces and unexposed exteriors with double-pass coat of resinous wood sealer.
   1. Thoroughly wax drawer glides and keels.

D. Finish exposed exterior surfaces of case and cabinets with acid, alkali, solvent, water, and abrasion-resistant finish.
   1. Coat surface with non-fiber lifting stain or toner to secure desired color. Allow color coat to dry thoroughly.
   2. Apply first sealer coat, allow it to dry thoroughly, sand it, and dust it carefully with tack rags.
   3. Apply second sealer coat and allow it to dry thoroughly.
   4. Apply double pass coat of chemical-resistant synthetic varnish capable of providing semi-gloss finish and allow it to dry thoroughly.

E. Finish shall withstand the following tests without effect to slight allowable change in gloss and slight discoloration:
   1. Apply 5 drops of following reagents with following percentages by weight to surface and cover drop with watch glass for 60 minutes at from 74 to 80 degrees Fahrenheit:
      a. 28 percent Ammonium Hydrozide.
      b. 99 percent Glacial Acetic Acid.
      c. 37 percent Hydrochloric Acid.
      d. 30 percent Nitric Acid.
      e. 75 percent Phosphoric Acid.
      f. 40 percent Potassium Hydroxide.
      g. 40 percent Sodium Hydroxide.
      h. 10 percent Sodium Hydroxide.
      i. 70 percent Sulfuric Acid.

2. Flush reagents from surface with water, scrub surface with soft bristle brush under running water, rinse surface, and allow surface to dry.
3. After from 16 to 24 hours, scrub surface with damp paper towel, dry surface with paper towel, and evaluate surface.
4. Saturate 1-inch cotton ball with the following solvents, place on surface, and cover cotton ball with inverted 2 ounce wide mouth bottle for 60 minutes at from 74 to 80 degrees Fahrenheit:
   a. Acetone.
   b. Carbon Tetrachloride.
   c. Ethyl Acetate.
   d. Ethyl Alcohol.
   e. Ethyl Ether.
   f. Gasoline.
   g. Methyl Ethyl Ketone.
   h. Naphtha.
   i. Toluene.
5. Flush reagents from surface with water, scrub surface with soft bristle brush under running water, rinse surface, and allow surface to dry.
6. After from 16 to 24 hours, scrub surface with damp paper towel, dry surface with paper towel, and evaluate surface.

F. Finish shall withstand trickling of hot water, from 190 to 205 degrees Fahrenheit, on finish set at 45-degree angle from horizontal for 5 minutes with no visible effect after cooling and wiping dry.

G. Finish shall withstand placement of 2-inch by 3-inch by 1-inch cellulose sponge soaked with water on finish for 100 hours with no visible effect after wiping dry.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before fabrication, check building dimensions and rough-in of services.
   1. Starting work means acceptance of other in-place work.

3.02 INSTALLATION

A. Install products in accordance with the manufacturer's instructions.

B. Insulate areas between dissimilar metals to prevent electrolysis.

C. Sequence installation and erection to ensure mechanical and electrical connections are effected in an orderly and expeditious manner.

D. Cut, fit, and patch work as necessary, coordinating work fully with other trades involved.

E. Monitor connection of services mechanical and electrical services as specified in Sections 15050 and 16050.

3.03 ADJUSTING AND CLEANING

A. Test, clean, and adjust equipment and apparatus to ensure proper working order and conditions.

END OF SECTION

SECTION 13110

WATER STORAGE TANK CATHODIC PROTECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Design, furnish, install, energize, test, and adjust:
      a. Impressed current cathodic protection system to provide control of corrosion to interior submerged surfaces of water storage tank.
      b. Sacrificial cathodic protection system to provide control of corrosion to underside of water tank floor.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.
      b. Section 01660 - Testing, Training, and Commissioning.
      c. Section 01740 - Warranties and Bonds.
      d. Section 01770 - Closeout Procedures.
      e. Section 01782 - Operation and Maintenance Data.

1.02 REFERENCES

A. ASTM International (ASTM).

B. American Water Works Association (AWWA):
   1. D104 - Automatically Controlled, Impressed Current Cathodic Protection for the Interior of Steel Water Tanks.

C. NACE International (NACE):
   1. SP0388 - Impressed Current Cathodic Protection of Internal Submerged Surfaces of Carbon Steel Water Storage Tanks.

D. National Electrical Code (NEC).

E. National Electrical Manufacturers Association (NEMA):
   1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

F. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

G. Underwriters' Laboratories, Inc. (UL).

1.03 DEFINITIONS

A. NEMA Type 3R enclosures in accordance with NEMA 250.

1.04 SYSTEM DESCRIPTION

A. Cathodic protection system for control of corrosion on interior submerged surfaces of water tank shall be automatic potential controlled type with rectifier, platinized niobium wire anodes, copper-copper sulfate reference electrodes, plus all associated hardware, fittings, wiring, and other items required as specified:
   1. Anodes shall be installed in vertical fashion or in horizontal (hoop) fashion, as determined most efficient in providing adequate and even current distribution throughout water tank.
   2. System shall account for the various metals, coatings, and other materials in the protected area and volume.

B. Cathodic protection system for control of corrosion on underside (soil side) of water tank floor shall be sacrificial magnesium ribbon anode type installed in grid system or circular fashion, with all associated hardware, connectors, fittings, wiring, and other items as specified.

1.05 SUBMITTALS

A. General: Submit as specified in Section 01330.

B. Shop drawings:
   1. Complete fabrication, assembly; installation drawings, wiring and schematic diagrams; details, specifications, and data covering materials used.
   2. Indicate materials and methods of construction of systems components, and proposed methods of equipment mounting with sufficient supporting data for ENGINEER to verify that acceptable performance may be expected from systems as proposed.

C. Product data:
   1. Calculations indicating electrical resistance at interface between impressed current anode system and water in tank will be acceptable, and that anticipated anode life will conform to these Specifications.

D. Design data: Submit calculations of direct current and voltage ratings for rectifier unit prior to ordering rectifier unit.

E. Submit following reports:
   1. Report of initial and final adjustments to systems as specified in Field Quality Control.

F. Submit following as specified in Section 01770:
   1. Operation and maintenance data as specified in Section 01782:
      a. Submit operations and maintenance manuals.
      b. Provide manuals that describe operation and calibration of impressed current system that are suitable to be placed inside rectifier cabinet in a plastic wrap.
      c. These additional manuals shall include a place to note when system checks and calibrations are scheduled and conducted.

G. All materials in contact with water or exposed to interior of water tank shall be classified in accordance with NSF 61.

1.06 QUALITY ASSURANCE

A. Design:
   1. Cathodic protection systems shall be designed by a registered corrosion engineer or corrosion specialist certified by the NACE as a Senior Corrosion Technologist or Cathodic Protection Specialist with not less than 5 years experience with cathodic protection systems for water storage tanks.

B. Design parameters:
   1. Impressed current system for interior submerged surfaces of water tank shall include but not limited to:
      a. Total submerged surface area, including walls, floor, columns, ladders, piping, and all other appurtenances to high water level;
      b. Type and condition of coating, including estimated efficiency of coating over 20 years;
      c. Minimum protective current density of 0.5 milliamp per square foot bare surface area;
      d. Chemical analysis of water, including resistivity expressed as ohm-cm.
      e. Minimum anode service life of 20 years.
      f. Take into account internal tank appurtenances including internal coating, sample taps, mixer, and chlorine injection point.
   2. Sacrificial anode system for underside (soil side) of water tank floor, shall include but not be limited to:
      a. Total surface area to be protected.
      b. Resistivity of tank base material to be in contact with tank floor.
      c. Resistivity of material in which sacrificial anode material will be placed.
      d. Minimum anode service life of 30 years.

C. Construction/installation:
   1. All work shall be accomplished under supervision of CONTRACTOR's corrosion engineer or corrosion specialist.
   2. Installers of cathodic protection systems shall be technically competent and have experience with similar installations.

D. Regulatory requirements:
   1. All materials, workmanship, and installation shall conform with all requirements of legally constituted authorities having jurisdiction. These authorities include, but are not limited to:
      a. NEC.

b. General Construction Safety Orders of Industrial Accident Commission.
c. All other applicable state, county, and city codes and regulations.

E. Environment:
1. All equipment shall be suitable for mounting and operation in an exposed outdoor location subject to elements including direct sunlight.

1.07 WARRANTY

A. In addition to the warranty specified in General Conditions, provide an additional warranty from cathodic protection supplier to the OWNER that will warrant cathodic protection system for a period of 5 years after expiration date of Contract warranty, as specified in Section 01740.

B. Under terms of additional warranty, cathodic protection supplier shall repair or replace, without cost to OWNER, parts of cathodic protection system that fail during operation under any conditions which might be expected to arise in cathodic protection service.
1. This excludes damage from vandalism or accidental damage by OWNER.

C. Coordinate repairs or replacements under warranty with OWNER's personnel.
1. Accomplish repairs or replacements within 30 calendar days after notification by OWNER that system is not performing as specified.

D. If repairs within 30 calendar days will interfere unacceptably with OWNER's operation, accomplish repairs at a mutually acceptable later date.
1. Delay shall not relieve cathodic protection supplier of his obligation to make repairs without cost to OWNER.

1.08 MAINTENANCE

A. Operation and maintenance instructions:
1. The CONTRACTOR's corrosion specialist shall prepare and submit Operation and Maintenance instructions to the ENGINEER, for subsequent use by the OWNER's maintenance personnel.
2. The Operation and Maintenance instructions shall contain a detailed description of the operation of the cathodic protection systems, with recommendations and instructions for testing and maintaining the systems.

PART 2 PRODUCTS

2.01 IMPRESSED CURRENT SYSTEM

A. Rectifier:
1. Air cooled, automatic potential controlled unit, with following features:
a. Transformer shall have primary and secondary windings and shall include the following:
1) Not less than 20 incremental settings from 0 percent to 100 percent of full rating of rectifier unit.
2) Pre-heated varnish dipped and baked dry for maximum moisture and corrosion resistance.
3) Mounted securely within cabinet behind front instrument panel.

b. Silicon full-wave bridge rectifying elements.
c. AC circuit breaker of magnetic type.
d. Lightning, surge, and overload protection on both alternating current and direct current.
e. Individual voltmeter and ammeter.
f. Waterproof stainless steel cabinet in accordance with NEMA Type 3R enclosure requirements.
g. Provisions for mounting, grounding, and locking.
h. Provision to vary current output from 0 percent to 100 percent or rated capacity.
i. Provision for 120 or 240 volt, 60 hertz, single-phase alternating current power.
j. DC output capacity in volts and amperes in accordance with design.
k. Automatic controller shall be AWWA D104, Type A and shall adjust current output to compensate for changes in water level, temperature of water, water chemistry, and cathodic polarization, and shall include following provisions:
    1) Utilize long-life solid matrix copper-copper sulfate reference electrode(s) mounted within tank.
    2) Monitor tank-to-water potential, free of IR drop, to a preset value.
    3) Operate within 25 millivolt of preset value.
    4) Automatically limit current to preset value.
    5) Utilize potential meter to display tank-to-water potential, free of IR drop.
        a) Potential meter shall be analog type having a 2-inch or larger scale with full-scale readings of 1.5 volts or digital display.
    6) Provisions for cooling, if needed.

B. Anode assemblies:
1. Anode material:
a. Platinized niobium wire, minimum 0.062-inch diameter, with not less than 25 micro inches platinum.
2. Anode lead wires:
a. Minimum Number 8 American Wire Gauge (AWG), 7 strand, single conductor copper, with high molecular weight polyethylene insulation.
3. Anode suspension material:
a. Polyester cord, minimum 5/16-inch diameter size.

C. Reference electrodes:
1. Type:
a. Copper-copper sulfate, solid matrix design, guaranteed to remain stable (plus or minus 10 millivolts) for a minimum service live of 10 years.
2. Lead wires:
a. Minimum Number 14 AWG, stranded copper, single conductor, with high molecular weight polyethylene insulation.

D. Pressure entrance fittings:
1. Shall be designed to accommodate anode and reference electrode lead wires from interior of tank to rectifier unit on exterior of tank.
a. Size shall be 1-1/2 inch or smaller and have a minimum factory rating of 300 pounds per square inch.

E. Hand hole assemblies:
   1. Shall consist of a 6-inch diameter galvanized steel cover plate, rubber gasket, and a galvanized steel bar held in place by a 1/2-inch stainless steel bolt.

F. Miscellaneous:
   1. All metallic hardware used in conjunction with system shall be galvanized, cadmium-plated or coated as accepted by ENGINEER to protect against corrosion.

2.02 SACRIFICIAL ANODE SYSTEM

A. Anodes:
   1. Magnesium ribbon anode, galvomag alloy, high current output type, extruded on continuous steel wire core approximately 0.135-inch diameter, with cross section of 3/8 by 3/4 inch.
   2. Shall comply with following chemical composition:

Element	MG-MN Alloy
Aluminum	0.010 maximum
Zinc	None
Manganese	0.50-1.30
Copper	0.02 maximum
Silicon	None
Iron	0.03 maximum
Nickel	0.001 maximum
Others	0.05 each
Magnesium	Balance

B. Cables:
   1. Number 8 AWG, stranded copper, single conductor with high molecular weight polyethylene insulation.

C. Miscellaneous:
   1. All associated items such as electrical connectors, tapes, conduits and fittings, enclosures, and other shall be in accordance with ASTM and UL Standards.

PART 3 EXECUTION

3.01 INSTALLATION

A. Materials and equipment shall be inspected prior to installation.
   1. Any defective components shall be repaired or replaced.

B. Cathodic protection systems shall be installed in accordance with drawings submitted by CONTRACTOR that have been reviewed and returned without exception by the ENGINEER.

3.02 FIELD QUALITY CONTROL

A. Energizing, adjusting, and testing impressed current cathodic protection system:
   1. When construction is completed and tank is filled to normal capacity a native state structure-to-electrolyte potential survey inside reservoir shall be made by the Corrosion Specialist before energizing system.
   2. Survey shall be made using a portable copper-copper sulfate reference electrode and a voltmeter with a minimum input impedance of 10 megaohms.
      a. Structure-to-electrolyte potential survey shall consist of measuring and recording potential of water tank wall at test holes adjacent to wall, while lowering portable reference electrode from top of tank to floor.
      b. Potential measurements shall be taken at 1-foot intervals from water level to floor.
   3. Upon establishing native state conditions, rectifier shall be energized and adjusted to ensure that all potentials inside reservoir meet criteria of cathodic protection as specified in NACE SP0388. Another complete potential survey shall than be made at final rectifier output.
   4. An in-service report including structure-to-electrolyte surveys and rectifier output shall be provided to ENGINEER.
   5. After cathodic protection system is tested and accepted by ENGINEER, cathodic protection system shall be turned off and left off for first service year of water tank.
   6. Cathodic protection system shall be re-energized, tested, adjusted, and set for continuous operation after first year inspection of internal coating system has been completed and accepted.
   7. Submit test reports to ENGINEER describing tests and test results for each test phase.

B. Energizing and testing sacrificial anode cathodic protection system:
   1. Before connecting magnesium ribbon anode system under tank floor-to-tank structure, conduct native state potential survey by measuring potential of tank bottom with respect to a portable copper-copper sulfate reference electrode in contact with soil as close as possible to tank.
      a. Potential measurements shall be made and recorded at no less than 6-feet intervals around perimeter of tank.
   2. Connect sacrificial anode system to tank inside test box or enclosure installed for this purpose.
   3. After a polarization period of at least 2 hours, measure and record anode current flow to tank.
   4. Repeat potential survey around perimeter of tank, measuring and recording tank-to-reference electrode potentials at same locations where native state potential measurements were taken.
   5. Submit test reports to ENGINEER describing tests and test results for each test phase.

C. Provide a minimum of 8 hours of on-site training in system calibration, operation, and maintenance during Testing Phase and Commissioning Phase as per Section 01660.

END OF SECTION

SECTION 13112

PIPELINE CORROSION MONITORING FACILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Pipeline corrosion monitoring facilities, including pipe joint bonding, pipe flange insulation, corrosion monitoring test stations, and associated equipment, materials, and miscellaneous items.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

B. ASTM International (ASTM):
   1. B 6 - Standard Specification for Zinc.

C. NACE International (NACE):
   1. SP0169 - Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
   2. SP0286 - Electrical Isolation of Cathodically Protected Pipelines.

1.03 DEFINITIONS

A. Ferrous metal pipe: Any pipe made of steel or iron as well as containing steel or iron as a principal structural material, except reinforced concrete pipe and concrete cylinder pipe.

B. Foreign-owned structure: Any buried pipe or cable not specifically installed under this Contract.

C. Lead, lead wire, joint bonds, cable, conductor, insulated copper conductor: The same as wire.

D. Electrically continuous pipeline: A pipeline which has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable bond resistance for each joint as specified in this Section.

E. Electrical isolation: The condition of being electrically isolated from other metallic structures including, but not limited to, pipe, reinforcement, and casing, and the environment as defined in NACE SP0169.

1.04 SUBMITTALS

A. Submittals prior to starting construction:
   1. Three sets of catalog data for the manufactured items of materials, equipment, components, and test equipment to be used in the work described in this Section and indicated on the Drawings. Include:
      a. Specific performance data.

b. Material descriptions, ratings.
c. Capacities.
d. Brand names.
e. Catalog or part numbers.
f. General or specific types.
g. All other pertinent information and data.

2. Include the following items:
   a. Factory-installed pipe joint bonding equipment.
   b. Pipe joint bonding cables.
   c. Test station boxes and terminal boards.
   d. Test station cables.
   e. Exothermic welding equipment.
   f. Exothermic weld caps.
   g. Coal tar mastic coating.
   h. Zinc reference electrodes.
   i. Pipe flange insulation materials.
   j. Testing instruments and equipment.
   k. Testing plans and schedule.
3. Ensure that items furnished fit the space available.
   a. Make necessary field measurements, including those for connections, and order such sizes and shapes of equipment in order that the final installation suits the true intent and meaning of the drawings and specifications.
4. Where equipment requires different arrangement of connections from those indicated on the Drawings, install the equipment to operate properly and in accordance with the intent of the Drawings and specifications.
   a. Make all changes in the Work required by the different arrangement of connections.

B. Contact closeout submittals:
   1. Upon acceptance of the submittals, furnish 3 final copies of catalog data of materials, equipment, and components together with operating and maintenance instructions.

1.05 QUALITY ASSURANCE

A. Regulatory requirements: All materials, workmanship, and installation shall conform with all requirements of the legally constituted authorities having jurisdiction. These authorities include, but are not limited to:
   1. The National Electric Code.
   2. General Construction Safety Orders of the Industrial Accident Commission.
   3. All other applicable Laws and Regulations.

B. Nothing in the Drawings or this Section is to be construed to permit work not conforming to the above-referenced regulations and codes.
   1. Where larger size or better grade materials than required by these regulations and codes are specified, the Drawings and this Section shall have precedence.
   2. Obtain any required permits and inspections.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store all materials and equipment in such a manner as to protect from the detrimental effects of the elements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe joint bonding cables:
   1. Number 2 American Wire Gauge (AWG) stranded copper, single conductor, with high molecular weight polyethylene insulation designed for direct burial and cathodic protection use.
   2. Provide sufficient length for minimum slack of 2 feet to avoid stress during the backfilling of the pipe, and in the event of pipe deflection and/or movement.
   3. Equip cables with a tinned copper crimp-type ring terminal on each end for connection to the threaded bosses on the bell and spigot ends of the pipe sections.
      a. Terminal: Manufacturers: One of the following or equal:
         1) Thomas & Betts Corporation, Edison, New Jersey, STA-KON #G2-12.
   4. Connect the pipe joint bonding cables to the threaded bosses using monel alloy hex head national course threaded bolts, 1/2-inch diameter by 2 inches long each, and monel alloy flat washers.

B. Corrosion monitoring test stations:
   1. Flush mount type test stations: Each test station shall include the following:
      a. Housing boxes: 12 by 12 by 12 inches deep "PC" service box, open base type, complete with heavy-duty steel or cast iron traffic cover.
         1) Imprint top of cover shall be "CORROSION TEST STATION."
         2) Manufacturers: One of the following or equal:
            a) Hubbell Power Systems, Inc., Shelton, Connecticut, Model No. PC1212BG12.
      b. Test boxes: Cast aluminum suitable for mounting on 2-inch diameter rigid polyvinyl chloride conduit.
         1) Manufacturers: One of the following or equal:
            a) Gerome Electric Supply Co., Uniontown, Pennsylvania.
         2) Cover: Cast aluminum with locking mechanism.
         3) Terminal block: 8 terminal type of glass-reinforced laminated plastic mounted inside test box, with nickel-plated brass terminal studs (non-turning), nuts, lockwashers, and shorting straps.
      c. Polyvinyl chloride conduit: Schedule 80, 2 inches diameter by 36 inches long.

C. Test station cables:
   1. Number 10 AWG stranded copper, single conductor, with XHHW insulation of the color as indicated below.
      a. Test station cable insulation shall indicate the source or type of pipeline or structure each represents when terminated inside the test stations, as follows:
         1) WHITE - Pipeline being constructed under this Contract.
         2) BLUE - Water line.

3) GREEN - Sewer line.
4) YELLOW - Gas line.
5) RED - Casing.

b. The test cable color shall be impregnated in the insulation material. Colored tape or paint will not be acceptable.

c. Where 2 sets of test cables of the same color from 2 pipelines of the same type are terminated in the same test station, identify 1 set or distinguish from the other set by means of the installation of heat shrink sleeves on the cables.
   1) The heat shrink sleeves shall be 12 inches long each placed on the cables a minimum of every 8 feet from the pipeline to the test station.
   2) The color of the heat shrink sleeves used for this purpose shall be black.

d. In addition to the heat shrink sleeve identification, where 2 sets of the same color test cables are terminated in the same test station, label both sets of cables inside the test station to distinguish 1 set from the other.

D. Test station cable terminals:

1. For connecting corrosion monitoring test station cables to the pipeline being constructed under this Contract, install crimp-type ring terminals (1/2-inch diameter, tinned copper) on the ends of the cables.
   a. Terminals for Number 10 AWG Cable:
      1) Manufacturers: One of the following or equal:
         a) Thomas & Betts Corporation, Edison, New Jersey, STA-KON No. 10-12.
2. For terminating the cables inside the corrosion monitoring test stations, use crimp-type ring terminals that are 1/4-inch diameter, tinned copper.
   a. Terminals for Number 10 AWG Cable:
      1) Manufacturers: One of the following or equal:
         a) Thomas & Betts Corporation, Edison, New Jersey, STA-KON No. C10-14.

E. Exothermic (thermite) weld equipment:

1. General:
   a. Use exothermic (thermite) welding to attach corrosion monitoring test station cables to existing metallic pipelines crossed by the pipeline being constructed under this Contract using exothermic (thermite) welding.
   b. Equipment and weld material:
      1) Manufacturers: One of the following or equal:
         a) ERICO Products, Inc. (CADWELD), Cleveland, Ohio.
   c. Interchanging of thermite weld materials from different manufacturers will not be allowed.
   d. The welder size and type, the weld metal charge size and type, and the associated items used shall be as determined and recommended by the manufacturer in accordance with the following parameter:
      1) Pipe material (i.e., steel, cast iron, ductile iron).
      2) Pipe size (diameter) and wall thickness.
      3) Cable size.
      4) Orientation of weld connection.

2. Equipment:
    a. Molds:
        1) Molds must be constructed of graphite.
        2) Ceramic "one-shot" molds will not be acceptable.
    b. Adaptor sleeves:
        1) Provide sleeves for Number 10 AWG cable, and Number 2 AWG joint bond cables.
        2) Prefabricated factory sleeved joint bonds or bond cables with formed sleeves made in the field are acceptable.
        3) Attach field-formed joint bond sleeves with the appropriate size and type of hammer die provided by the thermite weld manufacturer.
    c. Cartridges:
        1) Use cast iron thermite weld cartridges for all cast and ductile iron pipes and fittings.
        2) Maximum cartridge size: 25 grams for steel and 32 grams for cast and ductile iron materials, respectively.

F. Thermite weld caps: Weld caps used to cover finished exothermic weld connections of test cables to pipes:
    1. Install weld caps using the appropriate primer in strict accordance with the manufacturer's recommendations.
    2. Manufacturers: One of the following or equal:
        a. Royston Laboratories, Inc. Pittsburgh, Pennsylvania, Handy-Caps.

G. Coal tar mastic coating:
    1. Manufacturers: One of the following or equal:
        a. Tapecoat Company, Evanston, Illinois, Tapecoat TC Mastic.

H. Zinc reference electrodes:
    1. 4 by 1.4 by 9 inches long, cast of high purity zinc in accordance with ASTM B 6.
    2. Supply the zinc reference electrodes packaged in permeable cloth bags containing the following:
        a. 50 percent bentonite.
        b. 50 percent gypsum.
    3. Supply each zinc reference electrode with a 100 foot long lead wire of Number 10 AWG stranded copper, single conductor, with yellow XHHW insulation.
    4. Connect the lead wire to the steel core of the zinc reference electrode by silver soldering.
        a. Epoxy encapsulate or tape wrap the connection to ensure waterproofing.
        b. Provide connection stronger than the Number 10 AWG cable being used.

I. Pipe flange insulation materials:
    1. Manufacturers: One of the following or equal:
        a. Central Plastics Company, Shawnee, Oklahoma.
    2. Flange gasket: Type "E" full flange face type, constructed of neoprene faced phenolic, of proper size and ANSI pressure rating as required.
    3. Insulating sleeves: Mylar, 1/32-inch thick, of proper size to fit flange bolts; 1 sleeve required for each bolt.
    4. Insulating washers: G3 glass phenolic, 1/8-inch thick, of proper size to fit flange bolts. 2 washers are required for each bolt.
        a. For insulated pipe flanges that will be buried, use stainless steel bolts and nuts instead of standard carbon steel parts.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Furnish and install all materials and equipment associated with pipe joint bonding, corrosion monitoring stations, and insulated flanges as indicated on the Drawings and described in this Section.
      a. Bond all pipe joints for all buried ferrous metal pipe and provide corrosion monitoring stations as indicated by the ENGINEER or in this Section.
      b. Install all items as specified and indicated on the Drawings. Any changes in the design or method of installation of an item as specified and indicated on the Drawings must be accepted prior to installation.
      c. Coordinate the installation of the various components to coincide with other construction phases of the Project so that installation of the items in this Section can be completed in the most efficient and expedient manner.

B. Special techniques:
   1. General:
      a. In order to form an electrically continuous pipeline facility in the areas required, bond buried and aboveground pipe joints as specified.
         1) Included in the specified electrically continuous pipeline sections, bond all vault and manhole piping and fittings as necessary.
         2) Pipe joints that are to be field welded for restraining purposes, as specified, will not require bonding.
      b. Each bonded pipe joint shall be tested as specified under paragraph "Testing During Construction."
   2. Ductile iron pipe:
      a. Bond all ductile iron pipe joints, except as indicated on the Drawings and as specified in this Section, to provide complete electrical continuity along the pipeline system.
      b. Install 2 bonding cables across each pipe joint using the exothermic welding process in accordance with the manufacturer's instructions and recommendations, and as specified elsewhere in this Section.
      c. Bond pipe couplings and expansion fittings in strict accordance with the details indicated on the Drawings, ensuring that rings, spools, center pieces, and other associated parts are connected.
      d. Bonding cable connections on the ductile iron pipe joints and associated fittings shall be inspected by the ENGINEER before the application of coating and the backfilling of the pipe.
         1) Coat the bonding cable connections using thermite weld caps and coal tar mastic as indicated on the Drawings and specified elsewhere in this Section.
   3. Black steel pipe:
      a. Bond all black steel pipe joints, except as indicated on the Drawings and as specified in this Section, to provide complete electrical continuity along the pipeline system.
      b. Install 2 bonding cables across each pipe joint using the exothermic welding process in accordance with the manufacturer's instructions and recommendations, and as specified elsewhere in this Section.

c. Bond pipe couplings and expansion fittings in strict accordance with the details indicated on the Drawings, ensuring that rings, spools, center pieces, and other associated parts are connected.
d. Bonding cable connections on the black steel pipe joints and associated fittings shall be inspected by the ENGINEER before the application of coating and the backfilling of the pipe.
1) Coat the bonding cable connections using thermite weld caps and coal tar mastic as indicated on the Drawings and specified elsewhere in this Section.

C. Corrosion monitoring test stations:
1. General:
a. Install corrosion monitoring test stations along the pipeline system in accordance with the Drawings and this Section:
1) Position each test station off the streets and in protected, accessible locations, as accepted by the ENGINEER.
2) Connect test station cables to the various pipeline structures in accordance with the Drawings and this Section.
3) Connect test station cables inside the test boxes using crimp-type ring terminals of the size required and the type specified in this Section.
4) Place underground cable runs installed less than 24 inches below the finish grade in conduit.
2. Flush mount test stations:
a. Install the flush mount test stations in accordance with the Drawings and this Section.
b. Install the 12-inch by 12-inch by 12-inch service boxes even with the finish grade and bed in pea gravel.
1) The pea gravel shall be a minimum of 6 inches deep.
2) The pea gravel inside the service box shall be no higher than 2 inches above the bottom of the box.
c. The 2-inch diameter polyvinyl chloride conduit installed inside the box shall extend no more than 3 inches above the bottom of the box.
1) The top of the polyvinyl chloride conduit shall be trimmed smooth and flat.
d. The test station terminal box or boxes (as required), complete with terminal boards, hardware, and cover(s), shall be laid inside the service boxes, but shall not be installed on the polyvinyl chloride conduit.
e. The test cables terminated inside the test station terminal boxes shall each have a sufficient coil of slack cable to allow the test station terminal boxes to be lifted out of the service boxes for a minimum distance of 18 inches.

D. Exothermic welding procedures:
1. The connection of copper cables, including bonding cables and test station cables, to steel and ductile iron surfaces shall be made by the exothermic (thermite) weld method.
a. Observe proper safety precautions, welding procedures, exothermic weld material selection, and surface preparation as recommended by the welding equipment manufacturer.

b. Ensure that the pipe or fitting wall thickness is of sufficient thickness that the exothermic weld process will not damage the integrity of the pipe or fitting wall or protective lining.

2. Before each connection is made, clean the surface to bare metal by making a minimum 2-inch by 2-inch window in any previously applied pipeline coating, and then file or grind the surface to produce a bright metal finish.
   a. Accomplish grinding with a vitrified type grinding wheel.
      1) The use of a resin, rubber, or shellac impregnated type grinding wheel will not be acceptable.
   b. The prepared metal surface shall be dry.
3. Install copper sleeves on the ends of the cables before welding to the metal surface.
   a. Remove only sufficient insulation from the cables to allow the installation of the copper sleeves and proper placement in the welder mold.
   b. Perform thermite welding in strict accordance with the manufacturer's written instructions.
   c. After the weld connection has cooled, remove all slag by wire brushing, and physically test the cable connection by several sharp blows with a hammer.
      1) Remove and replace any defective connections.
   d. After the weld is completed, trim cable insulation smooth prior to coating.
      1) Clean welds and surrounding area free of slag and dirt prior to coating.
   e. The completed weld connections shall be inspected and accepted by the ENGINEER before final coating of the welds and backfilling of the pipe.
4. Following the cleaning and testing of each weld, install a prefabricated thermite weld cap over the weld connection area.
   a. Use the proper weld cap primer for the installation of the weld cap, in strict accordance with the manufacturer's specifications and recommendations.
   b. Following the installation of the thermite weld cap, coat the entire cable connection weld area with 2 coats of coal tar mastic, in accordance with the manufacturer's specifications and instructions.
      1) Allow sufficient time between the coating applications to provide proper curing of the coating.
      2) Apply sufficient coating to ensure that any exposed metal, including copper cable, is completely covered.
5. Completed pipe joint bonding connections and test station cable connections shall be inspected and accepted by the ENGINEER prior to the backfilling of the pipe.

E. Cable splicing and insulation repair:
   1. Cable splicing will not be allowed, except as accepted by the ENGINEER.
      a. Make acceptable cable splices using a suitable sized copper alloy compression connector as accepted by the ENGINEER, or by mechanically securing and solder with a 50/50 rosen cure solder.
         1) The completed splice shall be inspected and accepted by the ENGINEER, after which it shall be spiral wrapped with 2 layers of high voltage rubber insulating tape using a 50 percent overlap during the wrapping.
         2) Cover the rubber splicing tape wrap with 2 layers of a high quality vinyl electrical tape, also applied with a 50 percent overlap.

2. Any damage to cable insulation shall be inspected by the ENGINEER to determine whether repairs to the insulation can be made or the cable must be replaced.
    a. If accepted by the ENGINEER, repairs to damaged cable insulation shall be made in the following manner:
        1) Thoroughly clean the cable in the area of the insulation damaged to remove all dirt, grease, and other materials.
        2) Wrap the cable with a minimum of 2 layers of high voltage rubber tape for a distance of at least 4 inches beyond the insulation damage area in both directions.
            a) The tape wrapping shall be made in a spiral manner using a minimum 50 percent overlap.
        3) Completely cover the high voltage rubber tape wrapping with a minimum of 2 layers of good quality vinyl electrical tape, for a distance of 4 inches beyond the high voltage rubber tape wrapping in both directions.
            a) Apply the vinyl electrical tape in a spiral manner using a minimum 50 percent overlap.

F. Zinc reference electrodes:
1. Install the zinc reference electrodes at the location and in the manner as indicated on the Drawings.
    a. Place the reference electrodes at a maximum distance of 12 inches from the pipe.
    b. Do not handle the reference electrodes or lower by the cable.
    c. Remove plastic or paper bags used for protection during shipping from the reference electrode before installation.
    d. Place native soil free of rocks and clods around the reference electrode in 6-inch lifts and well compacted.
        1) When compacted soil has been placed on the top of the reference electrode, pour water into the hole to saturate the reference electrode, the backfill, and the surrounding soil.
    e. Continue backfilling with soil compacted in 6-inch lifts to the ground surface.
    f. Any damage caused to the reference electrode or its components will require replacement of the entire assembly.

G. Cable installation:
1. Install buried cables straight without kinks, and a minimum cover of 24 inches.
    a. Install test station cables with less than 24 inches of ground cover in rigid polyvinyl chloride conduit, as accepted by the ENGINEER.
    b. The bottom of the cable trench shall be free from stones, roots, or other materials that might damage the insulation of the cables.
    c. Install cables in conduit from the top of the pipe to the test boxes where backfill may damage the cables.
2. Each cable shall be continuous in length and free of splices unless otherwise specified or accepted by the ENGINEER.
    a. Use care during installation to avoid abrasions, punctures, cuts, or any other damage to cable insulation.
    b. Repair or replace any damage to insulation.

H. Cable warning tape:
   1. All buried cables (except pipe joint bonding cables) shall have warning tape placed 10 inches to 12 inches above the entire lengths during the backfilling operations.
      a. Bring the warning tape to within 6 inches of the finish grade.

I. Pipe flange insulation:
   1. Provide pipe flanges with electrical insulating materials (insulating flange kits) at the locations indicated on the Drawings to provide electrical isolation of specified sections of the pipeline from the other sections.
      a. Install all piping and piping components free of foreign materials and construction debris.
      b. The gasket seating surface shall be free from tool marks, scratches, pits, deposits, or gouges greater than the regular machining marks in a circular pattern (except of the specified surface finish typically 125-200 AARH).
         1) If the seating surface is damaged, machine within the tolerance of the flange specification.
         2) If remachining is not possible, replace the flange.
   2. Install the insulating flange kit materials in strict accordance with the manufacturer's instructions and recommendations.
      a. Align pipe flanges for installation of bolts (studs) flange gasket, insulating sleeves and washers, and metallic washers and bolts.
      b. Use lubricant or anti-seizing compound, as recommended by the insulating flange kits, on bolt and nut threads to provide proper engagement and facing of parts.
      c. Install the bolts (studs) and associated parts finger-tighten in the sequence as outlined in the manufacturer's installation instructions.
      d. After the installation is completed, torque the studs in the proper sequence as directed by the manufacturer's installation instructions.
   3. Following the completed installation of each insulating flange kit, conduct electrical resistance testing to ensure that all flange insulation components have been properly installed and that proper electrical insulation has been achieved.
      a. Measure the electrical resistance across each individual stud (bolt) in the flange, in accordance with NACE SP0286.
         1) Accomplish the testing in the presence of the ENGINEER, with the pipe empty and one side of the pipe flange undergrounded at the time of the testing.
         2) Accomplish the testing with an ohm-meter acceptable to the ENGINEER.
         3) The minimum acceptable resistance across each individual stud (bolt) shall be 50,000 ohms.
      b. Remove and replace any defective insulating parts with new parts.
         1) Following the removal and replacement of defective parts, repeat the resistance tests with all flange studs (bolts).

3.02 FIELD QUALITY CONTROL

A. Testing during construction:
   1. Furnish all necessary equipment and materials and make all electrical connections to the pipe as required to test the electrical continuity of bonded pipe joints.

2. Conduct a continuity test on each pipe joint that is required to be bonded.
    a. Test the electrical continuity of each pipe joint before bonding and after the bonds have been installed, but before backfilling of the pipe.
3. Test equipment required:
    a. Furnish the following equipment and materials:
        1) Digital low resistance ohmmeter: Manufacturers: One of the following or equal:
            a) Biddle, Model 247001.
        2) One set of duplex helical current and potential hand spikes. Manufacturers: One of the following or equal:
            a) Biddle, Model Number 241001, cable length as required.
        3) One calibration shunt rated at 0.001 ohms and 100 amperes. Manufacturers: One of the following or equal:
            a) Biddle, Model Number 249004.
    b. Store the above-described equipment at the project site and maintain the equipment in good working condition.
        1) The equipment shall be available for use by the ENGINEER or the OWNER during the construction.
        2) Upon completion of the Project, turn the equipment over to the OWNER along with all manuals and associated items.
4. Test procedure:
    a. Measure the resistance of each pipe joint before and after bonding, using the low resistance ohmmeter in accordance with the manufacturer's written instructions.
    b. Use the helical hand spikes to contact the pipe on each side of the joint.
        1) When taking measurements after the pipe joint bonding cables have been installed, do not touch the exothermic weld or the bonding cables.
    c. Clean the contact area to bright metal by filing or grinding, with all surface rusting or oxidation removed.
    d. Take measurements both forward and reversed to ensure no DC interference.
    e. Record the measured pipe joint resistances on a permanent record and submit 3 copies to the ENGINEER.
    f. Repair any damaged pipe coating in accordance with the specifications, using only compatible and accepted materials.
5. Test records:
    a. Maintain a complete record of all resistance testing conducted at each pipe joint, before and after joint bonding cables have been installed.
    b. Submit the original and 3 copies of the test data to the ENGINEER for evaluation within 24 hours after the testing has been completed.
    c. The test records shall Include:
        1) The location (pipeline station number) and a brief description of the joint type, fitting.
        2) The date of the test and the status of the joint (before or after bonding).
        3) The resistance measured.
        4) Any comments.
    d. Notify the ENGINEER at least 24 hours before pipe joint resistance testing is to be conducted, in order that the testing may be witnessed by the ENGINEER.

B. Testing after construction:

1. Perform electrical continuity testing on the entire bonded pipeline system or specified bonded sections of the pipeline system installed as part of Project to ascertain and ensure that all pipe joint bonding has been properly installed and is functioning as designed.
    a. Complete the continuity testing after the pipe joint bonding and installation of the corrosion monitoring test stations have been completed.
    b. Purchase the following test equipment at least 60 days before the continuity testing is to begin, to ensure that it will be available for the testing:
        1) One each digital multimeter with case and test leads: Manufacturers: One of the following or equal:
            a) Beckham Instruments, San Diego, California, Model HD-100.
        2) Two each copper/copper-sulfate reference electrodes: Manufacturers: One of the following or equal:
            a) Tinker & Rasor, Inc., San Gabriel, California, Model 8B.
        3) One pound copper sulfate crystals: Manufacturers: One of the following or equal:
            a) Tinker & Rasor, Inc., San Gabriel, California.
        4) One quart copper sulfate anti-freeze solution: Manufacturers: One of the following or equal:
            a) Tinker & Rasor, Inc., San Gabriel, California.
    c. Store the equipment at the project site and maintain the equipment in good working condition.
        1) The equipment shall be available for use by ENGINEER or the OWNER.
        2) Turn the equipment over to the OWNER along with all manuals and associated items upon completion of the project.
2. At least 3 weeks before continuity testing is to be accomplished, submit a testing plan and schedule to the ENGINEER.
    a. This plan and schedule shall include a list of the equipment that will be used for the testing, including power supply, auxiliary (temporary) ground, reference electrodes, voltmeters.
3. Testing procedure:
    a. Conduct the continuity tests by measuring the response of the potential of the piping to the application of a simulated cathodic protection test current in the following manner:
        1) Install an auxiliary (temporary) ground at a minimum distance of 10 feet from the pipeline near or adjacent to a corrosion monitoring test station.
        2) Connect the auxiliary ground to the positive DC output terminal of a portable cathodic protection rectifier unit or "steady source" DC power supply, as accepted by the ENGINEER.
        3) Connect the negative DC output terminal of the rectifier or DC power supply to the pipeline by means of the test cables in the corrosion monitoring test station.
        4) Adjust the DC output of the rectifier or power supply to provide a pipeline potential no more negative than minus 2.00 volts with respect to a standard copper/copper-sulfate ($Cu/CuSO_4$) reference electrode in contact with the earth directly over the pipeline at the test station location.

5) Record the DC voltage and current output of the rectifier or power supply, along with the pipeline-to-Cu/$CuSO_4$ potential measured at or near the auxiliary ground.
6) With the DC test current turned on and off on a cycling basis (by means of a current interrupter installed in the test circuit), "on" and "off" pipe-to-Cu/$CuSO_4$ potential measurements shall be taken at each corrosion monitoring test station in both directions away from the auxiliary ground and power source.
7) Pipe-to-Cu/$CuSO_4$ potential measurements of "foreign" lines and/or casings located at test stations shall also be taken with the simulated cathodic protection current "on" and "off."
8) All measurements shall be recorded.

b. When the pipe-to-CU/$CuSO_4$ potential change from "off" to "on" becomes less than 300 millivolts, move the auxiliary ground and the power supply to a new location, with the testing procedure as described in Items a through g repeated until the entire bonded pipeline or bonded pipeline sections have been tested.
1) Take all pipe-to-Cu/$CuSO_4$ potential measurements utilizing the Digital Multimeter and the copper/copper-sulfate reference electrodes to be purchased by the CONTRACTOR as part of the Project, and as specified earlier in this Section.
2) Accomplish all continuity testing in the presence of the ENGINEER.

C. Inspection:
1. Upon completion of all work, the corrosion control facilities installed under this Contract will be inspected and tested by the ENGINEER to ensure complete conformance with the Contract Documents.
2. Any unapproved deviations or changes from the design made by the CONTRACTOR during the installation of these facilities shall be corrected.
3. Any or all deficiencies in the facilities found through the final testing shall be corrected to meet the requirements of the Contract Documents.

END OF SECTION

SECTION 13122

METAL BUILDING SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Prefabricated metal building systems for Maintenance Building.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01455 - Special Tests and Inspections.
      b. Section 01610 - Project Design Criteria.
      c. Section 01612 - Seismic Design Criteria.
      d. Section 01614 - Wind Design Criteria.
      e. Section 01740 - Warranties and Bonds.
      f. Section 01770 - Closeout Procedures.
      g. Section 03600 - Grouting.
      h. Section 08800 - Glazing.
      i. Section 09960 - High-Performance Coatings.
      j. Section 14624 - Monorail Crane System.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.

B. American Institute of Steel Construction (AISC):
   1. 360 - Specification for Structural Steel Buildings.
   2. Code of Standard Practice for Steel Buildings and Bridges.

C. American Iron and Steel Institute (AISI):
   1. SG02 - North American Specification for the Design of Cold-Formed Steel Structural Members.

D. ASTM International (ASTM):
   1. A 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

3. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
4. A 490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
5. A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
6. A 780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
7. B 187 - Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
8. B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
9. D 1494 - Standard Test Method for Diffuse Light Transmission Factor of Reinforced Plastics Panels.
10. F 959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
11. F 436 - Standard Specification for Hardened Steel Washers.
12. F 1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
13. F 1852 - Standard Specification for “Twist Off” Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

E. American Welding Society (AWS):
1. D1.1 - Structural Welding Code - Steel.
2. D1.3 - Structural Welding Code - Sheet Steel.

F. California Code of Regulations (CCR):
1. Title 24 - Building Standards Code.

G. FM Global (FM).

H. International Accreditation Service (IAS):
1. AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems.

I. Metal Building Manufacturing Association (MBMA):
1. Metal Building Systems Manual.

J. Occupational Safety and Health Administration (OSHA):
1. Occupational Safety and Health Standards:
   a. 1910.23 - Guarding Floor and Wall Openings and Holes.

K. Society for Protective Coatings (SSPC):
1. SSPC-SP2 - Hand Tool Cleaning.

L. Steel Door Institute (SDI):
1. A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

M. Underwriters’ Laboratories, Inc. (UL):
1. 580 - Tests for Uplift Resistance of Roof Assemblies.

1.03 DEFINITIONS

A. Primary framing: An assemblage of beams and columns that support the secondary framing members and that collects loads to transfer to the building foundation.

B. Secondary framing: Members that directly support roof, wall, or floor surfaces and convey loads to the primary framing.

1.04 SYSTEM DESCRIPTION

A. System:
   1. Design: Furnish metal building with vertical walls, gable roof, and with column layout as indicated on the Drawings.
   2. Size:
      a. Furnish metal building of the size and configuration indicated on the Drawings.
      b. Coordinate manufacturer's design dimensions for metal building system components, including columns, with equipment foundations, and details indicated on the Drawings.
   3. Roof slope: Use a roof slope of 5 inch vertical in 12 inches horizontal
   4. Provide building with horizontal and vertical bracing where indicated on the Drawings.
   5. Column reactions shall be vertical and horizontal only.
      a. No bending moments shall be transferred at column bases.
   6. The building roofing system will be listed for a UL 580, Class 60 designation.
   7. Provide a support framing for installing a motorized monorail system as indicated on the Drawings and in accordance with Section 14624.
   8. Openings: Frame openings for doors, windows, louvers, equipment with structural framing to replace panels and secondary framing cut for opening.
      a. Provide curbs to suit roof-mounted equipment compatible with roof sheathing.

B. Performance requirements:
   1. General:
      a. Design of the metal building structure and its appurtenances shall conform to the requirements of the IBC, the Metal Building Systems Manual, and the requirements of this Section.
         1) Where the Metal Building Systems Manual conflicts with the requirements of this Section, the more restrictive requirements will govern.
      b. Do not include collateral or auxiliary loads in load combinations where dead loads offset other load effects (for example, uplift due to wind loads).
      c. Hot-rolled structural steel sections or welded-up plate sections: Design in accordance with AISC 360.
      d. Cold-formed steel structural members: Design in accordance with the AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
      e. Anchor bolts:
         1) Design anchor bolts to resist column reactions reported from analysis.

2) Design anchor bolts in accordance with ACI 318 Appendix D for cracked concrete to fail in a ductile manner, yielding the steel section before fracturing the surrounding concrete.
3) Assume concrete foundation strength, f' c = 4,000 psi at 28 days.

2. Loading:
   a. General:
      1) Design building for dead load, live loads, and combinations of loads including unbalanced loads in accordance with the IBC and the MBMA Metal Building Systems Manual, except as modified in this Section.
      2) Reduction in wind, live, or snow loads based on tributary loaded area will not be permitted.
   b. Roof loading requirements:
      1) Live load: Minimum 20 pounds per square foot assumed to act vertically on horizontal projected area of roof.
   c. Collateral loading: Uniform roof load of 10 pounds per square foot assumed to act vertically on horizontal projected area of roof to account for miscellaneous accessories supported from the structure.
      1) Collateral loading shall be considered a live load.
      2) Design primary and secondary framing to support the additional weight of mechanical equipment such as fans, air conditioners, etc. shown on plans.
         a) Mechanical equipment weights are in addition to collateral loading.
   d. Auxiliary loading:
      1) Structural members: Any single point along the secondary roof framing members shall be designed to carry a concentrated load of 250 pounds in addition to the roof live load.
      2) Roof panels: Design panels to support a 200-pound load uniformly distributed over a 2-square-foot area centered between supporting framing members, without exceeding a panel deflection to span ratio of 1/180 in a 2-span condition.
      3) Auxiliary loading shall be considered a live load.
      4) Auxiliary is to be considered concurrently with collateral loading.
   e. Wind loading requirements: As specified in Section 01614.
      1) Design roof purlins and structural frames for loads specified, but not less than 30-pound-per-square-foot uplift on horizontally projected roof area.
   f. Seismic loading requirements: As specified in Section 01612.
      1) Bolted joints subject to seismic loading shall be designated pre-tensioned joints.
3. Deflection limitations:
   a. Primary frames:
      1) Gravity deflection:
         a) Live load deflection: L/240.
         b) Total load deflection: L/180.
      2) Horizontal drift of rigid frames measured at eave indicated on the Drawings:
         a) Seismic drift limitation:
         b) Wind drift limitation: H/120.

b. Secondary framing:
    1) Gravity deflection:
        a) Live load deflection: L/240.
        b) Total load deflection: L/180.
    2) Horizontal deflection: L/180.
c. Deflection of roof and wall panels: Span/180.
d. Deflection calculations should be based on the wind loads presented in AISC Design Guide 3.
    1) Deflection calculations should be based on the unreduced wind loads required in the IBC (50-year reoccurrence intervals).

4. Climatic conditions:
    a. Gutters and downspouts: Design for a rainfall rate of 5 inches per hour.
    b. Temperature: Provide for movement (expansion or contraction) caused by a range of ambient temperature of 120 degrees F without detrimental effects.

1.05 SUBMITTALS

A. Product Data:
    1. Manufacturer's installation instructions.
    2. Manufacturer's standard color charts and profiles:
        a. Exterior wall and roof panels.
        b. Interior wall and roof liner panels.
        c. Gutters and downspout trim.
    3. Manufacturer's list of approved clamps that may be used to hang suspended items from roof purlins and details of acceptable methods of attachment to purlins.

B. Shop drawings:
    1. Shop drawings: Catalog cuts, design and erection drawings, and other data needed to clearly describe design, materials, construction details, fasteners, and erection.
        a. Erection drawings shall include building dimensions, required foundation footprint, anchor bolt and base plate settings, bracing, main and secondary framing, and sections and details required to fully describe construction of building.
        b. Indicate quantity, size, grade, embedment, and projection, and location of anchor bolts.
    2. Calculations: Submit engineering design calculations for the complete structural system, including coverings and foundations, sealed and signed by a Professional Engineer licensed in the state where the project is located.
        a. Clearly indicate foundation reactions at all columns. Identify all applied loads, load factors, and load combinations used to develop the reactions.
        b. Calculations will be submitted for record information only.
            1) ENGINEER's review of calculations will be for general conformance to the loading requirements of this Section.
            2) The building manufacturer shall remain fully responsible for the structural design and adequacy of the metal building system.

3. Calculations: Submit heat gain-loss calculations to demonstrate compliance with CCR Title 24.
4. Descriptive data: Submit data for the following items either on the shop drawings or separately: Accessories, each type of flashing, trim closures, caps and similar items, fasteners, doors, roof openings, gutters, and downspouts.

C. Quality control submittals:
1. Building manufacturer.
   a. If requested by the ENGINEER, submit a record of manufacturer's metal building systems of similar design manufactured and erected in the 5-year period preceding the bid date for this project.
      1) Include date of installation, location of metal building, and name and address of OWNER.
   b. Submit evidence of manufacturer’s certification under IAS AC472 Accreditation.
      1) Certification must be valid for the facility at which the metal building will be fabricated.
   c. Confirmation of UL 580 wind uplift rating.
2. Erector:
   a. Submit welder qualification certificates.

D. Record documents:
1. 1 set of reproducible “Record Drawings” for the erected structure.
   a. Drawings shall bear the seal and signature of a Professional Engineer, registered in the state where the work is constructed and who provided responsible charge for the design.

E. Closeout submittals: Submit Contract Closeout Submittals as specified in Section 01770.
1. Operating and Maintenance Information.
2. Warranty.
3. Certificate of Compliance: At the completion of the metal building manufacture, the manufacturer will furnish a letter to the ENGINEER stating that the work was performed in accordance with the approved construction documents.

1.06 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer shall have been engaged in the design, manufacture, and erection of metal building systems of the type specified for at least 5 years preceding the Bid Date of this Contract.
1. Building manufacturer shall be certified by IAS AC472 Accreditation.
2. The manufacturer’s Engineer of Record shall hold current license as a Professional Engineer in the state where the work will be constructed.

B. Erector qualifications: Erectors shall be trained, approved, and certified by the manufacturer prior to Bidding of the Project. Erectors shall demonstrate at least 3 years experience in successfully erecting metal building systems of the type specified in Section 01610.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver materials and fabrications to the job site in manufacturer's original containers with seals unbroken and labeled with manufacturer's identification and number.

B. Delivery:
   1. Deliver materials dry and undamaged, and store out of contact with ground.
   2. Cover materials with weathertight coverings and keep dry.
   3. Provide good air circulation and protection from surface staining for roof and wall covering sheets.

C. Storage and protection: Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

1.08 WARRANTY

A. Provide OWNER with warranty that exterior finish system for metal panels shall be guaranteed against blister, peeling, cracking, chipping, or material rust-through for a period of 25 years from the date specified in Section 01740.

B. Provide OWNER with warranty stating that the metal building system shall be guaranteed against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of 25 years from the date specified in Section 01740.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Buildings: One of the following or equal:
   1. American Buildings Company.
   2. Behlen Building Systems.
   3. Butler Manufacturing Company.
   4. CBC Steel Building.

2.02 MATERIALS

A. Primary framing (rigid frames):
   1. Welded plates or hot-rolled steel columns and roof beams, complete with necessary splice or connector plates for bolted field assembly.
      a. Minimum nominal thickness of structural shapes or their elements shall be 1/4-inch.
   2. Welding procedures, welder qualifications, and welding quality standards shall be in accordance with AWS D1.1 and AWS D1.3.
   3. Base, cap, compression plates, and stiffener plates shall be factory-welded in place, and shall have shop-fabricated connection holes.
      a. Provide minimum 4 anchor bolts per column base.
   4. Columns and roof beams shall be fabricated complete with holes in webs and flanges for attaching bracing and roof and sidewall framing.

5. Shop finishing:
    a. Shop primed for field painting:
        1) Clean ferrous surfaces of oil, grease, loose rust, loose mill scale, and other foreign substances, in accordance with the SSPC-SP2.
    b. Shop primed and field-coated high solids epoxy and polyurethane coating system:
        1) Apply 1 coat of shop primer in accordance with SSPC Paint Specification No. 15 for temporary corrosion protection.
        2) Remove shop primer as specified in Section 09960 prior to field coating.

B. Secondary framing (purlins, girts, framing at end-walls and openings, eave struts, bracing):
    1. Hot rolled structural steel or cold-formed members.
    2. Minimum thickness: 16-gauge.
    3. Bracing elements constructed of wire rope, stranded tendons, or other similar material is not permitted.
        a. Rolled angle sections or solid steel bar is permitted.
    4. Provide factory-punched holes for panel connections.
    5. Shop finishing - hot rolled sections:
        a. Shop-primed for field painting:
            1) Clean ferrous surfaces of oil, grease, loose rust, loose mill scale, and other foreign substances, in accordance with the SSPC-SP2.
        b. Shop primed and field-coated high solids epoxy and polyurethane coating system:
            1) Apply 1 coat of shop primer in accordance with SSPC Paint Specification No. 15 for temporary corrosion protection. Remove shop primer as specified in Section 09960 prior to field coating.
            2) Prepare surfaces and apply finishes as specified in Section 09960.
    6. Shop finishing (cold-formed sections):
        a. Shop primed for field painting:
            1) Clean ferrous surfaces of oil, grease, loose rust, loose mill scale, and other foreign substances, in accordance with the SSPC-SP2.
        b. Shop-primed and field-coated high solids epoxy and polyurethane system:
            1) Apply 1 coat of shop primer in accordance with SSPC Paint Specification No. 15 for temporary corrosion protection.
            2) Remove shop primer as specified in Section 09960 prior to field coating.

C. Roof and wall panels:
    1. Roll-formed minimum 24 gauge steel.
    2. Minimum 24-inch panel width with interlocking side seams.
    3. Factory cut to maximum possible length to minimize end laps.
    4. Factory pre-punched for fastening.
    5. Panel finish:
        a. Galvanized interior and exterior faces.
        b. Zinc-coated to G90 coating designation in accordance with ASTM A 653.
    6. Ridge panel: 1-piece, factory formed to match roof slope at each side, of same material as roof panels, and capable of completely sealing roof ridge.

D. Bolted joint components: High-strength steel bolts used for steel-to-steel structural connections.
   1. Galvanized in accordance with ASTM A 153.
   2. Bolts: ASTM A 325 or A 490, Type 1.
   3. Nuts: ASTM A 563, heavy hex. Grade and finish to match bolts as specified in AISC “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.”
   4. Washers: ASTM F 436; flat unless otherwise noted.
      a. Load indicator devices:
         1) Twist-off type tension-control bolt assemblies: ASTM F 1852, with strength level in accordance with ASTM A 325.
         2) Compressible washer direct tension indicators: ASTM F 959, Type A 325 for ASTM A 325 bolts.
   5. All bolts furnished for the project shall be a single size and grade.

E. Anchor rods: Hot-dip galvanized complying with ASTM F 1554.

F. Fasteners and washers:
   1. Fasteners and washers used for attachment of wall and roof panels.
   2. Fasteners: Vinyl-coated steel or stainless steel.
   3. Washers: Neoprene or other accepted type washer capable of being used to assure watertightness at fastening locations.

G. Gutters and downspouts:
   1. 24 gauge steel.
   2. Galvanized in accordance with ASTM A 653 to G90 designation.
   3. Field painted. Color to be selected by OWNER to complement wall panels.

H. Doors and frames:
   1. Provide hinged doors in accordance with published recommendations of SDI A250.8.
      a. Doors and frames shall be Level III.
   2. Provide each door with a heavy-duty, corrosion resistant, cylinder lock set to match locks on Master Key System.
   3. Provide weatherstripping and threshold for all doors.
      a. Windows and glazing:

I. Provide windows and glazing as indicated on the Drawings and as specified in Section 08800.

J. Touch-up painting materials:
   1. For structural elements:
      a. Shop primer: Manufacturer’s standard primer.
      b. Touch-up paint: Same as shop primer.
   2. For sheet metal skin:
      a. Exterior finish paint: Match specified coating.
         1) Color: Color as selected by the ENGINEER.

K. Insulation:
   1. Thermal value:
      a. Roof insulation: R-19 ss defined in Table 502.2(2) of the IECC.
   2. Wall insulation: R-19 as defined in Table 502.2(2) of the IECC.
   3. Caulking material: Elastomer type, manufacturer's standard.

2.03 FABRICATION

A. Shop fabrication:
   1. Structural elements:
      a. Fabricate rigid frame of hot-rolled sections or continuously welded plate sections.
      b. Field connections shall be bolted unless otherwise accepted by the ENGINEER.
   2. Wall panels:
      a. Provide panels that are 1 piece from base to eave and have exposed fasteners located on outside of panels.
      b. Provide top and bottom closures and bottom supports.
   3. Roof panels:
      a. Panel splicing: Panels may be spliced with minimum end overlap of 9 inches at purlins.
      b. Ridge panel: Provide 1 piece ridge panel, factory formed to match roof slope, of same material as roof panel, and capable of completely sealing roof ridge.
      c. Expansion of roof panels: Provide means to allow expansion of roof panels.
   4. Fasteners for roof and wall panels:
      a. Fasteners: Secure with fasteners that assure maximum weather-tightness, proper bearing surface, and permanent seal at point of fastening.
      b. Washers: Use washers capable of assuring water-tightness at fastening locations.
   5. Accessories:
      a. Gutters, downspouts, and hangers:
         1) Provide 4-inch gutters, downspouts, and hangers as indicated on the Drawings.
      b. Vents:
         1) Provide vents of size and location indicated on the Drawings.
         2) Provide louvers that are operable and that have screens.

B. Tolerances:
   1. Hot-rolled sections: In accordance with AISC Code of Standard Practice for Steel Buildings and Bridges.
   2. Cold-formed and built-up sections: In accordance with MBMA Metal Building Systems Manual.

2.04 SOURCE QUALITY CONTROL

A. General:
   1. Components of the metal building system fabricated in the manufacturer's shop will be subject to special inspection, as specified in this Section.
   2. The manufacturer shall communicate the proposed fabrication schedule to the CONTRACTOR with sufficient notice and lead time to schedule the required inspections.

B. Source inspection:
   1. Components of the metal building system that will be subject to special inspection are as indicated in Attachment 13.1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Verify site conditions prior to start of work. Unacceptable conditions shall be reported to ENGINEER.
   2. Starting of erection of metal building system work shall indicate acceptance of existing conditions.
      a. Manufacturer or manufacturer's trained erector shall review and examine existing site conditions, foundation, and surface preparation, and adequacy of site-prepared components prior to commencing erection of the building.

3.02 ERECTION

A. General:
   1. Erect in accordance with the MBMA, Metal Building Systems Manual and manufacturer's instruction, except as modified in this Section.
   2. Separate dissimilar materials with gaskets or suitable insulating coatings.
   3. Keep exposed surfaces clean and free from sealant, metal cuttings, and other foreign materials.

B. Framing and structural members:
   1. Set anchor rods by template and securely tie into formwork before concrete placement.
   2. Provide uniform bearing under baseplates and sills by filling using a non-shrinking grout as specified in Section 03600.

C. Walls and roof:
   1. Erect a structure that will be free from water leaks and meet design requirements.
   2. Direct side lap edges away from the prevailing winds at the site.
   3. Do not exceed the maximum fastener spacings specified.
      a. Space fasteners uniformly not to exceed: 8 inches on center at ends of covering, 12 inches on center at intermediate supports and at roof covering side laps, and 18 inches on center at wall covering side laps.
   4. Install fasteners in straight lines within a tolerance of 1/2 inch per bay.
   5. Seal side laps, ends of roof, wall coverings, and joints at accessories.
      a. Drive fasteners to the surface and seat gasketed heads and washers.
   6. Fasten accessories to framing members, except as otherwise accepted by the ENGINEER.

D. Gutters and downspouts:
   1. Attach securely to the building.
   2. Install gutters sloped to drain with adequate provisions for expansion and contraction.

E. Doors and roof openings:
   1. Anchor securely to the supporting construction.
   2. Install doors plumb and true and adjust to provide operation.

3.03 FIELD QUALITY CONTROL

A. General:
   1. Installation of metal building system will be subject to special inspection and evaluation during construction, as specified in this Section.

B. Site inspection:
   1. Special inspection of the metal building system components will be performed at the time and frequency outlined in Schedule 13-1.
   2. The elements of the metal building system construction that will be subject to special inspection are as indicated in Attachment 13-1.

3.04 ADJUSTING

A. Field painting:
   1. Prepare and touch up abraded or corroded spots on shop-primed surfaces immediately after erection.
      a. Use the same material as was used for the shop coat.
   2. Paint shop-primed ferrous surfaces as specified in Section 09960.

B. Paint primed surfaces of doors and windows with 2 coats of an exterior enamel acceptable to the Architect.

C. Touch-up factory finished surfaces of roof and wall panels with the manufacturer's recommended paint where damaged or abraded.

D. Where shop processes such as shearing or punching leave edges of galvanized steel unprotected by galvanization, touch up unprotected edges as specified in this Section.

E. Galvanized surfaces: Repair damaged galvanized surfaces in accordance with recommendations of the American Hot-Dip Galvanized Association ASTM A 780.

3.05 CLEANING

A. Remove excess materials, equipment, and debris incidental to this work upon completion.

3.06 PROTECTION

A. During erection, the erector shall be responsible for the protection of this and all adjacent work from damage.

SCHEDULE 13-1 Metal Building System Construction Special Inspection			
IBC Table 1704.3	**Inspection Task**	**Frequency/Timing of Inspection**	**Criteria Reference**
Prior to beginning installation of metal building, verify high-strength bolts, nuts, and washers:			
1.a.	Identification markings conform to ASTM standards required by approved design.	**Periodic**: Confirm from stockpile of materials delivered to site whether material furnished complies with the materials in the approved design.	
Inspection of high-strength bolted joints:			
2.a.	Joints designated bearing-type connections by the approved design.	Provide **continuous** inspection of the initial installation of each type and size of joint. Subsequent installations of the same type and size of joint may be inspected on a **periodic** basis with inspections of a minimum of **20%** of installations, or once per calendar week, whichever is more frequent.	
2.b.	Joints designated slip-critical connections by the approved design.	Provide **continuous** inspection as specified in Section 01455.	
Verification of structural steel material:			
3.a.	Identification markings conform to ASTM standards required by approved design.	**Periodic**	
Prior to beginning installation of metal building, verify weld filler materials:			
4.a.	Identification markings conform to the AWS specification required by approved design.	**Periodic**	
Inspection of structural steel welding:			
5.a.1.	Complete and partial penetration groove welds.	Provide **continuous** inspection as specified in Section 01455.	
5.a.2.	Multipass fillet welds.	Provide **continuous** inspection as specified in Section 01455.	
5.a.3.	Single-pass fillet welds greater than 5/16 inch.	Provide **continuous** inspection as specified in Section 01455.	
5.a.4.	Single-pass fillet welds less than or equal to 5/16 inch.	Provide **continuous**: inspection of the initial production of each type and size of welded joint. Subsequent production of the same type and size of joint may be inspected on a **periodic** basis with inspections of a minimum of **20%** of installations, or once per calendar week, whichever is more frequent.	

SCHEDULE 13-1 Metal Building System Construction Special Inspection			
IBC Table 1704.3	**Inspection Task**	**Frequency/Timing of Inspection**	**Criteria Reference**
Inspection of steel frame joint construction for compliance with approved design:			
6.a.	Bracing and stiffening details.	Provide **periodic** inspection of any bracing and stiffening details of construction. Inspection should include, as a minimum, verification of member sizes and proper orientation. A minimum of **15%** of locations should be verified.	
6.b.	Member locations.	Provide **periodic** inspection of member locations. Inspection should include, as a minimum, verification of member sizes and proper spacing/location. A minimum of **15%** of locations should be verified.	
6.c.	Connection joint details.	Provide **periodic** inspection of joint details of construction. Inspection should include, as a minimum, verification of miscellaneous steel detailing, including stiffener plates, concrete pourstops, gusset plates and similar miscellaneous steel framing.. A minimum of **15%** of locations should be verified.	

Attachment A

Metal Building Construction Report Los Osos Water Recycling Facility San Luis Obispo County				
Permit No.:			Structure:	
Date:			Weather:	
Contractor:			Min/Max Temp:	
Dwg. Ref:				
Location:				

Element Description	Table 1704.3	Conforms
High Strength Bolts, Nuts, and Washers		
General:		
Fastener components are protected in closed containers from dirt and corrosion.	1.a.	❑Yes ❑No
Fastener components that accumulate dirt or rust may not be cleaned and incorporated into work.	1.a.	❑Yes ❑No
Fasteners may not be reused.	1.a.	❑Yes ❑No
All material within the grip of the bolt is non-compressible steel.	1.a.	❑Yes ❑No
Burrs extending greater than 1/16 inch above the faying surface are removed.	1.a.	❑Yes ❑No
Materials:		
Bolt grade: ❑ A325 ❑ A490 ❑ F1852 ❑ Other:_____	1.a.	❑Yes ❑No
Bolt size: ❑ 5/8 inch ❑ 3/4 inch ❑ 7/8 inch ❑ 1 inch ❑ 1 1/8 inch ❑ 1 1/4 inch ❑ Other _____	1.a.	❑Yes ❑No
Bolt finish: _____	1.a.	❑Yes ❑No
Nut grade: ❑ A194 ❑ A563 ❑ Other: _____	1.a.	❑Yes ❑No
Nut finish: _____	1.a.	❑Yes ❑No
Washer grade: ❑ F436 ❑ F959	1.a.	❑Yes ❑No
Washer finish:_____	1.a.	❑Yes ❑No
Hole: ❑ Standard ❑ Oversized ❑ Short-slotted ❑ Long-slotted		❑Yes ❑No
Bearing Type Joints:		
Faying surfaces may be uncoated, coated, or galvanized.	2.a.	❑Yes ❑No
All plies of joint have been drawn into firm contact	2.a.	❑Yes ❑No
Pretensioned Joints:		
Faying surfaces may be uncoated, coated, or galvanized.	2.a.	❑Yes ❑No
Pre-installation verification of fastener assembly and installation procedures	2.a.	❑Yes ❑No
Bolts tightened in joint in accordance with Section 8 of RCSC Specification	2.a.	❑Yes ❑No
Slip Critical Joints:		
Faying surfaces are not coated	2.b.	❑Yes ❑No
Faying surfaces to be coated have been prepared in accordance with RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts"	2.b.	❑Yes ❑No
Galvanized faying surfaces have been prepared in accordance with RCSC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts"	2.b.	❑Yes ❑No
Pre-installation verification of fastener assembly and installation procedures	2.b.	❑Yes ❑No
Bolts tightened in joint in accordance with Section 8 of RCSC Specification	2.b.	❑Yes ❑No

Element Description	Table 1704.3	Conforms
Welding of Structural Steel		
General:		
Materials:		
Welded Joints:		

Remarks:			
Inspector		Date	

END OF SECTION

SECTION 13206A

FIBERGLASS REINFORCED PLASTIC ABOVEGROUND STORAGE TANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Fiberglass reinforced plastic aboveground storage tanks.

B. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01612 - Seismic Design Criteria.
      b. Section 01614 - Wind Design Criteria
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 06608 - Fiberglass Reinforced Plastic.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
   2. B16.5 - Pipe Flanges and Flanged Fittings.
   3. RTP-1, Reinforced Thermoset Plastic Corrosion Resistant Equipment.

B. American Society for Testing and Materials (ASTM):
   1. D 2240 - Test Method for Rubber Property - Durometer Hardness.
   2. D 3299 - Specification for Filament-Wound Glass Fiber Reinforced Thermoset Resin Chemical-Resistant Tanks.
   3. D 4097 - Specification for Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Chemical-Resistant Tanks.

C. National Institute of Standards and Technology (NIST):
   1. U.S. Voluntary Product Standard:
      a. PS15-69 – Custom Contact-Molded Reinforced-Polyester Chemical-Resistant Process Equipment.

1.03 DESIGN CRITERIA

A. Design tanks in accordance with ASTM D 3299, follow the procedures and methods, and utilize the equations and formulas; and incorporate safety factors and allowable design stresses and strains set forth in ASME RTP 1 and other design requirements as specified in Section 06608.

B. Minimum structural wall thickness shall be 0.375 inch. Not more than 50 mil. of corrosion liner may be used in structural calculations.

C. Dimensions:
   1. Sodium Hypochlorite Tank: 8-foot inside diameter by 8-foot straight shell with domed cover.

D. Ambient Conditions: 45 to 90 degrees Fahrenheit, indirect sunlight.

E. Chemical Environment: Product shall be suitable for the following chemical conditions:
   1. Sodium Hypochlorite Tank:
      a. Chemical: Sodium hypochlorite solution.
      b. Concentration: 12.5 percent.
      c. pH: 11 to 13.
      d. Specific Gravity: 1.34.

F. Insulate sodium hypochlorite tank.

G. Nozzle locations as indicated on the Drawings.

H. Fire retardancy for Class 1 fire rating required.

I. Seismic design criteria shall be as specified in Section 01612.

J. Wind design criteria shall be as specified in Section 01614.

K. Support conditions as indicated on the Drawings.

1.04 SUBMITTALS

A. Submit as specified in Section 06608, Fiberglass Reinforced Plastic, including ASTM RTP-1 certification.

B. Submit color selection chart showing all manufacturer's standard colors.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Manufacturer of proposed corrosion resistant fiberglass reinforced plastic structures for a minimum of 5 years with satisfactory performance record as specified in Section 06608.
   2. Manufacturer shall be RTP-1 certified and comply with procedures set forth in RTP-1 during design, fabrication, and quality assurance. Manufacturers that are not RTP-1 certified will not be accepted.

B. The manufacturer-approved installer shall have installed products of similar fiberglass reinforced plastic equipment on a minimum of 5 projects with a satisfactory performance record.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Xerxes Corporation, Anaheim, CA.
   2. Ershigs, Inc., Bellingham, WA.
   3. Belco Manufacturing Company, Belton, TX.

2.02 MATERIALS

A. Materials as specified in Section 06608.
   1. Submit manufacturer's data sheets for each resin used to verify compatibility of the resin with the product the tank will be storing.

B. Resin:
   1. For Non-fire Retardant Applications: Premium grade vinyl ester resin as recommended by the resin manufacturer for the specific operating environment.
      a. Manufacturers: One of the following or equal:
         1) Derakane, 411.
         2) Reichhold Dion, VER 9100.
         3) Interplastic, VE 8300.
   2. For Fire Retardant Applications:
      a. Premium grade vinyl ester resin as recommended by the resin manufacturer for the specific operating environment.
      b. Add antimony trioxide or pentoxide for Class I fire rating to the structural laminate only.
      c. Manufacturers: One of the following or equal:
         1) Derakane, 530.
         2) Ashland Hetron, 992.
         3) Interplastic, VE 8440.
         4) Reichhold Dion, VER 9300FR.

C. Minimum Corrosion Liner:
   1. 1 "C" or synthetic veil.
   2. In addition to 1 ”C” or synthetic veil, include 1-1/2 ounce per square foot mat to a total minimum thickness of 0.096 inch on surfaces exposed to the service environment.

D. Ultra Violet Stabilizer: Add to the resin used in the wax coat for exterior surfaces in the type and amount recommended by the resin manufacturer.

2.03 FABRICATION

A. Fabrication Method: Hand lay-up or filament wound at construction with integral molded bottom knuckle in accordance with applicable portions of Section 06608.

B. Structural Section with Internal Veil: Prohibited.

C. Color:
   1. Sodium Hypochlorite Tank: As directed by the ENGINEER.

D. Legs and Tie Down Lugs: Components laminated onto tank wall shall be Type 316 stainless steel.

E. Anchor Bolts: Type 316 stainless steel, of size and length recommended by tank manufacturer.

F. Flanges:
   1. All flange dimensions, except thickness, and bolting shall conform to the following standards:
      a. 2 inches through 24 inches: ANSI B16.5 Class 150.
      b. 30 inches through 42 inches: ANSI B16.1 Class 125.
   2. Flange faces shall be perpendicular to the centerline of the nozzle centerline within 1 degree and shall be flat to plus or minus 1/32 inch up to and including 18-inch equivalent diameter and plus or minus 1/16 inch for equivalent diameters greater than 18 inches.
      a. The minimum flange shear thickness shall be 4 times the flange thickness.
      b. The flange thickness shall be in accordance with PS 15-69 for 25 pounds per square inch pressure rated flanges.
   3. Flanges shall be made by hand lay-up construction with nozzle neck and flange made integrally in one piece as specified in Section 06608.
   4. Press molded or filament wound flanges not allowed.
   5. Use 1/8-inch thick full-faced elastomeric gaskets having a Shore A Durometer hardness of 60, within plus or minus 5, as determined by ASTM D 2240 for flanged joints. Elastomer specified by Fabricator to be resistant to chemical environment.

G. Gussets:
   1. Reinforce nozzles, except manways, with plate or conical gussets to match piping.
   2. Conical gussets having comparable strength may be substituted for plate gussets.

H. Reinforcement of Nozzle and Manhole Openings in Vessel Walls:
   1. In accordance with ASTM D 3299 for filament wound vessels or ASTM D 4097 for contact-molded, hand lay-up, vessels as specified in Section 06608.
   2. When reinforcing materials are cut to facilitate placement around an installed nozzle or opening, stagger joints in successive reinforcing layers to avoid overlapping and do not place so that the joints are parallel to the axis of the tank. The principle fiber direction of the woven roving reinforcement (0 degree/ 90 degrees) shall be parallel to the tank axis.
   3. Coordinate the locations of the nozzles for level sight glasses for the instrument being furnished.

I. Cover: Domed top with bolted manway and/or nozzles as indicated on the Drawings.

J. Platforms, handrail, and ladders: As indicated on the Drawings.

K. Level sight glasses:
   1. One of the following or equal:
      a. Plast-O-Matic: Series GL Double Walled Level Indicator.

2. Material of construction: Double wall construction with Pyrex glass inner wall and acrylic outer wall, UV resistant and compatible with the fluid being stored.
3. Level indicator shall be no smaller than 3/4 inch and no larger than 2 inches in diameter.
4. Translucent and with graduation marks.
5. Quantity per tank: As required to cover the shell height, each level sight glass to be not more than 4 feet long.
6. Provide a diaphragm type manual isolation valve at each nozzle for the level sight glasses as indicated on the Drawings.

2.04 TANK INSULATION

A. Where specified, provide insulation as follows:
   1. Provide 2-inch thick, 2-pound density polyurethane foam board to tank structural laminate before the laminate has a chance to harden, so that the insulation bonds to the tank wall.
   2. Provide exterior fiberglass protective laminate over the polyurethane foam board to a thickness of 0.145 inch.
   3. Provide expansion joints as needed on straight shell exterior fiberglass protective laminate. Provide a lip at expansion joints to keep moisture out of the joints. Minimum overlap shall be 1 inch.
   4. At fittings, remove insulation and reinforce connection with fiberglass laminate to the outer side of the structural wall laminate. Replace insulation, cover with fiberglass laminate, and caulk interface around fitting.

2.05 VESSEL ASSEMBLY

A. All cutouts from the equipment shall be marked, indicating their original location, and retained. All cutouts shall become the property of the OWNER.

B. Do not remove centerlines marked on the equipment for use in assembly until after inspection by the ENGINEER.

C. Install flanged nozzles with bolt holes straddling principle centerlines of the vessel. For tank tops, nozzle bolt holes straddle radial centerlines.

D. When requested, Fabricator shall supply to the CONTRACTOR, at the earliest possible time, a template that locates anchor bolt holes within plus or minus 1/8 inch for each vessel.

E. Provide a non-skid surface on the exterior surface of the dome. Silica grit may be applied in conjunction with the final resin coat. Other methods may be submitted.

F. Furnish and overlay on the outside of the equipment a plastic nameplate showing the following information:
   1. Name of manufacturer.
   2. Date of manufacture.
   3. OWNER's purchase order number.
   4. Equipment name/number.
   5. Resin number and manufacturer.
   6. Design pressure and temperature.
   7. Vessel diameter, height, and weight.

G. Butt joints or shell joints shall be in the number and location(s) as indicated on the fabrication drawings. Additional joints are not allowed. Slip joints, "mod joints," or other methods not conforming to the fabrication drawings are not allowed. If joint locations are not indicated on the fabrication drawings, fabricator shall submit number and location.

H. Allowable tolerances shall be as listed in ASTM D 3299 or ASTM D 4097, except as modified herein or on the fabricator drawings.

I. When joining components, gaps at mating edges shall be limited to 1/4-inch maximum, and misalignment of inside surfaces shall not exceed 1/3 inch of the lesser wall thickness.

J. The outside surface of vessel flat bottoms after assembly shall be flat within plus or minus 1/2 inch. In addition, localized indentations or protrusions shall not exceed plus or minus 1/4 inch within 2 feet.

PART 3 EXECUTION

3.01 TANK INSTALLATION

A. For flat bottom vessels without legs, the foundation must provide full non-elastic support to the flat bottom through the use of grout, which will allow continuous support even though surfaces may not be flat.

B. All anchor lugs or leg pads shall be set on a 1-inch thick layer of non-shrink grout. Do not use hard shim to fill void between the lugs and foundation.

C. Unless otherwise agreed, independently support all piping so as not to apply loads to the vessel nozzles. Isolate potential load due to thermal expansion of piping from the vessel. During installation, do not force piping into alignment, which can create excessive stresses in the tank.

D. Do not mate raised face flanges or ring gaskets to full faced fiberglass reinforced plastic nozzles.

E. Vertically support ladders at the containment floor. Do not vertically support ladders at the tank foundation. Ladder lugs attached to the vessels shall provide lateral support only.

F. Where tank foundations are cut out to accommodate full bottom drains, fill the cutout area after tank installation with grout or other material that will provide localized support.

3.02 MANUFACTURER’S FIELD SERVICES

A. Coordinate field service work with the manufacturer’s representative, OWNER, and ENGINEER prior to initiating such work.

B. CONTRACTOR shall furnish a qualified Manufacturer’s Representative to provide manufacturer’s field services as specified in Specification Section 01660.

C. Require manufacturer's representative to perform the following services as described below and as specified in Section 01660. The specified durations are the minimum required time on the job site. Additional services and/or longer durations shall be provided as needed at no cost to the OWNER to meet the required quality of work.
   1. Installation Assistance: As required.
   2. Installation Inspection: 2 Workdays.
   3. Start-Up/Testing Assistance: None.
   4. Final Acceptance Checkout: None.
   5. Post Start-Up Checkout: None.

END OF SECTION

SECTION 13206F

HYDROPNEUMATIC BLADDER TANK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydropneumatic bladder tank.

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01612 - Seismic Design Criteria.
   b. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
1. Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels, Division 1.

1.03 SYSTEM DESCRIPTION

A. Design requirements:
1. General: Design, fabricate, and test tanks in accordance with ASME Code.
2. Hydropneumatic bladder tank shall designed for conditions specified below:

	40-TNK-305	**60-TNK-735**	**60-TNK-XXX**
Service	Recycled Water	Non-Potable Water (Treated Groundwater)	Potable Water (Treated Groundwater)
Minimum Capacity	12,000 gallons	1,980 gallons	528 gallons
Maximum Diameter	12 feet	6 feet	4 feet
Maximum Operating Pressure	200 psi gauge	125 psi gauge	125 psi gauge
Temperature Range	20 to 115 degrees F	20 to 115 degrees F	20 to 240 degrees F
Tank Mounting	Horizontal	Vertical	Vertical

3. Pressure rating: Unless otherwise indicated on Drawings, all hydropneumatic pressure tanks shall be fabricated in accordance with ASME Code for unfired pressure vessels, for a design pressure rating of at least the lesser of 50 percent or 500-psi gauge above maximum operating pressure with a 1/8-inch corrosion allowance applied to shell, heads, and attachment thicknesses.
4. Seismic design: Design tank for seismic design criteria as specified in Section 01612.

1.04 SUBMITTALS

A. CONTRACTOR is responsible for completing the Pressure Vessel Inspection Request Form that can be found at the California's Department of Industrial Relations website http://www.dir.ca.gov/dosh/pressure.html#PresureVessel.

B. CONTRACTOR shall coordinate point of contact with OWNER.

C. Product data: List of materials and coatings used.

D. Shop drawings and calculations:
1. Detail drawings or manufacturer's literature to indicate compliance with the specified requirements.
2. Shop drawings: Dimensional drawings indicating vessel dimensions, wall thickness, mounting, and anchorage requirements.
3. Calculations: Copy of structural, seismic, and wind loading calculations for the support system sealed and signed by a Professional Structural Engineer licensed in the state where the project is located.

E. Test reports and certifications:
1. Certification and ASME Code data reports in accordance with the ASME Code and other similar codes.
   a. The certification shall include certification of post weld heat treatment, joint radiography, and hydrostatic testing.

F. Close-out submittals:
1. OWNER's manual:
   a. Test reports and certifications: The certification shall include certification of post weld heat treatment, joint radiography, and hydrostatic testing.
   b. Certification and ASME Code data reports in accordance with the ASME Code and other similar codes.
   c. Fabrication drawings.
   d. Copy of structural, seismic, and wind loading calculations for the support system signed by a Structural Engineer registered in the state where the Project is located.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hydropneumatic bladder surge tank: One of the following or equal:
1. TNK-305:
   a. Young Engineering Manufacturing, 12000 BST-27.
   b. John Wood Company, equivalent model.

2. TNK-735:
    a. Wessels Company, Model FXA 7500.
    b. John Wood Company, equivalent model.
3. TNK-765:
    a. Bell and Gossett, Model PTA-457
    b. Wessels Company, equivalent model.
    c. John Wood Company, equivalent model.

2.02 MATERIALS

A. Construct tanks using low carbon steel in accordance with requirements of ASME Boiler and Pressure Vessel Code, unless otherwise indicated on the Drawings.

2.03 COMPONENTS

A. Lifting lugs: Provide lifting lugs.

B. Anchor bolts:
1. Size: Anchor bolts shall have a nominal diameter of at least 3/4 inch, unless otherwise indicated on the Drawings, and shall be anchored to concrete foundations using methods designed to transfer the full ultimate strength of the anchor bolt to the concrete foundation.
    a. Attach anchor bolts to the tank by use of anchor bolt chairs or rings, as required.
2. Chairs or rings: Design chairs or rings to transfer 125 percent of the ultimate strength of the bolt, or 150 percent of the calculated load, whichever is less, to the tank shell.

C. Nameplates and code stamps:
1. Each tank shall bear a stainless steel ASME nameplate.
2. Each nameplate shall bear the applicable code symbol.
3. Manufacturer shall be authorized by ASME to apply the applicable code symbols.

D. Fittings and attachments:
1. Fittings larger than 1 inch shall be flanged.
2. Fittings 1 inch and smaller shall be National Pipe Thread.

E. Access openings: Access openings shall be flanged, and, unless otherwise indicated on the Drawings, have a nominal diameter of at least 24 inches.
1. The cover plate and flange of access openings shall each have a net thickness, after machining, of at least 1/2 inch or as required to meet the vessel design pressure.
2. Reinforce openings in accordance with the ASME Code.
    a. Weld shell attachments for
        1) Pipe supports.
        2) Tank gauges.
        3) Instruments.
        4) Other items as indicated on the Drawings before application of the tank lining.

F. Bladder: Provide sealed bladder system to separate liquid from the steel tank and the air cushion meeting:
   1. Replaceable heavy-duty butyl rubber bladder rated for the maximum operating temperature specified.
   2. Liquid contained inside the bladder through an exterior system fill connection.
   3. Bladder and system connection mounted on a tank flanged connection so that bladder is replaceable through the tank flanged connection.
   4. Tank factory pre-charged to 30-psi gauge with minus 40 degree F dew point dry air.

2.04 APPURTENANCES

A. Air/gas charging valve: Valve shall be standard schrader valve.

B. Drain connection: Drain connection on tank air side shall be the manufacturer's standard size for the tank size.

C. Manual air vent valve: Screwdriver operated, low projection type vent for shallow height clearance installation or needle valve, designed for the tank pressure rating at the maximum operating temperature with 1/8-inch male pipe thread connection.

D. Pressure gauge:
   1. Pressure gauges shall be 0 to 125 psi gauge dial range.
   2. Pressure gauge shall be separated from the tank by ball valves and insulating bushings.

E. Air relief valve: Air relief valve shall be sized by manufacturer in accordance with ASME code for unfired pressure vessels.

2.05 FABRICATION

A. Welding:
   1. Weld reinforcement shall be in accordance with ASME Code.
   2. Excessive reinforcement shall be ground down to within the ASME Code requirements, and as required to install the lining systems.
   3. All internal corners and edges shall be ground to a 1/8-inch radius, or a greater radius if required by the lining system.

B. Protective coating:
   1. Interior surfaces: Factory coated with high solids epoxy coating as specified in Section 09960.
   2. Exterior surfaces: Factory coated with primer compatible with field coating specified in Section 09960.

2.06 SOURCE QUALITY CONTROL

A. Tests: After fabrication, but prior to application of linings each tank shall be tested in accordance with the ASME Code.

PART 3 EXECUTION

3.01 INSTALLATION

A. Special techniques: Install in accordance with the recommendations of the manufacturer.

END OF SECTION

SECTION 13209A

PRESSURE FILTER VESSEL

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes: Pressure filter vessel and internal piping as described herein.

B. The Work to be provided by the vessel SUPPLIER of the pressure filter vessels, internal piping, and filter media, includes the following:
   1. Submission of shop drawings and other descriptive information.
   2. Fabrication of the equipment.
   3. Factory testing.
   4. Delivery of the equipment to the Project site or designated storage location as directed by the CONTRACTOR.
   5. Installation assistance, quality control, quality assurance, and inspection.
   6. Follow-up services as specified.

C. The SUPPLIER shall coordinate with the CONTRACTOR for shipment and delivery of the equipment provided in this section. The CONTRACTOR will be responsible for installing the SUPPLIER's equipment, unless otherwise noted in this specification.

D. Related Sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01612 - Seismic Design Criteria.
      b. Section 01614 - Wind Design Criteria.
      c. Section 01660 - Testing, Training, and Commissioning.
      d. Section 01740 - Warranties and Bonds.
      e. Section 01782 - Operation and Maintenance Data.
      f. Section 17302 - Flow Measurement – Magnetic Flowmeters.

1.02 INVITED SUPPLIERS

A. One of the following SUPPLIERS, or equal:
   1. Filtronics, Inc.

1.03 PERFORMANCE AND DESIGN REQUIREMENTS

A. Filter:
   1. Design Criteria:

Design Criteria		
Description	**Units**	**Criteria**
Flow Rate (maximum)	gpm	40(1)(2)
Vessel		
Orientation	-	Vertical
Equipment Tag	-	60-FLT-716
Diameter	in	18
Straight Shell Length	in	77
Number of Internal Cells	-	2(1)
Filter Media		
Electromedia® I		
Depth	in	27
Support Media	-	
Depth	in	7
Performance		
Max. Iron Content	mg/L	0.30
Max. Manganese Content	mg/L	0.53
Max. hydrogen sulfide/dissolved sulfide	mg/L	0.50
Total Organic Carbon Content	mg/L	0.00
Total Contaminant Reduction	%	>95
Check valve Buna-N seal, Stainless Steel internals	Each	1
Floating suction strainer with non-floating hose	Each	1
Piping	-	Stainless Steel, Type 304, Sch. 80

Notes:
(1) Normal operation will be one cell in filtration mode at a total flow of 20 gpm, max, and one cell in backwash or standby mode.
(2) In rare cases, both filtration cells will be used simultaneously for a max filtration rate of 40 gpm.

1.04 SUBMITTALS

A. SUPPLIER shall submit for review engineering Drawings as per Specification 01330 – Submittal Procedures. The submittal engineering drawings shall show the following:
   1. Shop Drawings: Complete layout and fabrication drawings, including dimensions, weights, and details of components.
   2. Product Data: Provide data verifying specification compliance of all products furnished hereunder. Shipping and installed dimensions and weights of all items and fabrication, including connection drawings and product data sheets.

3. Installation Instructions:
    a. Filter: Provide connection requirements and installation procedures.
    b. Media:
        1) Provide instructions for loading media.
        2) Provide instructions for washing and skimming media.
4. SUPPLIER's Field Report: Indicate personnel present and actual tests and start up procedures that are to be provided and performed by SUPPLIER.
5. Operation and Maintenance Manuals, as specified in Section 01782.
6. Provide anchor bolt details, embedment depth, edge distance, calculations, and installation instructions stamped by a Registered Civil or Structural Engineer meeting the requirements of Section 01612 – Seismic Design Criteria and Section 01614 – Wind Design Criteria. CONTRACTOR is responsible to coordinate the anchor bolt design with the footing design shown on the Contract Drawings. The anchor bolts shall be designed to work with the footing dimensions as shown on the Contract Drawings.
7. Signed pressure test report from vessel fabricator.

1.05 WARRANTY

A. The Fe-Mn pressure filter equipment manufacturer shall guarantee that the materials and/or the workmanship of the equipment supplied be free of defects for a period of 2 years from the date specified in Section 01740.

PART 2 PRODUCTS

2.01 DESIGN, CONSTRUCTION AND MATERIALS

A. All piping and fastening hardware inside the vessel not directly welded to the vessel shall be Type 304 SST Sch. 80 unless specified otherwise.

B. Filter Vessels: Provide pressure filter vessels meeting the following requirements:
1. Construction:
    a. All vessel components and internal piping shall be constructed of stainless steel.
    b. The tank shall be designed for a maximum allowable working pressure of 60 psig at 120 degrees Fahrenheit. Fabricator's test data report shall be submitted for each vessel.
    c. Ports and connections for each filter shall be as listed below.
        1) Inlet: 2-inch. One inlet connection per filter cell.
        2) Outlet: 2-inch. One outlet connection per filter cell.
        3) Drain: One connection at lowest elevation in each filter cell to allow full withdrawal of tank contents by gravity.
        4) Air vent: One per filter cell.
        5) Vessels shall be designed to allow one cell to be in filtration mode while the adjacent cell is in backwash or standby mode.
2. Filter internal equipment shall consist of the filter inlet (or upper) and outlet (or lower) systems. These systems consist of a header and lateral pipes.
    a. The filter inlet assembly shall be designed with the following features:
        1) All piping shall be stainless steel Type 304, Sch. 80.
        2) Inlet piping shall be designed to allow 36 inches of freeboard between the top of media bed to bottom of inlet piping.

b. The filter outlet assembly shall be designed with the following features:
   1) Steel plate with nozzles.
   2) Flow Nozzles and Inserts:
      a) Nozzles shall be 0.3 mm slot size, NPT.
      b) Each media retaining underdrain nozzle shall be molded of NSF certified polypropylene. They shall screw into the nozzle insert adapters and shall have narrow, slot openings suitably sized for compatibility with the filter media. The slots shall be designed to prevent clogging from small particles. The nozzles shall be designed to uniformly distribute washwater during the backwash cycle, and collect filtered water during the filtration cycle. The nozzles should be of unibody construction requiring no epoxy or metal fasteners for installation.
      c) Each nozzle shall be designed to allow the direct placement of media (as specified) on top of the nozzle.
      d) The manufacturer shall supply torque and other installation instructions and requirements to account for the variation in temperature from installation to service and other effects that may cause the nozzles to loosen in service.
      e) Nozzles shall be installed by SUPPLIER and back-out torques checked in the field during installation.
   3) Outlet header pipe and nozzles beneath steel plate.
   4) All piping shall be stainless steel Type 304, Sch. 80.
   5) All fasteners, tie-downs and brackets for outlet header and lateral pipes shall be designed and provided by SUPPLIER.

3. All materials shall be NSF-61 certified.
4. All hardware fasteners shall be stainless steel Type 304.
5. All internal support brackets and structure members shall either be stainless steel Type 304.

C. Filter Media:
   1. Filter media must meet or exceed all performance requirements in Article 1.03 of this Section.
   2. Filter media must be NSF-60/61 certified.

D. Filter Accessories:
   1. Flowmeters:
      a. Flowmeters shall be 2 inches in diameter, magnetic type construction, working pressure of 150 psi. Total flow shall be 6 digit direct reading with clock type register in units of gallons per minute.
         1) Provide Flowmeter Per Specification Section 17302.
      b. Meters shall be constructed of cast bronze with AWWA Class D (ISOPSI) with integrated NPT threaded connections. Interior wetted parts shall be NSF certified.
      c. 316 Stainless Steel electrodes.
      d. Influent and backwash flow meter: quantity of 1.
      e. Effluent flowmeter: quantity of 1.
   2. Backwash flow control valve: quantity of 1.
      a. The backwash flow control valve shall be electrically controlled and have a mechanical limit stop. The stop will go through the cover of the valve and limit the opening distance of the valve.

b. Alignment pins shall be provided to assure proper re-assembly of the cover to the valve body after maintenance or inspection.
c. The diaphragm may be replaced without removing the valve from the line.

3. Automation controls
   a. A single 120VAC power feed will be provided to the filter skid. All components requiring power shall be prewired to a single NEMA 4X, 316 SS junction box, which shall service as the main interface point for customer connection.
   b. Automation shall be for full, unattended operation including normal filtration, backwashing and purge (rinse) cycles. Controls shall be integrated into Fleck 2850 control heads or equal. Double pole, double throw relays shall be used to isolate all outputs from field devices. System ON-OFF switch shall be Allen-Bradley or equal. Separate operator adjustable timers shall be included for all normal operating cycles. Differential pressure switch shall be adjustable 0 to 70 psi. Operation will include filtration timer with differential pressure override and backwash timer with interlocking relays.
   c. The filter outlet shall have an automated 3-way valve so that the outlet line shall supply water for backwashing to the inlet of the tank.
   d. Filter control cabinet shall include terminal for receipt of water level signal and shall also include provisions for automatic operation based upon signal received.
   e. The owner or their engineers will, at their discretion and with sufficient notice to the manufacturer, witness the factory testing of the hardware and software of the Filter Control prior to shipment.
   f. Provide 120VAC rated dry contact output for connection to the plant SCADA indicating when a backwash sequence is active.
      1) Wired to the NEMA 4X, 316 SS junction box.

2.02 FABRICATION AND MANUFACTURE

A. All welds to be continuous, sharp corners to be dulled with power grinder.

B. Factory assemble components units to the greatest extent practical. Remainder of equipment shall be field installed by the CONTRACTOR.

PART 3 EXECUTION

3.01 INSTALLATION

A. CONTRACTOR will verify vessel dimensions and tolerances per shop drawings and report any discrepancies to ENGINEER within the first 5 days of inspection by the SUPPLIER. CONTRACTOR will provide report to ENGINEER and SUPPLIER.

B. Installation of the equipment will be by the CONTRACTOR in accordance with the Contract Documents and the SUPPLIER's engineering drawings and instructions.

C. Should any underdrain materials including the screens or pipes become damaged in any way, SUPPLIER shall remove and replace them before the placement of the media.

D. SUPPLIER shall inspect and provide written approval for installation of all filter internal piping before placement of media.

E. SUPPLIER shall provide the following on-site field visits:
   1. 1 day for the following:
      a. Inspection of all vessels with internal piping fully installed.
      b. Training of CONTRACTOR for filter media washing.
   2. 1 day for filter startup, testing, optimization, and training of OWNER's staff.
   3. 1 additional day of training of OWNER's staff during Commissioning Phase as per Section 01660.
   4. Service time spent remedying equipment deficiencies/problems provided by the SUPPLIER shall not count toward the listed service days and trips.

3.02 FIELD TESTING

A. Field Checks:
   1. Prior to the final acceptance field testing, the SUPPLIER shall field verify that all components are installed properly and function as specified herein. These checks for proper installation and alignment shall include, but not be limited to:
      a. Pressure vessel installation.
      b. Internal piping.
      c. Media depth.

B. Upon completion of these checks, the SUPPLIER shall submit to the OWNER, written certification that the vessel and components associated with SUPPLIER's scope of work have been properly installed, are in good condition, are functioning properly, and are in accordance with the Contract Documents.

END OF SECTION

SECTION 13210

WELDED STEEL TANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Welded, ground-supported, flat-bottom, steel tanks with concrete ring-wall type foundations and concrete column footings.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01612 - Seismic Design Criteria.
      b. Section 01330 - Submittal Procedures.
      c. Section 01614 - Wind Design Criteria.
      d. Section 01740 - Warranties and Bonds.
      e. Section 01757 - Disinfection.
      f. Section 03200 - Concrete Reinforcing.
      g. Section 03300 - Cast in Place Concrete.
      h. Section 09974 - Coating for Welded Steel Water Tanks.
      i. Section 11122 - Reservoir Mixer.
      j. Section 13110 - Water Storage Tank Cathodic Protection System.
      k. Section 17206 - Level Measurement – Ultrasonic.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. Specification for Structural Steel Buildings.

B. American Water Works Association (AWWA):
   1. D100 – Standard for Welded Carbon Steel Tanks for Water Storage.

C. ASTM International (ASTM):
   1. A 36 -Standard Specification for Carbon Structural Steel.
   2. A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   3. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   4. D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).

5. D 4318 - Standard Test Methods for Liquid Limit Plastic Limit, and Plasticity Index of Soils.
6. Steel Structures Painting Council (SSPC) – SSPC-SP-5 White Metal Blast Cleaning Specification.

D. California Code of Regulations (CCR):
1. Title 22 - Social Security.

E. NSF International (NSF):
1. 61 - Drinking Water System Components – Health Effects.

F. National Fire Protection Agency (NFPA):
1. Standard 22 - Standard for Water Tanks.

1.03 DEFINITIONS

A. Bottom capacity level (BCL): Water level (elevation) above which the specified capacity is provided. BCL is water level (elevation) at the top of the outlet nozzle.

B. Maximum operation level (MOL): MOL is equal to TCL.

C. Tank capacity: Net volume, in gallons, that may be removed from a tank filled to top capacity level and emptied to bottom capacity level.

D. Top capacity level (TCL): Water level (elevation) equal to lip of overflow.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
1. General:
   a. Tank design and workmanship: In accordance with AWWA D100, except as modified in this Section.
   b. In accordance with CCR, Title 22, Division 4, Chapter 16, Article 6, §64585 Design and Construction.
   c. In accordance with applicable portions of AISC Specification for Structural Steel Buildings.
   d. Inlet pipe flow rate: 100 gallons per minute design.
   e. Tank shall be in accordance with NSF 61.
   f. Tank shall be designed by a civil or structural engineer registered in the state where the Project is located.
   g. Bolted tanks will not be considered.
   h. In addition to other requirements, tank will be in accordance with NFPA requirements.
2. Tank dimensions and capacity:
   a. Inside diameter: 35 feet.
   b. Net capacity: 122,342 gallons.
   c. Bottom capacity level: Elevation indicated on the Drawings.
   d. Maximum operating level: Same elevation as top capacity level.
   e. Top capacity (overflow) level: Elevation indicated on the Drawings.
3. Design loads:
   a. Nozzle connections:
      1) Capable of resisting following loads:
         a) Dead loads.

b) Hydraulic thrust loads.
c) Wind design criteria as specified in Section 01614, except as noted below.
d) Seismic design criteria as specified in Section 01612.
e) Moments and forces due to movement of flexible piping connections to tank shell.

2) Reinforce shell in accordance with AWWA D100.

b. Pressure:
1) Design tank for pressure loss for air flowing in and out of the vent.

c. Roof live load:
1) 20 pounds per square foot.

d. Seismic:
1) Design in accordance with AWWA D100 using pseudo dynamic approach in Section 13. Design for vertical seismic acceleration.
2) Vertical accelerations: 67 percent of horizontal acceleration.
3) Seismic importance factor: 1.5.
4) Simultaneously combined vertical and horizontal accelerations.
5) Combine wall shell hoop stresses using the square root of the sum of the squares.
6) Column seismic lateral load: Lateral pressure based on calculated hydrodynamic load.
7) Seismic Use Group: III.
8) Spectral response coefficients $S_{DS,}$ $S_{D1,}$ and soil profile type as specified in Section 01612.

e. Snow load: Not applicable.

f. Wind:
1) Basic wind speed: 100 miles per hour.
2) Wind exposure: C.

4. Assembly bolts:
a. Bolted connections shall be avoided wherever a suitable welded connection can be provided.
b. In accordance with ASTM A 307, Grade B, or ASTM A 325.
c. Hot-dip galvanize.

5. Column base plates:
a. Provide 1/4-inch minimum wear plate seal-welded to the tank bottom with 1/4-inch welds.
b. Provide column baseplate held in place by clip angle guides seal-welded to the tank bottom or wear plate.

6. Column concrete footing:
a. Shall be designed by the tank manufacturer:
b. Minimum footing thickness: 18 inches.
c. Joint material: 1/2 inch asphalt impregnated cane fiber joint material in accordance with ASTM D 1751.
d. Allowable soil bearing pressure for dead load plus live load: 1,000 pounds per square foot. The allowable bearing pressure is in addition to weight of super imposed water column and tank bottom.
e. Allowable soil bearing pressure for dead load plus live load plus wind or seismic load: 1,800 pounds per square foot. The allowable bearing pressure is in addition to weight of super imposed water column and tank bottom.

7. Copper bearing steel: Not required.

8. Corrosion allowance:
    a. 1/8 inch.
    b. In accordance with AWWA D100, Section 3.9.
    c. In addition to minimum plate thickness specified.
    d. Cannot be used in design calculations for strength and stiffness. Dead loads shall include weight of corrosion allowance.
    e. Apply to tank shell plates, roof plates, floor plates, and all other structural members such as rafters and columns.
9. Floor plates:
    a. Minimum thickness: 1/4 inch, not including corrosion allowance.
    b. Minimum thickness of marginal sketch plates under shell bottom ring: 5/16 inch, not including corrosion allowance.
    c. Butt weld joints between annular bottom plates.
10. Foundation anchor bolts and chairs:
    a. Anchor bolts:
        1) In accordance with ASTM A 307.
        2) Maximum allowable anchor bolt stress: 15,000 pounds per square inch plus a 1/3 increase for load combinations that included wind and seismic loads.
        3) Minimum anchor bolt diameter: 1-1/4 inches.
        4) Maximum anchor bolt spacing: 10 feet.
        5) Threaded upset ends that are capable of developing the full ultimate strength of the anchor bolt.
    b. Anchor bolt chairs: Design anchor bolt chairs for an ultimate strength of not less than 1.25 times the ultimate strength of the anchor bolts.
11. Openings in tank shell:
    a. Locate openings in the tank shell where indicated on the Drawings.
    b. Provide suitable reinforcement and welding around openings in the tank shell.
    c. Submit design calculations for all reinforcements of openings.
12. Pipe connections:
    a. Locate pipe connections where indicated on the Drawings.
    b. Provide suitable reinforcement and welding around pipe connections to the tank shell.
    c. Submit design calculation for all pipe connections.
13. Ring walls concrete footing:
    a. As indicated on the Drawings.
    b. Top of concrete ring wall footing shall meet the tolerance of AWWA D100, Section 12.6.2.
    c. Mechanically-anchored tanks:
        1) Support tank above concrete ring wall footing on 1-inch minimum thickness of grout.
    d. Materials and construction per Sections 03200 and 03300.
14. Roof:
    a. Weathertight steel construction. Lap weld roof plates on outside.
    b. Roof pitch: 3/4 inch in 12 inches. No eave projections.
    c. Minimum roof plate thickness: 1/4 inch, not including corrosion allowance.
    d. Support roof plates with steel rafters.
    e. Supported rafters at their outer ends by an angle or similar support welded to the inside face of the tank shell plates and at their inner ends by 1 or more columns.
    f. Provide 3-foot radius knuckle around edge of roof.

15. Roof columns:
    a. Carry roof loads by a center column as indicated on the Drawings.
    b. Type: tubular.
    c. Hermetically seal weld at both ends.
16. Roof system:
    a. Provide roof support system using 1 center column
    b. Maximum spacing of roof rafters supporting roof plates: 7 feet at tank periphery or at any other point.
    c. Maximum deflection in the roof structure: 1/200 of the span under the combined condition of live and dead loads.
    d. Seismic design of the roof framing and columns is required.
    e. Select roof beams with adequate lateral stiffness to prevent buckling, or provide bridging.
        1) Do not consider friction between the roof beams and roof plates for determining roof beam stability.
17. Shell plates:
    a. Roll curved shell plates to the required radius for the full plate length (no end tangents) regardless of thickness.
18. Tank anchorage:
    a. Mechanically anchor tank.
    b. Minimum base for subgrade area inside the concrete ring wall: 12 inches of clean washed sand.
        1) Sand:
            a) Compatible with cathodic protection manufacturer's recommendations.
            b) Free of oil, salts, and other impurities.
            c) Maximum resistivity: 40,000 ohm-centimeter.
            d) Clean, coarse, natural sand.
            e) Non-plastic when tested in accordance with ASTM D 4318.
            f) Particle size:
                (1) 100 percent passing a 1/2-inch sieve.
                (2) Not more than 20 percent passing Number 200 sieve.
19. Welding:
    a. Butt joints: Complete penetration welds.

1.05 SUBMITTALS

A. Submit per Section 01330.

B. Calculations:
    1. Submit design calculations at same time that the detailed tank drawings are submitted.
    2. Design calculations shall be signed and sealed by a civil or structural engineer registered in the state where the Project is located.

C. Certifications.

D. Certified mill tests for steel plate and structural members.

E. Product data.

F. Radiographic weld inspection reports and film.

G. Shop drawings.

H. Welding details.

I. Welding procedures.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Tank fabricator:
      a. Regularly engaged in the design, fabrication, and erection of welded steel tanks of the type specified in this Section for a period of not less than 10 years.
      b. Provide a list of all tank projects completed in the last 5 years, including names, addresses, and telephone numbers of the reference for each project.

B. Certifications:
   1. Submit certificate that the tank and accessories have been properly designed, fabricated, erected, installed, inspected, and tested in accordance with AWWA D100, and is ready for full-time service.

1.07 WARRANTY

A. The reservoir shall be warranted against leakage for a period of 5 years starting from the date specified in Section 01740.

B. The coating applicator shall guaranty, in writing, that all materials and workmanship are in accordance with this Specification and will satisfy the service conditions for a period of 5 years starting from date specified in Section 01740.

1.08 PRE-INSTALLATION MEETINGS

A. Fabrication conference:
   1. Convene prior to fabrication of the tank.

B. Pre-coating conference:
   1. Schedule prior to the start of coating application.
   2. Attendees shall include the coating manufacturer and coating subcontractor.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Reject tank plates that show signs of corrosion or pitting.

B. Handling plates: Do not drag or otherwise handle plates in any manner that might cause scratching or gouging of the metal.

1.10 PRIME SUPPLIER AND ERECTOR

A. CONTRACTOR shall provide a tank fabrication and erection Contractor who shall be responsible for design, fabrication, and erection of the tank and its appurtenances, coating the tank, providing cathodic protection system, and providing the tank mixer.

1.11 PROJECT CONDITIONS

A. Existing conditions:
   1. Tank erector shall supply electricity, compressed air, and other utilities needed for construction of the reservoir and its appurtenances

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Crosno Constructors, Inc.
   2. Pacific Tank Solutions.
   3. Paso Robles Tank.

2.02 ACCESSORIES

A. Chlorine injection point:
   1. 1-inch female NPT connection on tank
   2. Location: 2 feet – 6 inches above tank floor.
   3. 150 pound retractable injector quill:
      a. SAF-T-FLO EB-146-S-S-12-0-V-10.
      b. Or equal.

B. Drain:
   1. 6-inch by 12-inch flush connection per API 650.
   2. Place bottom of drain flush with bottom of tank.

C. Ladders:
   1. Coat ladders and appurtenances with the same coating as specified for adjacent tank surfaces.
   2. Provide fall prevention safety devices on interior and exterior ladders.
   3. Construct ladders and brackets using steel in accordance with ASTM A 36.
   4. Exterior Ladder:
      a. Provide an exterior steel ladder and roof hatch access platform with guardrail as indicated on the Drawings.
      b. Fit ladder with a safety cage that has a lockable access.
   5. Interior Ladder: Provide an interior steel ladder as indicated on the Drawings.

D. Ladder safety devices:
   1. Provide a safety system on both ladders complete with galvanized steel safety rail, safety sleeve, and 2 safety harnesses.
   2. Install catholically isolated from tank ladder using rubber gaskets.
   3. Manufacturers: One of the following or equal:
      a. North, SAF-T-CLIMB.
      b. DBI, RAILOK.

E. Liquid level indicator: As specified in Section 17206.

F. Locate accessories where indicated on the Drawings.

G. Manholes in shell:
   1. Two 30-inch diameter bolted manholes located in the bottom shell ring.
   2. Locate center of manholes 3 feet 6 inches above bottom of tank.
   3. Provide suitable means to hold the manholes in an open position.
   4. Use loose hinges to allow for easy bolting.
   5. Provide gaskets for a watertight seal.
   6. Round all exposed edges to a smooth 1/4-inch radius.

H. Nameplate: Provide nameplate that identifies the tank and is substantially in the form of the nameplate shown in figure C.2 of AWWA D100.

I. Overflow nozzle: Size as indicated on the Drawings; flanged with Number 14-mesh bronze screen.

J. Roof hatch:
   1. Access hatch with ladder:
      a. Size: 2 feet 6 inches by 3 feet 0 inches.
   2. Access hatch for mixer:
      a. Size: 2 feet 0 inches by 2 feet 0 inches.
   3. Locking roof hatch with compression spring operators and automatic positive action hold-open arm.
   4. Locate hatchs where indicated on the Drawings.
   5. Provide landing over roof knuckle at ladder.
   6. Provide guardrail where indicated on the Drawings.

K. Roof vent:
   1. Provide one 2-foot maximum height, umbrella-type, lightproof, screened vent at least 6 inches in diameter.
   2. Locate vent at the center of the tank.
   3. Design vent for an airflow of at least 500 cubic feet per minute with a pressure loss across the vent of less than .25 inches of water.
   4. Cover vent with a Number 14 bronze screen.
   5. Provide special freeze resistant insert screen.
   6. Provide pressure-vacuum relief mechanism that will operate if the screen frosts over or becomes clogged.

L. Sample tap:
   1. 3/4-inch threaded connection.
   2. Location: four taps located as shown on the Drawings.

M. Tank overflow:
   1. The maximum pumping flow rate to the tank is 100 gallons per minute.
   2. Design the tank overflow for 1.25 times the maximum pumping flow rate.
   3. Maximum water level at the full overflow rate: 6 inches above the weir.
   4. Overflow type and details as indicated on the Drawings.
   5. Provide gusset plate support for overflow.

N. Cathodic Protection appurtenances:
   1. Provide sealed hand holes, panel brackets, taps, conduit supports, and other appurtenances required by the cathodic protection system supplier.

O. Mixer:
   1. Provide mixer per Section 11122.

2. Provide 24-inch-by-24-inch curbed, lockable hatch for mixer where indicated on the Drawings.
3. Provide lifting chain hook and through-roof fitting for mixer power cable.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. Assembly devices:
   1. Do not use fitting-up holes.
   2. Assembly devices may be welded to the adjoining parts during erection, but must be carefully removed after erection by chipping, or burning and chipping, in a manner that will not deface the metal surface of the tank plates.

B. Cathodic protection:
   1. Provide cathodic protection as specified in Section 13110.

C. Coating:
   1. Coat tank as specified in Section 09974.

D. Construct ring wall and tank anchorage as indicated on the Drawings.

E. Grade preparation:
   1. Construct subgrade and tank floor to the grade and shape indicated on the Drawings.

F. Provide bracing and support of the tank while under construction.
   1. Design and install bracing and supports for wind protection.

G. Tolerances:
   1. Tank wall plumbness: Less than 1 inch in 200 inches.
   2. Column plumbness: Less than 1 inch in 500 inches.
   3. Tank roundness: Within 3/4 inch of the tank radius indicated on the Drawings.
   4. Peaking: Less than 1/2 inch in 36 inches.
   5. Banding: Less than 1/2 inch in 36 inches.
   6. Local deviation:
      a. Less than 1/2 inch in 36 inches.
      b. Local deviations will be determined by use of a 36-inch straight edge and a 36-inch radius board.
      c. Local deviations include dings and dents.

H. Welding:
   1. Do not weld poor fitting, wet, oily, or dirty steel.
   2. Do not weld in high winds or during weather such that the operator cannot work in physical comfort.
   3. Thoroughly clean each layer of weld metal with a power-driven wire brush.
      a. Peen welds to prevent excessive residual stresses in welds that are not free to move as the weld metal cools.
      b. Peening may be used to loosen slag.

3.02 FIELD QUALITY CONTROL

A. Certified welders:
   1. Welds shall be performed by a certified welder.
   2. Submit up-to-date certification papers.

B. Damaged plates: Tank plates with pitting or deep gouges will be rejected.

C. Leak tests:
   1. Test tank floor in accordance with AWWA D100 after welding and before coating.
   2. Repair leaks appearing in the shell or bottom of the tank when it is first filled after coating. Recoat the affected areas after repairing leaks.
   3. OWNER will provide water for testing the tanks for the first test at no cost to the CONTRACTOR. CONTRACTOR is responsible for the cost for water for subsequent tests.
   4. Provide all equipment, piping, valves, pumps, and other facilities required to fill the tanks for any and all test work.

D. Submit welding procedures.

E. Weld tests:
   1. Inspect welds at anytime when required by ENGINEER. Inspect welds using radiographic procedures.
   2. ENGINEER will be present to witness the inspection of welds.
   3. ENGINEER has the right at any time to call for and witness the radiographic inspection of welds.
   4. CONTRACTOR responsible for cost of radiographic inspection.
   5. Repair welds found to be defective, at no additional cost to the OWNER.
   6. Field inspect of welds in accordance with AWWA D100.

3.03 CLEANING

A. Clean and disinfect tank as specified in Section 01757.

END OF SECTION

SECTION 13217

PLASTIC LINER FOR CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Plastic liners for concrete structures.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01312 - Project Meetings.
      b. Section 01330 - Submittal Procedures.
      c. Section 03200 - Concrete Reinforcing.

1.02 REFERENCES

A. ATSM International (ASTM):
   1. D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
   2. D 2240 - Standard Test Method for Rubber Property - Durometer Hardness.

1.03 PERFORMANCE REQUIREMENTS

A. Plastic liner:
   1. Impermeable to sewage gases and liquids.
   2. Non-conductive to bacterial and fungus growth.
   3. Impact resistant.
   4. Flexible.
   5. Have elongation sufficient to bridge up to 1/8 inch settling cracks.
   6. Attached to concrete by T-lock mechanism.
   7. Adhesive bond not allowed unless otherwise indicated on the Drawings specific locations.
   8. Withstand 15 psi back hydrostatic pressure applied to liners under surface without losing anchorage and without rupture and leakage.

1.04 SUBMITTALS

A. General: Submit as specified in Section 01330.

B. Product data: Submit manufacturer’s literature and illustrations for all components indicating size, dimensions, and configuration. Include manufacturer's installation instructions.

C. Design data.

D. Shop drawings: Indicate materials, dimensions, details of construction; proposed layout of liner sheets for cast-in-place structures; location and type of field welds; installation details of how structure will be lined, and how returns, corners, joints, and coverage will be accomplished.

E. Samples:
   1. 12-inch-by-12-inch plastic liner.
   2. All joint and weld strips.

F. Spark type detector proposed for testing.

G. Test reports.

H. Manufacturer's Field Reports.

I. Certificates.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications: Minimum 5 years experience manufacturing specified product, with satisfactory performance record.

B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 3 projects of similar scope as Project with satisfactory performance record.

C. Qualifications of welders:
   1. Welder shall prequalify by successfully passing welding test before performing welding of liner.
   2. Re-qualification may be required.
   3. Make test welds in presence of ENGINEER.
   4. Submit weld specimen for testing.
   5. Welding test procedure:
      a. Lap 2 minimum 15 inch long by 9-inch wide pieces of liner 1-1/2 inches along longer edge.
      b. Hold pieces of liner vertically.
      c. Position minimum 19-inch long welding strip over edge of lap with 2-inch tabs at top and bottom.
      d. Weld strip to both pieces of liner.
   6. ENGINEER will test welds as follows:
      a. Test each welding strip tab separately.
      b. Apply 10-pound pull normal to face of liner with liner being held firmly in place.
      c. Pull test results:
         1) Satisfactory: No separation between welding strip and liner when tested.
      d. Cut 3 test specimens from welded sample.

e. Test specimens for tension across welds.
f. Tension test results:
   1) Satisfactory: No failed specimen.
   2) Retest: One failed specimen.
   3) Disqualified: More than 1 failed specimen.
g. Retest:
   1) Test 3 additional specimens cut from original welded sample.
   2) Satisfactory: No failed retest specimen.

7. Disqualified welders may submit new welding samples when disqualified welders have had sufficient off-the-job training or experience to warrant re-examination.

1.06 PRE-INSTALLATION CONFERENCE

A. Conduct as specified in Section 01312.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following or equal:
   1. Ameron, T-lock Amer-Plate.

2.02 MATERIALS

A. Plastic liner sheet with and without locking extensions, and joint, corner, and welding strips:
   1. Composition: Minimum 99 percent high molecular weight polyvinyl chloride resin.
   2. Copolymer resins not allowed.
   3. Meet performance requirements.
   4. Color: White.

2.03 FABRICATION

A. Thickness of material:
   1. Liners with locking extensions: Minimum 65 mils.
   2. Liners without locking extensions: Minimum 65 mils.
   3. Welding strips: Minimum 94 mils to maximum 156 mils.
   4. Joint strips: Minimum 75 mils.

B. Sheet and strip sizes:
   1. Sheet size: As large as practicable with continuously welded minimum 1/2 inch laps.
   2. Joint strips: 4 inches wide, within 1/4 inch.
   3. Welding strips: 1 inch wide, within 15 mils.

C. Edge treatment of joint, welding, and outside corner strips: Beveled.

D. Locking extensions:
   1. Incorporate integral locking extensions in liners to be cast into concrete.
   2. Use same material as liner plate for extensions.

3. Provide cross section with minimum height of 0.375 inch and minimum web thickness of 85 mils.
4. Place extensions approximately 2-1/2 inches apart and so liner will be held permanently in place when extensions are embedded in concrete.
5. Make extensions parallel and continuous except where omitted for joints and transverse weep channels and strap channels.
6. Weep channels and strap channels, which involve omission of locking extensions, may be made during manufacture of liner.

E. Weep channels:
1. Provide at 8-foot maximum intervals longitudinally along liner, leave gaps, minimum 2 inches, or 3-1/2 inches for extruded sheets, to maximum 4 inches wide, in locking extensions to provide unobstructed transverse weep channels.
2. For areas behind liner that are not properly served by regular weep channels, provide additional weep channels 2 inches wide by cutting away locking extensions.
3. Cut weep channels into extruded sheet so that maximum of 1/32 inch of base locking extension is left on sheet.
4. At transverse joints in cast-in-place structures, leave minimum 2 inches to maximum 4-inch gaps in locking extensions to provide transverse weep channels.
5. When locking extensions are removed to provide weep channels at joints, base of extension left on sheet shall not exceed 1/32 inch.
6. Provide transverse weep channels approximately 12 inches away from each liner return where surfaces lined with plastic liner join surfaces that are not so lined.
7. Clear outlets of transverse weep channels of obstructions that could interfere with proper function of transverse weep channels.

F. Strap channels:
1. Cut transverse strap channels in locking extensions of sheets with extruded locking extensions so straps can be placed into and perpendicular to locking extensions.
2. Channels shall not be less than 1/2 inch wide and not more than 3/4 inch wide, cut so that maximum of 1/32 inch of base of locking extension is left in base of strap channel.
3. Place strap channels at minimum 15 inches to maximum 18 inches on center.
4. Do not cut strap channels through 2 extensions on each side of sheet.

G. Flaps: When transverse flaps are required, fabricate so that maximum of 1/32 inch of base of locking extension is left on sheet.

H. Adhesives and cleaners for use with plastic liner with locking extensions: Water soluble or dispersible, nonflammable product not detrimental to plastic liner.

2.04 SOURCE QUALITY CONTROL

A. ENGINEER may sample each type of sheet, strip, and welded joint for:
1. Material tests.
2. Tests for holes.
3. Tests of welded joints.

B. Materials from which specimens fail the tests shall be rejected.

C. Submit proposed repair methods.

D. ENGINEER may authorize repair of defects.

E. Material tests:
1. Tensile strength in accordance with ASTM D 412, Method A, die B.
2. Hardness in accordance with ASTM D 2240, Type D durometer.
3. Weight change specimen size: 1 inch by 3 inch.
4. Test for tensile strength and weight change at 28-day intervals.
5. Condition test specimens to constant weight at 110 degrees F before and after submersion in following solutions for 112 days at 77 degrees F, with a tolerance of plus or minus 5 degrees F.

Chemical Solution	Concentration
Sulfuric Acid	20 percent(1)
Sodium Hydroxide	5 percent
Ammonium Hydroxide	5 percent*
Sodium Hypochlorite	1 percent(1)
Nitric Acid	1 percent*
Ferric Chloride	1 percent
Soap	0.1 percent
Detergent (linear alkyl benzyl sulfonate or gas)	0.1 percent
Bacteriological (Biological Oxygen Demand)	Maximum 700 milligrams per liter
Notes: (1) Volumetric percentages of reagents of chemically pure grade.	

6. Plastic liner sheets, joint, corner, and welding strips shall have following physical properties when tested at 77 degrees F, with a tolerance of plus or minus 5 degrees F.

Property	Initial	After 112 Days Submersion in Previously Specified Chemical Solutions
Tensile Strength	2,200 psi minimum	2,100 psi minimum
Elongation at Break	200 percent minimum	200 percent minimum
Shore Durometer, Type D	Within 1 second 50-60; at 10 seconds 35-50	Within 5 with respect with respect to initial test result
Weight Change		Within 1.5 percent maximum

7. Liner locking extension embedded in concrete shall withstand test pull of at least 100 pounds per linear inch, applied perpendicularly to concrete surface for 1 minute, without rupture of locking extensions or withdrawal from embedment.
8. Perform tests at temperature between 70 degrees F to 80 degrees F, inclusive.
9. Plastic liner sheets, including locking extensions and joint, corner, and welding strips shall be free of cracks, cleavages, and defects adversely affecting protective characteristics of material.

F. Tests for holes:
   1. Test liner for holes using spark detector.
   2. Repair sheets having holes and retest liners until no holes are found.
   3. ENGINEER may take test samples at point of manufacture during production of strip material.

G. Tests of welded joints:
   1. Examine specimens for cracks or separations.
   2. Test specimens in tension after flexing.
   3. Specimen shall withstand minimum load of 132 pounds per linear inch of weld, or product of 2,000-psi times minimum thickness in inches of material adjoining weld, whichever is greater.
   4. Thickness shall be taken within 2-inch gauge length.
   5. Reject liner and liner joints containing tears, cracks, or separations.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface preparation: Use patterns or mark sheet layouts directly on forms where complicated or warped surfaces are involved.

3.02 INSTALLATION

A. Positioning liner:
   1. Position liner installed in cast-in-place structures so locking extensions are parallel to axis of structures.
   2. Closely fit liner sheets to inner forms.
   3. Cut sheets to fit curved and warped surfaces, using minimum number of separate pieces.

B. Securing liner in place:
   1. Finish nails may be used on wood forms.
   2. Where form ties or form stabilizing rods pass through liner, make provisions to maintain liner in close contact with forms during concrete placement.

C. Liner returns:
   1. Install liner returns where indicated on the Drawings and wherever surfaces lined with plastic liner join surfaces which are not lined, such as brick, clay pipe, cast iron pipe, manhole frames, and metal or clay tile gate guides.
   2. Fabricate liner returns by joining minimum 3-inch wide strips of liner to main liner with corner strips.
   3. Continuously weld corner strips to returns and to main liner and wherever possible, apply from back of lining.
   4. Provide locking extensions on returns to lock returns to concrete of plastic lined, cast-in-place structures.
   5. Seal liner to adjacent construction.

3.03 CONCRETE OPERATIONS

A. Concrete placement:
   1. Carefully vibrate concrete placed against liner to avoid damage to liner and to produce dense, homogeneous concrete securely anchoring locking extensions into concrete.
   2. Use external vibrators in addition to internal vibrators, particularly along lower terminal edge of plastic liner.

B. Removing forms:
   1. In removing forms, protect liner from damage.
   2. Do not use sharp instruments to pry forms from lined surfaces.
   3. When forms are removed, pull nails that remain in liner without tearing liner, and clearly mark resulting holes.
   4. Mark form tie holes before ties are broken off.
   5. Within limits of unlined invert, remove banding straps used in securing liner to forms for cast-in-place structures, and fill voids left in invert at edge of liner with cement mortar or other material acceptable to ENGINEER.

3.04 FIELD JOINTING OF LINER

A. General:
   1. Make no field joint in liner until structure has been backfilled and 30 days have elapsed.
   2. Where groundwater is encountered, do not make joint until pumping of groundwater has been discontinued for at least 30 days and no visible leakage is evident at joint.
   3. Liner at joints shall be free of mortar and other foreign materials and shall be clean and dry before joints are made.
   4. Do not bring hot joint compound in contact with liner.
   5. Do not apply coating over joints, corners, or welding strips.

B. Field joints in cast-in-place structures shall be one of following types:
   1. Type C-1:
      a. Make joints with 4-inch joint strips, and secured along each edge to adjacent liner by welding strips.
      b. Gaps between ends of lock extensions shall not exceed 1 inch.
      c. Width of spaces between adjacent sheets of liner shall not exceed 1/2 inch.
      d. Use joint at transverse contraction joints in concrete.
   2. Type C-2:
      a. Make joints by overlapping sheets not less than 1-1/2 inches and securing overlaps to adjacent liner with welding strips.
      b. Upstream sheet shall overlap downstream sheet.
      c. Length of overlapping sheet parts without locking extensions shall not exceed 4 inches.
      d. Apply welding strips to back of joint.
      e. Use joint at longitudinal joints in concrete and transverse liner joints other than at transverse contraction joints in concrete.

3. Type C-3:
    a. Make joints by putting sheets of liner together and applying welding strips over back of joints before concrete is poured, and applying welding strips over front of joint, after concrete is poured.
    b. Do not use this type of joint at transverse joints, which extend to lower terminal edges of liner or at joints where gaps between adjoining sheets of liner exceed 1/8 inch.

C. Installation of welding strips:
1. Employ qualified welders to fusion weld welding strips to joint strips and liner.
2. Continuously weld joint in one operation until joint has been completed.
3. At lower terminal edges of liner, extend each transverse welding strip at least 2 inches to provide tabs.
4. ENGINEER may test each transverse weld by applying 10-pound pull to tab, normal to face of structure.
5. Hold liner adjoining welding strip in place during application of force.
6. When weld failure develops, maintain 10 pounds pull until no further separation occurs.
7. Defective welds will be retested after repairs have been made.
8. Trim tabs away neatly after welding strip has passed test.

D. Joint reinforcement:
1. Apply 12-inch long welding strips as reinforcement across transverse joints in liner that extends to lower terminal edge of liner on each side structure.
2. Center reinforcement strips over joint being reinforced, locating as close to lower edge of liner as practicable.
3. Weld reinforcement strips in place after transverse welding strips have been tested and test tabs removed.

3.05 FIELD QUALITY CONTROL

A. Tests:
1. Clean surface of liner to permit visual inspection and spark testing.
2. Physically test welds with nondestructive probing method.
3. Liner, when installed, may be tested by ENGINEER, using spark type detector.
4. Properly repair and retest areas of liner failing to meet field test.
5. Use spark type detector for testing.
6. Test each transverse welding strip, which extends to lower edge of liner.
7. Extend welding strips below liner to form tabs.
8. Apply 10-pound pull normal to face of structure by means of spring balance.
9. Hold liner adjoining welding strip against concrete during application of force.
10. Maintain 10-pound pull when weld failure develops, until no further separation occurs.
11. Retest defective welds after repairs have been made.
12. Trim tabs away neatly after welding strip has passed inspection.
13. Provide equipment required to test liner in accordance with manufacturer's instructions.
14. Provide personnel qualified to perform testing.
15. Perform testing in presence of ENGINEER.

B. Inspections: Liner shall be applied and secured to forms and inspected by ENGINEER prior to placement of reinforcing steel as specified in Section 03200.

3.06 PROTECTION AND REPAIR

A. Take necessary measures and precautions to prevent damage to liner from equipment and materials used in, or taken through Work.

B. Repair damage to installed liner as follows:
   1. Patch nail and tie holes and cuts, tears, and abraded areas.
   2. Fuse patches made entirely with welding strip to liner over entire patch.
      a. Limit use of this method to patches that can be made with single welding strip.
   3. Do not use parallel, overlapping, or adjoining welding strips.
   4. Larger patches may consist of smooth liner over damaged area with edges covered with welding strips fused to patch and to liner adjoining damaged area.
   5. Limit width of single patch of latter type to 4 inches.

END OF SECTION

SECTION 13446

MANUAL ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Valve and gate actuators.
   2. Handwheel actuators.
   3. Key operated valves.
   4. Bench stands.
   5. Floor stands.
   6. Accessory equipment and floor boxes.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 09960 - High-Performance Coatings.
      b. Section 11294B - Heavy-Duty Fabricated Stainless Steel Gates.

1.02 REFERENCES

A. Aluminum Association (AA):
   1. DAF-45 - Designation System for Aluminum Finishes.

B. American Water Works Association (AWWA).

1.03 SUBMITTALS

A. Shop drawings: Include shop drawings for hydraulic gate lifts with shop drawings for gates as integrated units.

1.04 QUALITY ASSURANCE

A. Provide valve actuators integral with valve or gate, except for valve actuators utilizing T-wrenches or keys, and portable actuators intended to operate more than 1 valve.

B. Provide similar actuators by 1 manufacturer.

C. Provide gates and hand operating lifts by 1 manufacturer.

D. Provide hydraulic gate lifts by 1 manufacturer.

E. Provide hydraulic valve actuators and motorized actuators by 1 manufacturer.

1.05 MAINTENANCE

A. Extra materials:
   1. Key operated valve keys or wrenches: Furnish a minimum 4 keys with 4-foot shafts and 3-foot pipe handles or wrenches with 4-foot shafts and 3-foot handles for operating key operated valves.

PART 2 PRODUCTS

2.01 VALVE AND GATE ACTUATORS

A. Stem covers:
   1. Aluminum pipe; threaded cap on top; bolted aluminum flange on bottom; 1- by 12-inch slots cut at 18 inches on center in front and back of pipe; capable of covering threaded portion of greased stems that project above actuators when gates or valves are opened or closed. Clear plastic stem covers with mylar indicating strips are also acceptable in accordance with Section 11294B.

B. Stem cover flanges, pipes and caps:
   1. After fabrication, etch and anodize aluminum stem covers to produce the following chemical finishes in accordance with AA publication DAF-45:
      a. A 41 - Clear Anodic Coating.
      b. C 22 - Medium Matte Finish.

C. Gate stem covers: Concentric with stem.

D. Position indicators:
   1. Tail rods on hydraulic cylinders, or dial indicators with clear full-open and closed position indicators, calibrated in number of turns or percentage of opening. Indicating strips are also acceptable in conjunction with clear plastic stem covers.

E. Manual or power actuator size:
   1. Sized to deliver maximum force required under most severe specified operating condition, including static and dynamic forces, seat and wedge friction, and seating and unseating forces with safety factor of 5, unless otherwise specified.

F. Actuator size: Capable of supporting weight of suspended shafting unless carried by bottom thrust bearings; shaft guides with wall mounting brackets.

G. Provisions for alternate operation: Where specified or indicated on the Drawings, position and equip crank or handwheel operated geared valve actuators or lifts for alternate operation with tripod mounted portable gate actuators.

H. Operation: Counterclockwise to open with suitable and adequate stops, capable of resisting at least twice normal operating force to prevent overrun of valve or gate in open or closed position.

I. Open direction indicator: Cast arrow and legend indicating direction to rotate actuator on handwheel, chain wheel rim, crank, or other prominent place.

J. Buried actuator housing: Oil and watertight, specifically designed for buried service, factory packed with suitable grease, completely enclosed space between actuator housing and valve body so that no moving parts are exposed to soil; provide actuators with 2-inch square AWWA operating nut.

K. Worm gear actuators: Provide gearing on worm gear actuators that is self-locking with gear ratio such that torque in excess of 160 foot-pounds will not need to be applied to operate valve at most adverse conditions for which valve is designed.

L. Traveling nut actuators: Capable of requiring maximum 100 foot-pounds of torque when operating valve under most adverse condition; limit stops on input shaft of manual actuators for fully open and closed positions; non-moving vertical axis of operating nut when opening or closing valve.

2.02 HANDWHEEL ACTUATORS

A. Manufacturers: One of the following or equal:
   1. Rodney Hunt Company.
   2. Whipps, Inc.

B. Coating: Handwheel as specified in Section 09960.

C. Mounting: Floor stand or bench stand. Unless otherwise indicated on the Drawings position actuator 36 inches (nominal) above top of walkway surface.

D. Bearings above and below finished threaded bronze operating nut: Ball or roller.

E. Wheel diameter: Minimum 24 inches.

F. Indicator: Opening direction indicated with arrow, and word OPEN cast on top of handwheel indicating direction for opening.

G. Pull to operate: Maximum 40 pounds pull at most adverse design condition.

H. Stem travel limiting device: Setscrew locked stop nuts above and below lift nut.

I. Grease fittings: Suitable for lubrication of bearings.

2.03 HAND-CRANKED GEARED ACTUATORS

A. Type: Single removable crank; fully enclosed.

B. Mounting: Floor and bench stand. Unless otherwise indicated on the Drawings position actuator 36 inches (nominal) above top of walkway surface.

C. Operating nut: When scheduled for portable actuators.

D. Geared lifts: Single speed with minimum ratio of 2 to 1. 2-speed with minimum ratio of 4 to 1 if required by gate manufacturer.

E. Teeth on gears, spur pinions, bevel gears, and bevel pinions: Cut.

F. Lift nuts: Cast manganese bronze.

G. Exterior surfaces on lift parts: Smooth.

H. Bearings above and below flange on lift nuts: Ball or roller; capable of taking thrust developed by opening and closing of gates under maximum operating head; with sleeve bearings and sufficient grease fittings for lubrication of moving parts, including bearings and gears.

I. Crank rotation indicator: Cast arrow with word OPEN in prominent location readily visible indicating correct rotation of crank to open gate.

J. Hand cranks: 15-inch radius; requiring maximum 25 pounds pull to operate gate at maximum operating head; with:
   1. Revolving brass or nylon sleeves.
   2. Gears, spur pinions, bevel gears, and bevel pinions with cut teeth.
   3. Cast manganese bronze lift nuts.
   4. Cast-iron or cast aluminum lift parts with smooth exterior surfaces.

K. Indicator: Dial position type mounted on gear actuator; or clear plastic cover; marked with fully open, 3/4, 1/2, 1/4, and closed positions.

2.04 FLOOR BOXES

A. Manufacturers: One of the following or equal:
   1. Rodney Hunt Company.
   2. Whipps, Inc.

B. Floor boxes: Cast-iron; with:
   1. Counter type indicator.
   2. Hinged, lockable lid with directional arrow.
   3. 2-inch square AWWA operating nut.
   4. Packing gland providing drip-tight seal around valve shaft.

2.05 FLOOR STAND

A. Manufacturers: One of the following or equal:
   1. Rodney Hunt Company.
   2. Whipps, Inc.

B. Floor stand assemblies: Heavy-duty cast-iron, suitable for mounting specified actuator.

2.06 BENCH STANDS

A. Manufacturers: One of the following or equal:
   1. Rodney Hunt Company.
   2. Whipps, Inc.

B. Bench stands: Handwheel actuators or hand crank, geared actuators conforming to hand-cranked geared actuator requirements, except capacity to be mounted on haunch, wall bracket, or self-contained gate yoke.

2.07 ACCESSORY EQUIPMENT

A. Wall brackets or haunches: As indicated on the Drawings.

B. Stems: Stainless steel; sized to match output of actuator; minimum gate or valve operating stem diameter; maximum 200 slenderness ratio.

C. Stem couplings: Stainless steel or silicon bronze; internally threaded to match stem; lockable to stem by keyed attachment or bolts.

D. Stem guides: Stainless steel with silicon bronze bushing, or stainless steel with UHMW bushing; maximum 200 slenderness ratio; capable of being mounted with wall bracket; adjustable in 2 directions.

E. Wall brackets: Stainless steel, capable of withstanding output of actuator, adjustable in 2 directions.

F. Stem stuffing boxes: Stainless steel, with adjustable gland and packing.

G. Fasteners and anchor bolts: Type 316 stainless steel.

H. Geared valve actuators: Provided with cut gears, either spur or worm; sized to operate valves at most adverse design condition; with maximum 40-pound pull at handwheel or chain wheel rim.

I. Geared valve traveling nut actuators: Acceptable only where specified or indicated on the Drawings.

J. Accessory equipment for valves and gates requiring remote actuators: Operating stems, stem couplings, stem guides, wall brackets, and stem stuffing boxes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install floor boxes in concrete floor with lid flush with floor.

B. After installation of gate and stem covers, mark stem covers at point where top of stems are at full-open position and at closed position.

C. Attach floor stand to structure with anchor bolts.

D. Install stem stuffing boxes where operating stems pass through intermediate concrete floor slabs.

3.02 SCHEDULES

A. Geared actuators: Provide geared actuators for following valves:
   1. Butterfly valves larger than 6 inches, nominal size, on liquid service.
   2. Butterfly valves larger than 10 inches, nominal size, on gas and air service.
   3. Plug valves 6 inches, nominal size, and larger.

B. Handwheel actuators: Provide handwheel actuators for valves mounted 6 feet or less above floors.

C. Chain wheel actuators: Provide chain wheel actuators for valves mounted more than 6 feet to centerline above floors.

END OF SECTION

SECTION 13447

ELECTRIC MOTORIZED ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Electric motor-driven actuators for valves and gates.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
   3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01740 - Warranties and Bonds.
      b. Section 11294B - Heavy-Duty Fabricated Stainless Steel Slide Gates.
      c. Section 15111 - Ball Valves.
      d. Section 15112 - Butterfly Valves.
      e. Section 15116 - Plug Valves.
      f. Section 15117 - Specialty Valves.
      g. Section 16050 - General Work Results for Electrical.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. AWWA C504 - Rubber-Seated Butterfly Valves.
   2. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.

B. FM Global (FM).

C. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 DEFINITIONS

A. NEMA:
   1. Type 4 enclosure in accordance with NEMA 250.
   2. Type 4X enclosure in accordance with NEMA 250.
   3. Type 7 enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

A. Product data:
   1. Electrical ratings:
      a. Voltage and number of phases.

b. Starting and running current.
c. Voltage levels and source for control and status.

2. Description of integral control interface.
3. Integral and remote control station components.
4. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
5. Gear ratios for both manual and motorized actuation.
6. Opening and closing directions.
7. Allowable starts per hour.
8. List of all included options and accessories.
9. Full travel times.
10. Gearbox data including gear ratio, and gearbox efficiency.
11. Affidavit in accordance with AWWA C542.

B. Shop drawings:
1. Wiring diagrams:
a. Include all options and expansion cards furnished with each actuator.
2. Dimensioned drawings of each valve and actuator combination.
3. Dimensioned drawings of each valve gearbox.
4. Electric motor data.
5. Letters from both the motorized operator manufacturer and the gate manufacturer confirming that the proposed gate stem configuration has been coordinated with motorized operator selection. Both manufacturers shall confirm that the proposed gate stem configuration provides the most efficient combination of stem diameter/pitch/lead, will keep the operating temperature at the stem nut to a minimum during operation, and will meet the specified motorized operator operating speed requirements.

C. Calculations: Submit the following for each valve/gate size and class:
1. Operating torque calculations.
2. Maximum torque calculations for seating and unseating.
3. Maximum operating torque at starting and normal operation.
4. Indicate factor of safety for all torque calculations.

D. Test reports:
1. Factory test report and certificate.

E. Manufacturer's instructions:
1. Include manufacturer's instructions, description of system operation, start-up data and troubleshooting check lists.

F. Operations and maintenance data:
1. Include manufacturer's literature; cleaning procedures, replacement part lists, wiring diagrams, and repair data.
2. Include a list of all configurable parameters, and the final values for each.
3. List of recommended spare parts.
4. List of special tools necessary for proper operation and/or maintenance.
5. Exploded view drawings that illustrate all assemblies, sub-assemblies, and components.
6. Routine test procedures for all electronic and electrical circuits.

7. Troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.
8. Certified factory and field-test results.

1.05 QUALITY ASSURANCE

A. Obtain required information from the valve/gate supplier, including but not limited to:
   1. Interface to gate or valve.
   2. Operating range:
      a. Quarter turn or multi-turn.
      b. Required turns for full travel on multi-turn applications.
   3. Direction of rotation for opening and closing.
   4. Maximum and normal torque requirements.
   5. Additional sizing requirements indicated in the following Specifications:
      a. Section 11294B.
      b. Section 15111.
      c. Section 15112.
      d. Section 15116.
      e. Section 15117.

B. All motorized, intelligent actuators shall be the product of a single manufacturer for all 4-inch or larger valve and gate applications on this project, regardless of gate or valve type, manufacturer, or supplier.

1.06 WARRANTY

A. Refer to Section 01740.

1.07 SPARE PARTS

A. Provide the following spare parts (minimum 10 percent of total number of actuators of each model type furnished, but not less than 1 for each model of actuator furnished):
   1. Stem nut.
   2. Worm shaft subassembly.
   3. Drive sleeve subassembly.
   4. Complete actuator seal kit.
   5. Actuator gearbox oil (sufficient quantity to fill 4 gearboxes).
   6. Encoder.
   7. Control module.

B. Provide 1 spare motor for each size motor furnished.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers for lines 3-inch and smaller:
   1. Hayward:
      a. Series EJM (quarter-turn).
      b. Approved equal.

2. Asahi/America:
    a. Series 92 with DHC-100 Positioner (multi-turn).
    b. Approved equal.
3. Rotork:
    a. ROM Series (quarter turn).
4. Rotork:
    a. CVA Series (multi- turn).

B. Acceptable Manufacturers for lines 4 inches and larger:
1. Rotork Controls, Inc.:
    a. IQ (multi-turn).
    b. IQT (quarter-turn).
2. Limitorque Corporation:
    a. Accutronix MX.
3. EIM Corporation.

2.02 MANUFACTURED UNITS

A. Actuators for valves 3 inches and smaller:
1. Provide actuators complete and operable with all components and accessories required for operation.
2. Power supply:
    a. 120 VAC.
    b. Valve motion independent of power supply phase rotation.
3. Size actuator to move valves from full open to closed position within the time indicated below:
    a. Size the actuator to move valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
4. Control inputs:
    a. Capable of using discrete 120 VAC.
    b. Controls the valve when local-stop-remote is in REMOTE.
    c. Isolated inputs capable of operating from external control voltage source or internal power supply:
        1) Furnish 120 VAC control power supplies within the actuator.
    d. Provide the following inputs:
        1) OPEN.
        2) CLOSE.
5. Status outputs:
    a. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
        1) FULLY CLOSED.
        2) FULLY OPEN.
    b. All output contacts rated for 5 amps, 120 VAC.
6. Analog input:
    a. Provide a 4-20 milliamp analog input for analog modulating valves when indicated on the Drawings.
    b. Modulate valve to maintain position based on analog input value.
    c. Maximum input impedance 250 ohms.
7. Analog output:
    a. Provide an isolated 4-20 milliamp analog output when indicated on the Drawings.

8. Materials:
    a. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.
9. Components:
    a. Motors:
        1) Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
        2) Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety.
        3) Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius.
            a) Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
            b) 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
    b. Enclosures:
        1) Actuator housing ratings as indicated in the Motorized Actuator Schedule.
        2) Stainless steel external fasteners.
        3) Provide the following minimum enclosure ratings:
            a) Per Specification Section 16050.
    c. Manual actuators:
        1) Hand wheel for manual operation.
            a) Maximum 80 pound pull on rim when operating gate or valve under maximum load.
        2) Declutch lever: Padlockable, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.
    d. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
        1) Accurately cut to ensure minimum backlash.
    e. Bearings:
        1) Anti-friction bearing with caged balls or rollers throughout.
        2) Sealed-for-life type thrust bearings housed in a separate thrust base.
    f. Drive bushing:
        1) Easily detachable for machining to suit the valve stem or gearbox input shaft.
        2) Positioned in a detachable base of the actuator.

B. Actuators for valves 4 inches and larger:
    1. Provide actuators complete and operable with all components and accessories required for operation.
    2. Power supply:
        a. Voltage and phases as indicated on the Valve and Gate Actuator Schedule.
        b. Valve or gate motion independent of power supply phase rotation.
    3. Size actuator to move gates or valves from full open to closed position within the time indicated below:
        a. Size the actuator to move gates at minimum 12 inches per minute under maximum load.

b. Size the actuator to move plug valves and ball valves 24 inches and smaller from full-open to full-closed position in 30 seconds, plus or minus 10 percent, under maximum load.
c. Size the actuator to move plug valves and ball valves larger than 24 inches from full-open to full-closed position in 60 seconds, plus or minus 10 percent, under maximum load.

4. Control interface:
   a. Configuration:
      1) Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve positions switch settings, and options.
         a) Configurable from a hand-held configuring tool or input devices on the actuator.
   b. Local interface, integral to actuator:
      1) Selector switches:
         a) Local-stop-remote:
            (1) Motor actuator operation is prevented with the switch in STOP.
         b) Open-close:
            (1) Controls the valve when local-stop-remote is in LOCAL.
            (2) Spring return to center.
            (3) Configurable between maintained (actuator runs until end of travel, high torque, or a local-stop-remote is switched to STOP) and momentary (actuator stops when lever is released).
   c. Remote control station - (VCP):
      1) Provide remote control stations for all actuators located more than 5 feet above finished floor/grade or where indicated on the Drawings or Valve and Gate Actuator Schedule:
         a) NEMA rating as listed in Specification Section 16050:
         b) Local-stop-remote selector switch.
         c) Local mode control devices:
            (1) Operate valve when local-stop-remote integral to actuator is in REMOTE and local-stop-remote on remote control station is in LOCAL.
            (2) Open-stop-close maintained switch or OPEN, STOP and CLOSE pushbuttons where Maintained operation is indicated in the Valve and Gate Actuator Schedule.
            (3) Open-close spring-return switch or OPEN and CLOSE pushbuttons where momentary operation is indicated in the Valve and Gate Actuator Schedule.
         d) Pilots lights to indicate valve position:
            (1) FULLY OPEN.
            (2) FULLY CLOSED.
   d. Control inputs:
      1) Capable of using 120 VAC or 24 VDC inputs.
      2) Controls the valve when local-stop-remote is in REMOTE.
      3) Isolated inputs capable of operating from external control voltage source or internal power supply:
         a) Furnish control power supplies within the actuator.
      4) Provide the following inputs:
         a) OPEN.

b) CLOSE.
c) STOP.
d) OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a STOP input) and momentary (actuator stops when command is removed).

e. Status outputs:
1) Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
2) Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
a) FULLY CLOSED.
b) FULLY OPEN.
c) Local-stop-remote in REMOTE position.
3) All output contacts rated for 5 amps, 120 VAC and 24 VDC.

f. Analog input:
1) Provide a 4-20 milliampere analog input for analog modulating valves when indicated on the Drawings.
2) Modulate valve to maintain position based on analog input value.
3) Maximum input impedance 250 ohms.

g. Analog output[s]:
1) Provide an isolated 4-20 milliampere analog outputs when indicated on the Drawings:
a) Loop power sourced from the actuator power supply.
b) Capable of driving into a load up to 500 ohms.
c) Output proportional to process value(s) indicated on the Drawings.
d) Valve or gate position.
e) Operating torque.

2.03 FEATURES

A. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.

2.04 MATERIALS

A. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

2.05 COMPONENTS

A. Motors:
1. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
2. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a minimum of 25 percent factor of safety:
a. Design requirements for rubber-seated AWWA butterfly valves:
1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C542:

a) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.
b) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.

b. Design requirements for slide gates, gate valves, knife gate valves, globe valves, and diaphragm valves:
1) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C542.
2) Design for the maximum torque and thrust running load over the full cycle.
3) Maximum torque or thrust rating: The actuator stall torque or maximum thrust output shall not exceed the torque or thrust capability of the valve or gate, as determined by the valve or gate manufacturer.

3. Capable of being removed and replaced without draining the actuator gear case.
4. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
5. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius:
a. Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
b. 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
6. Provide the following motor protection features:
a. Jammed valve (no valve motion detected through a time delay).
b. High motor temperature (sensed by embedded thermostats).
c. High torque.
d. Single phasing protection for 3-phase motors.

B. Enclosures:
1. Actuator housing ratings as indicated in the Valve and Gate Actuator Schedule.
2. Stainless steel external fasteners.
3. Provide seals for each of the following areas:
a. Between the terminal compartment and the internal electrical elements.
b. Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
4. Provide the enclosure ratings as specified in Section 16050.

C. Position sensing:
1. Integral with valve actuator.
2. Gearing: Intermittent type; bronze or stainless steel; grease lubricated; totally enclosed.
3. Contacts: Heavy duty and silver-plated with wiping action or encoder wheel.
4. Remote indication contacts: As indicated on the Drawings.

5. Switches: Adjustable; allowing for trip points from fully open to closed positions of valve travel; not subject to breakage or slippage due to over travel; permits visible verification of switch position without disassembly.
6. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.
7. Valve range and position switch outputs field adjustable.

D. Torque sensing:
1. Capable of interrupting control circuit in both opening and closing when valve torque overload occurs.
2. Silver-plated contacts.
3. Graduated dials for both open and close directions of travel, each independently adjustable or 0-100 LTD display.
4. Positive means to limit adjustability to avoid exceeding actuator output torque capability with solid-state sensor embedded within the torque transducer.
5. Permits visible verification of switch position without disassembly.
6. Torque shutdown setting: 40 percent to 100 percent rated torque:
   a. Adjustable in 1 percent increments.
7. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
8. Independent of variations in frequency, voltage, or temperature.
9. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.

E. Manual actuators:
1. Hand wheel for manual operation:
   a. Maximum 80 pound pull on rim when operating gate or valve under maximum load.
   b. Provide pull chain when motorized actuator is located more than 6 feet above floor surface.
      1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.
      2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.
2. Declutch lever: With padlock, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.

F. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
1. Accurately cut to assure minimum backlash.

G. Bearings:
1. Anti-friction bearing with caged balls or rollers throughout.
2. Sealed-for-life type thrust bearings housed in a separate thrust base.

H. Drive bushing:
1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
2. Positioned in a detachable base of the actuator.

I. Lubrication:

1. Provide totally enclosed actuator gearing with oil filled gear case suitable for operation at any angle.
    a. Suitable for standard SAE80EP gear oil.
    b. Actuators requiring special or exotic lubricants are not acceptable.
2. Provide seals for all shafts.

2.06 ACCESSORIES

A. Setting tool:
1. If required for setting or configuring the actuator, provide a hand-held setting tool. Provide a hand-held setting tool capable of non-intrusive calibration and interrogation of the actuator.
    a. Furnish 1 setting tool for every 10 actuators.

2.07 SOURCE QUALITY CONTROL

A. Factory test:
1. Test each actuator in the factory, and submit an individual test certificate for each actuator.
2. Perform a high potential test and record the following information:
    a. Test voltage.
3. Simulate a maximum and typical valve loads and record the following information:
    a. Current and power factor at maximum and set torque values.
    b. Torque as measured by the actuator.
    c. Actuator output speed or operating time.
4. Performance testing: Conduct performance test for each actuator simulating valve operating torque from full-open to full-close and from full-close to full-open. The following information shall be recorded during each performance test:
    a. Torque at maximum torque setting.
    b. Current at maximum torque setting.
    c. Test voltage and frequency.
    d. Actuator output speed and operating time for full-open to full-close.
    e. Amperage draw on motors at breakaway and under normal operation.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install actuators in accordance with manufacturer's instructions.

3.02 MOTORIZED ACTUATOR SCHEDULE

A. Provide all actuators required by the Drawings. Major process actuators are listed in the Valve and Gate Actuator Schedule. The schedule does not include all number and types of actuators required for the Project.

B. Abbreviations relating to type:
1. BFV = Butterfly Valve.
2. BV = Ball Valve.
3. DV = Diaphragm Valve.

4. PV = Plug Valve.
5. SG = Slide Gate.

C. Abbreviations relating to actuator type:
1. O/C = Open and Close Service.
2. MOD = Modulating Service.

MOTORIZED OPERATOR SCHEDULE								
Tag No. of Associated Valve or Gate	**Reference Drawing**	**Valve or Gate Size, inches**	**Valve or Gate Type**	**Operator Function**	**Power Supply**	**Motor Horsepower (1)(2)**	**NEMA Enclosure Type**	**Notes**
03-EDR-321 03-EDR-322 03-EDR-324	02C06 02C06 02C08	24 x 24	SG	Per P&IDs	480-Volt, 3-Phase	2	Per Section 16050	
03-EDR-323 03-EDR-325	02C07 02C09	24 x 24	SG	Per P&IDs	480-Volt, 3-Phase	2	Per Section 16050	
10-EDR-041 10-EDR-051	10M01	24 x 66	SG	Per P&IDs	480-Volt, 3-Phase	2	Per Section 16050	
10-EDR-042 10-EDR-052	10M01	24 x 66	SG	Per P&IDs	480-Volt, 3-Phase	2	Per Section 16050	
20-EDM-094 20-EDM-104	20M02	120 x 12	SG	Per P&IDs	480-Volt, 3-Phase	1	Per Section 16050	1,2
30-EDR-211 30-EDR-221	30M02 30M03	18	BFV	Per P&IDs	480-Volt; 3-Phase	1	Per Section 16050	
31-EDM-244 31-EDM-245 31-EDM-246 31-EDR-240 31-EDR-247 31-EDR-248 31-EDR-249	31M01	12 12 12 18 6 6 6	BFV	Per P&IDs	480-Volt, 3-Phase	1	Per Section 16050	
32-EDR-281B 32-EDR-281C 32-EDR-281D	32M01	0.5	DV	Per P&IDs	120-Volt, 1-Phase	1	Per Section 16050	

MOTORIZED OPERATOR SCHEDULE								
Tag No. of Associated Valve or Gate	**Reference Drawing**	**Valve or Gate Size, inches**	**Valve or Gate Type**	**Operator Function**	**Power Supply**	**Motor Horsepower (1)(2)**	**NEMA Enclosure Type**	**Notes**
50-EAM-124 50-EAM-125	50M02	6	PV	Per P&IDs	480-Volt, 3-Phase	0.75	Per Section 16050	1,2, 3
50-EAM-127	50M02	6	PV	Per P&IDs	480-Volt, 3-Phase	0.75	Per Section 16050	1,2,3
50-EAM-128 50-EAM-129	50M02	8	PV	Per P&IDs	480-Volt, 3-Phase	0.75	Per Section 16050	1,2,3
50-EDR-404 50-EDR-405 50-EDR-406 50-EDR-407 50-EDR-408	50M01	6	BFV	Per P&IDs	480-Volt, 3-Phase	1	Per Section 16050	
50-EDR-411 50-EDR-412	50M01	6	PV	Per P&IDs	480-Volt, 3-Phase	1	Per Section 16050	
50-EDR-417 50-EDR-418	50M01	8	PV	Per P&IDs	480-Volt, 3-Phase	1	Per Section 16050	
50-EDM-413 50-EDM-415	50M01	36 x 66	SG	Per P&IDs	480-Volt, 3-Phase	5	Per Section 16050	
50-EDM-414 50-EDM-416	50M01	36 x 54	SG	Per P&IDs	480-Volt, 3-Phase	5	Per Section 16050	

MOTORIZED OPERATOR SCHEDULE								
Tag No. of Associated Valve or Gate	**Reference Drawing**	**Valve or Gate Size, inches**	**Valve or Gate Type**	**Operator Function**	**Power Supply**	**Motor Horsepower (1)(2)**	**NEMA Enclosure Type**	**Notes**
50-EDR-421 50-EDR-424 50-EDR-425 50-EDR-428	50M01	6	PV	Per P&IDs	480-Volt, 3-Phase	1	Per Section 16050	
60-EDR-713 60-EDR-760	60M01	2	BFV	Per P&IDs	120 Volt, 1-Phase	0.33	Per Section 16050	

Notes:
(1) Indicated motor horsepower is minimum required horsepower.
(2) Indicated motor horsepower is estimated. Submit calculations and data to substantiate proposed motor horsepower. If larger horsepower is required, all costs related to electrical system modifications and installations shall be borne by the CONTRACTOR.

END OF SECTION

SECTION 13920

PACKAGED ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMP SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Skid-mounted, electric-drive, packaged fire pump system.

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01600 - Product Requirements.
   b. Section 01610 - Project Design Criteria.
   c. Section 09960 - High-Performance Coatings.
   d. Section 15050 - Common Work Results for Mechanical Equipment.
   e. Section 15082 - Piping Insulation.
   f. Section 15958 - Mechanical Equipment Testing.
   g. Section 17100 - Control Strategies.
   h. Section 17101 - Specific Control Strategies.

1.02 REFERENCES

A. American Bearing Manufactures Association (ABMA).
1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):
1. B16.1- Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

C. ASTM International (ASTM):
1. A 48 - Standard Specification for Gray Iron Castings.
2. A 108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
3. A 181 - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
4. A 240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
5. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
6. A 283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
7. A 582 - Standard Specification for Free-Machining Stainless Steel Bars.

8. B 505 - Standard Specification for Copper Alloy Continuous Castings.
9. B 584 - Standard Specification for Copper Alloy Sand Castings For General Applications.
10. E 10 - Standard Test Method for Brinell Hardness of Metallic Materials.

D. Hydraulic Institute (HI):
1. 1.1-1.2 - Centrifugal Pumps for Nomenclature and Definitions.
2. 1.3 - Rotodynamic (Centrifugal) Pumps for Design and Application.
3. 1.6 - Centrifugal Pump Tests.
4. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application and Sound Measurement, and Decontamination.

E. National Electrical Manufacturers Association (NEMA):
1. 250 – Enclosures for Electrical Equipment (1000 V Maximum).

F. National Fire Protection Association (NFPA):
1. 13 – Standard for the Installation of Sprinkler Systems.
2. 20 – Standard for the Installation of Stationary Pumps for Fire Protection.
3. 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
4. 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.

1.03 DEFINITIONS

A. NEMA Type 4 enclosure in accordance with NEMA 250.

B. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 1.1-1.2, 1.3, 1.6, and 9.1-9.5 and as modified in this Section.

C. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.

1.04 SYSTEM DESCRIPTION

A. The Packaged Fire Pump System will have the following components:
1. Horizontal split case type centrifugal pump coupled to a 30 hp, 1,770 rpm, 460 V, 3 Φ, 60 Hz, ODP motor.
2. UL-Listed fire pump controller with solid-state soft starter, bypass contactor, and UL/FM listed Automatic transfer switch to Emergency Generator Feed.
3. 1/2-inch Automatic air release valve.
4. Test loop consisting of two manual BFVs and a flowmeter.
5. Jockey Pump with controller, 2 gate valves, a check valve, and piping.
6. Pressure sensing lines.
7. Steel skid containing all components, factory assembled and wired.

B. Design requirements:
1. Control panel: UL listed for fire protection service. NEMA Type 4 construction.
2. Pump: Horizontal split-case, UL listed and FM approved for fire protection service in accordance with NFPA 20.
3. Jockey pump: Vertical multi-stage centrifugal pump design.

4. Skid: Entire assembled package in accordance with UL or ETL certified for fire protection service, completely prefabricated, pre-wired, and pre-assembled, designed in accordance with NFPA 20.
    a. Maximum size 9 feet by 7 feet, oriented for piping connections and access as indicated on the Drawings.
5. Piping:
    a. Flowmeter loop.
    b. No relief valve.
    c. HVH connection.
    d. 125 pounds per square inch minimum rated pressure.
6. Connections:
    a. Power: Single connection at control panel,

C. Performance requirements:
1. Pump: Rated for 750 gpm at 50 pounds per square inch.
2. Controller:
    a. Fire Pump Controller:
        1) Automatically start and stop pump 1 time per week, on timer, set to run for 30 minutes.
        2) Automatically start the fire pump when pressure in the discharge header reaches 45 psig.
        3) Automatically stop the fire pump when pressure in the discharge header reaches 55 psig.
        4)
    b. Jockey Pump Controller:
        1) Automatically start the jockey pump when pressure in the discharge header reaches 55 psig.
        2) Automatically stop the jockey pump when pressure in the discharge header reaches 65 psig.

1.05 SUBMITTALS

A. Submit as specified in Section 15050, plus the following:
1. Certificates:
    a. UL listing of components.
    b. Third-party approval of packaged system.
    c. Certification of installer's C16 license status.

1.06 QUALITY ASSURANCE

A. As specified in Section 15050.

B. Installer qualifications: Installation shall be performed by a contractor holding a C16 license in California.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 15050.

1.08 PROJECT CONDITIONS

A. Environmental requirements:
   1. System will be installed indoors on a floor slab.
   2. Climate as specified in Section 01610.

1.09 WARRANTY

A. As specified in Section 15050.

1.10 MAINTENANCE

A. Special tools: For each package unit, provide 1 set of all special tools required for complete assembly or disassembly of the system components.

B. Spare parts: Deliver the following as specified in Section 01600:
   1. Pump thrust bearing set.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. TIGERFLOW Systems, LLC.
   2. Peerless.
   3. Aurora.

2.02 MATERIALS

A. As specified for individual components.

2.03 COMPONENTS

A. Fire indicated on the Pump:
   1. Manufacturers: One of the following or equal:
      a. Aurora Model 481.
      b. Fairbanks Morse.
   2. Materials: Materials in the Pump Schedule shall be the type and grade as specified below.
      a. Cast iron: ASTM A 48, Class 30 minimum.
      b. Bronze: ASTM B 584, UNS Alloy C83600 or C87500.
      c. Zincless bronze: ASTM B 584, UNS Alloy C93700.
      d. Leaded tin bronze: ASTM B 505, Alloy C93200.
      e. Type 316 stainless steel: ASTM A 276.
      f. Type 416 stainless steel: ASTM A 582.
      g. Steel: ASTM A 108, Grade as scheduled.
   3. Pump casing:
      a. Type: Axially split case; allow removal of rotating element without disturbing piping connections or alignment; mounted horizontally or vertically as scheduled.
      b. Material: As scheduled.

c. Construction: Of sufficient strength, weight, and thickness to provide accurate alignment and prevent excessive deflection.
d. Hydrostatic test: 5-minute hydrostatic test minimum 1.5 times design working pressure.
e. Casing assembly: Lifting eye bolts for removable half and doweling to facilitate alignment of bolted halves.
f. Suction and discharge: Single or dual suction as scheduled; piping connections in lower half of casing with side entry and exit unless otherwise indicated on the Drawings.
g. Suction and discharge piping connections: Flanged in accordance with ASME B16.1, Class 125.
h. Vent and taps:
    1) Provide casings with bolt 3/4 inch threaded high point and low point drain taps.
    2) Provide 1/2 inch threaded tap with valve and pressure gauge on the suction and discharge flanges.

4. Impeller:
    a. Type: As scheduled.
    b. Material: As scheduled.
    c. Water passages: Smooth, machined to reduce turbulence.
    d. Method of securing to shafts: Keyed and axially secured by bronze sleeves with nuts.
    e. Rotation: Clockwise looking from driver, unless otherwise indicated on the Drawings.
    f. Balance: As specified in Section 15050 to meet the vibration criteria as specified in Section 15958.
5. Wear rings:
    a. Impeller wear ring material:
        1) When bronze impeller scheduled, provide UNS Alloy C93200 wear ring.
        2) Impeller wear ring shall have a Brinell hardness number at least 50 less than the casing wear ring Brinell hardness number when tested in accordance with ASTM E 10.
    b. Casing wear ring material: Same material as impeller wear ring.
    c. Features:
        1) Able to allow compensation for minimum 1/8 inch wear.
        2) Removable.
        3) Fastened with recessed screws or keyed to casing to prevent relative rotation.
6. Pump shaft:
    a. Material:
        1) Steel, SAE 1045.
    b. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.
    c. Resonant frequency: As specified in Sections 15050 and 15958.
    d. Deflection: Maximum 0.002 inches under operating conditions.
7. Shaft sleeve:
    a. When bronze impeller scheduled, provide ASTM B 505, UNS Alloy C93200 shaft sleeve.
    b. Renewable, key locked or set screws in stuffing box, gland area, and bearings; able to protect shaft from pumped liquid and wear.

8. Bearings and bearing frame:
    a. Bearing type: Anti-friction, grease lubricated meeting ABMA standards; self-aligning spherical roller type radial bearings; angular contact ball type, or tapered roller for thrust bearings.
    b. Bearing lubrication:
        1) External grease fittings with grease relief pipe.
        2) Lip type grease seals and labyrinth type grease deflectors at both ends of bearing housings, able to prevent entrance of contaminants.
    c. Bearing life: Minimum ABMA 9 and 11 L10 life of 50,000 hours at rated design point.
    d. Pump bearing frames:
        1) 1-piece rigid construction with bearing housing at outboard (pump) end, and at inboard (driver) end.
        2) Materials:
            a) Pump bearing frame: ASTM A 48, Class 30 minimum, cast iron.
            b) Bearing housing and end cover: ASTM A 48, Class 30 minimum, cast iron.
    e. Bearing frame drain hole: Tapped, located as low as possible to drain leakage when adjacent to packing or seal.
9. Shaft stuffing box:
    a. Provide stuffing box with packing type seal as specified in Section 15050.
10. Supports, pedestals, and baseplates:
    a. Type: As specified below and in Section 15050.
    b. Materials: ASTM A 283 steel, hot-dip galvanized after fabrication and coated as specified in Section 09960.
    c. Pump and driver support strength: Able to withstand minimum 1.5 times maximum imposed operating loads or imposed seismic loads, whichever is greater.
    d. Configuration: Allow easy access to stuffing boxes, bearing frames, and couplings.
    e. Vertical mounted: When scheduled, structural base plate and support for vertically mounted pump and driver able to resist torsional and seismic loads and meet vibration criteria as specified in Section 15958.
11. Couplings:
    a. Types: Flexible coupling as recommended by the manufacturer and as specified in Section 15050.
    b. Flexible coupling life: Infinite at up to 0.30-degree misalignment angle total or per disk for disk type at maximum operating loads.
    c. Design coupling to withstand a minimum of 1.5 times the maximum operating torque and other imposed loads.
12. Equipment guards:
    a. Provide equipment safety guards as specified in Section 15050.
13. Drivers:
    a. Horsepower: In accordance with NFPA 20.
14. Controls: Provide controls system in accordance with NFPA 20 with additional remote inputs and outputs as indicated on the Drawings.
15. Finishes: Prepare surfaces and apply protective finishes as specified in Section 09960.

B. Drivers:
   1. Motors: As specified in Section 16222 and as specified in this Section.
      a. rpm: As scheduled:
      b. Enclosure: As scheduled.
      c. Electrical characteristics: As scheduled.
      d. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222.
      e. Motor accessories: As specified in Section 16222 and as specified in this Section.
      f. Non-reverse ratchets, type: When scheduled, able to prevent reverse rotation of pump and driver.

C. Controller:
   1. UL listed for fire pump service and meeting all requirements in accordance with NFPA 20.
   2. Housed in a NEMA Type 4 drip-proof enclosure and mounted on the skid.
   3. All internal components shall be front mounted and wired for ease of inspection and maintenance.
   4. All relays shall be of the plug-in type, identical, and complete with visual indication to show that the relays are energized.
   5. The controller shall include an LCD display to indicate battery voltage and amperes as well as system pressure in pounds per square inch.
   6. A solid-state pressure transducer shall be installed with a bulkhead fitting in the enclosure bottom so that all plumbing connections are made external to the controller.
   7. The controller piping and pressure system shall be rated for operation in system pressures up to 600 pounds per square inch within plus or minute 1.5 percent accuracy.
   8. The controller shall be equipped with a line printer-recorder, capable of operation between 8 to 30 volts direct current, that will produce hard copy reports of system status; including time, date, weekly test time, alternating current power failure status, print and stop mode status, sequential start time, RPT setting, system pressure set points, charger amperes and battery voltage plus pump running status reports and alarm data.
   9. The controller shall have the capability of storing 1024 events for furtherance to the line printer-recorder.
   10. The following parameters shall be programmable and included as standard:
      a. Start and stop pounds per square inch points.
      b. Stop mode: Manual or auto.
      c. Run period timer: 0 to 60 minutes.
      d. AC power failure: Enable or disable.
      e. Sequential start timer: 0 to 300 seconds.
      f. Weekly test timer.
      g. Print mode: Manual or auto.
      h. Printer deviation: 1 to 99 pounds per square inch.
      i. Language: English/French/Spanish.
   11. The following color coded visual and audio alarms shall be provided:
      a. SWITCH IN AUTO.
      b. HIGH RESERVOIR.
      c. LOW RESERVOIR.
      d. LOW ROOM TEMPERATURE.
      e. RELIEF VALVE DISCHARGE.

12. Alarm contacts (Form-C) rated at 10 amps, 220 volts alternating current/ 32 volts direct current, shall be provided for remote indication of:
    a. OFF/MANUAL mode to indicate pump is switched out of AUTO Mode.
    b. Fail to start.
    c. TEST mode.
    d. Alternating current power failure.
13. The controller shall be microprocessor based as manufactured by Cutler-Hammer model FT90.
    a. Computer and Relay based Fire Pump Controllers will not be acceptable.

D. Automatic Transfer Switch:
1. Ratings:
    a. The transfer switch shall be suitable for the available short-circuit current at the line terminals of the controller.
    b. The transfer switch shall have an ampere rating of not less than 115 percent of the motor full load current.
2. Construction:
    a. The transfer switch shall be installed in a barriered compartment of the fire pump controller. The complete assembly, controller, and transfer switch shall be shipped as a single unit.
    b. A single uni-gear motor shall electrically operate the transfer mechanism. It shall also be capable of being operated manually and shall have suitable provisions for readily disengaging the gear motor when necessary.
    c. The transfer switch shall be mechanically and electrically interlocked so that it shall not be possible for the load circuits to be connected to normal and emergency sources simultaneously, regardless of whether the switch is electrically or mechanically operated. The switch shall have a manual neutral.
    d. The alternate side shall be provided with an isolation switch sized to a minimum of 115 percent of the motor full-load current and a circuit breaker having a continuous current rating not less than 115 percent of full motor load amps, have overcurrent sensing elements of the non-thermal type, and instantaneous short-circuit overcurrent protection. The isolating switch and circuit breaker shall be mechanically interlocked and operated by a single handle. The isolating switch shall be supervised to indicate when it is open by audible and visual alarms.
    e. An auxiliary contact shall be provided to prevent sending the signal for starting of the emergency generator when the transfer switch commands it, if the isolation switch on the emergency generator side of the transfer switch is open.
    f. The transfer switch shall be provided with locked rotor overcurrent protection. The locked rotor protector shall be calibrated and set to a minimum of 300 percent of the motor full-load current and having a tripping time between 8 and 20 seconds.
3. Microprocessor Control:
    a. A solid-state sensing and control logic panel shall be separately mounted from the power-switching portion of the transfer switch. The two sections shall be connected together by control cables and plug-in connectors. The control section shall be capable of being isolated from the from the power section for maintenance.

b. The normal power source shall be set to pickup at 95 percent and drop out at 85 percent of nominal supply. The voltage sensing element on the alternate supply shall be set to pick up at 90 percent of nominal voltage.
c. All voltage sensing, frequency sensing, and timer setpoints shall be field adjustable.
d. The transfer switch shall automatically transfer its load circuit to the emergency generator upon failure of the normal power supply. In order to override momentary fluctuations in the system, a time delay transfer from normal to emergency generator power supply shall be adjustable up to 1,800 seconds. Upon restoration of normal supply, the transfer switch shall automatically retransfer its load circuits to the normal supply. Mechanically held transfer mechanisms shall be energized only momentarily during transfer or retransfer.
e. If the emergency generator should fail while carrying the load, transfer to the normal supply shall be made instantaneously upon restoration of the normal source to satisfactory conditions.
f. The transfer switch shall come complete with 5 LED to provide visual indication of the unit status, source 1 available, source 1 connected, source 2 available, and source 2 connected.
g. An engine test button shall be provided that will initiate an engine test.
h. A silence alarm button shall be provided that will silence the alarm buzzer.

E. Jockey Pump:
1. Materials:
a. Materials in the Pump Schedule shall be the type and grade as specified in this Section.
b. Bolts, studs, and cap screws:
1) Material: All wetted bolts, studs, and cap screws shall be stainless steel in accordance with ASTM A193, Type 316 or 316N, Grade B8MA or B8MNA. Nuts shall be stainless steel in accordance with ASTM A194, Type 316 or 316N, Grade 8MA or 8MNA.

2.04 ACCESSORIES

A. Piping components:
1. Flowmeter: Venturi-type flowmeter on piping loop with at least 5 upstream straight pipe diameters and 2 downstream straight pipe diameters.
a. Provide all necessary piping and valves on flowmeter loop for testing fire pump performance.
2. Air release valve: UL listed for fire protection service.
3. Pressure gauges: UL listed for fire protection service.
4. Valves:
a. Butterfly valve, UL listed for fire protection service, with tamper switches, at:
1) Pump discharge.
2) Flowmeter loop before meter.
3) Flowmeter loop after meter.
b. Wafer-type check valve: UL listed for fire protection service.
c. OS&Y valve, UL listed for fire protection service, with tamper switch, at pump suction.

2.05 FABRICATION

A. Shop assembly:
   1. System shall be fully fabricated, connected, wired with electrical and control wiring, and tested prior to shipping.
   2. All components, piping, pressure sensing lines, flowmeter loop, and valves shall be firmly anchored to the steel base by means of structural steel supports.

2.06 FINISHES

A. Provide manufacturer's standard prime and finish coat in accordance with NFPA 20.

2.07 SOURCE QUALITY CONTROL

A. Fabrication tolerances: As specified in Section 15050.

B. Tests: As listed in schedule. Provide advance warning of factory witnessed testing as specified in Section 15958.

PART 3 EXECUTION

3.01 INSTALLATION

A. Pump drain pipes: Connect galvanized steel pipe drains from drip pocket to equipment drain or as directed by ENGINEER; provide continuous downward slope to point of discharge using plugged tees and crosses for changes in direction.

B. Control strategy as specified in Sections 17100 and 17101.

3.02 FIELD QUALITY CONTROL

A. Witnessing: All field-testing shall be witnessed by the ENGINEER; provide advance notice of field-testing as specified in Section 15958.

B. Tests: Equipment performance, vibration, and noise testing shall be as scheduled and as specified in Section 15958.

C. Manufacturer's field services: Manufacturer shall inspect installed system before initial startup and certify that system has been correctly installed and prepared for startup as specified in this Section and Sections 15050 and 15958.

3.03 SCHEDULES

A. Pump schedule:
   1. Fire Pump:

Tag Number	**70-PMP-720**
General Characteristics:	
Service	Fire Water
Quantity	1

Tag Number	70-PMP-720
First Named Manufacturer's Model Number	481-11A
Torsional Analysis	Not Required
Minimum Pumped Fluid Temperature, degrees F	50
Normal Pumped Fluid Temperature, degrees F	65
Maximum Pumped Fluid Temperature, degrees F	80
Pump Characteristics:	
Pump and Driver Mounting	Horizontal
Suction Configuration	Double
Impeller Type	Francis Vane
Bearing Lubrication	Grease
Speed Control	Fixed Speed
Maximum Pump rpm	1,770
Minimum Pump rpm	1,770
Rated Design Point (At Maximum Revolutions per Minute):	
Flow, gpm	750
Head, psi	50
Minimum Efficiency, Percent	85
Rated Condition 2 (At Maximum Revolutions per Minute):	
Flow, gpm	1,125
Head, psi	38
Minimum Efficiency, Percent	80
Required Condition 3:	
Flow, gpm	1,000
Head Range, psi	42
Minimum Efficiency, Percent	83
Required Condition 4:	
Flow, gpm	450
Head Range, psi	55
Minimum Efficiency, Percent	60
Required Condition 5:	
Flow, gpm	0 (deadhead)
Head Range, psi	59
Minimum Efficiency, Percent	N/A

Tag Number	70-PMP-720
Other Conditions:	
Maximum NPSHr at Every Specified Flow, Feet	20
Minimum NPSHa at Every Specified Flow, Feet	29
Pump Materials:	
Pump Casing	Cast Iron
Impeller	Bronze
Motor Characteristics:	
Drive Arrangement	Horizontal, Coupled
Inverter Duty	Yes
Minimum Horsepower	30
Maximum Speed, rpm	1,770
Motor Voltage/Phase/Frequency	460 V/3Φ/60Hz
Enclosure type	ODP
Source Quality Control Testing:	
Test Witnessing	Witnessed
Performance Test Level	2
Vibration Test Level	2
Noise Test Level	2
Field Quality Control Testing:	
Performance Test Level	2
Vibration Test Level	2
Noise Test Level	2

2. Jockey Pump:

Tag Number	70-PMP-721
General Characteristics:	
Service	Fire Water
Quantity	1
First Named Manufacturer's Model Number	PVM2-30D
Maximum Noise, dBA at 3 feet	85
Torsional Analysis	Not Required
Minimum Pumped Fluid Temperature, degrees F	50
Normal Pumped Fluid Temperature, degrees F	65
Maximum Pumped Fluid Temperature, degrees F	80

Tag Number	70-PMP-721
Pump Characteristics:	
Pump and Driver Mounting	Vertical
Suction Configuration	Single
Impeller Type	Enclosed Type
Number of Impellers	Per Manufacturer
Bearing Lubrication	Grease
Shaft Seal Type	Single Mechanical, Balanced
Speed Control	Fixed
Maximum Pump rpm	3,460
Minimum Pump rpm	3,460
Rated Design Point (At Maximum Revolutions per Minute):	
Flow, gpm	7
Head, Feet	115
Minimum Efficiency, Percent	60%
Required Condition 2 (At Maximum Revolutions per Minute):	
Flow, gpm	14
Head Range, Feet	80
Minimum Efficiency, Percent	58
Required Condition 3 (At Maximum Revolutions per Minute):	
Flow, gpm	10
Head Range, Feet	105
Minimum Efficiency, Percent	55
Required Condition 4 (At Maximum Revolutions per Minute):	
Flow, gpm	5
Head Range, Feet	120
Minimum Efficiency, Percent	58
Required Condition 5 (At Maximum Revolutions per Minute):	
Flow, gpm	2
Head Range, Feet	128
Minimum Efficiency, Percent	55
Other Conditions:	
Shutoff Head, Feet	130
Maximum NPSHr at Every Specified Flow, Feet	10
Minimum NPSHa at Every Specified Flow, Feet	20

Tag Number	70-PMP-721
Pump Materials:	
Pump Head	Class 30 Cast Iron
Impeller	AISI 304 SS
Shaft	AISI 316 SS
Chamber	AISI 304 SS
Outer Sleeve	AISI 304 SS
O-Ring for Outer Sleeve	EPDM or FKM
Base	Cast Iron, A48-30B
Neck Ring	PTFE
Shaft Seal	Cartridge Type
Rubber Parts	EPDM or FKM
Driver Characteristics:	
Driver Type	Motor
Drive Arrangement	Vertical, Flexibly Coupled
Minimum Horsepower	3/4 hp
Maximum Speed, rpm	3,460
Motor Characteristics (when motor is driver type):	
Inverter Duty Rated	Yes
Motor Voltage/Phases/Hertz	460/3/60
Enclosure Type	TEFC
Source Quality Control Testing:	
Test Witnessing	Not Witnessed
Performance Test Level	1
Vibration Test Level	None
Noise Test Level	None
Field Quality Control Testing:	
Performance Test Level	1
Vibration Test Level	1
Noise Test Level	None

END OF SECTION

SECTION 13930

WET PIPE FIRE EXTINGUISHING SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Wet pipe fire extinguishing system.

B. Related sections:
1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 01660 - Testing, Training, and Commissioning.
   c. Section 01770 - Closeout Procedures.
   d. Section 01782 - Operating and Maintenance Data.
   e. Section 10400 - Signage.
   f. Section 13920 - Skid-Mounted, Engine-Driven Fire Pump.
   g. Section 16123 - 600 Volt or Less Wires and Cables.
   h. Section 16710 - Fire Alarm and Smoke Detection System.

1.02 REFERENCES

A. FM Global (FM).

B. National Fire Protection Association (NFPA):
1. 13 - Standard for the Installation of Sprinkler Systems, 2010 edition.
2. 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

C. Underwriters' Laboratories, Inc., (UL):
1. Fire Protection Equipment Directory.

1.03 SYSTEM DESCRIPTION

A. Requirements:
1. Provide all labor, materials, equipment and services required to furnish and install a complete automatic fire sprinkler system in the building scheduled and as indicated on the Drawings.
2. Conform with all codes referenced and requirements listed in this Section.
3. Fire protection subcontractor licensed in the state where the Project is located.

4. Coordinate fire sprinkler work with fire detection system that provides supervisory signals to sprinkler equipment.
    a. Alarm detection requirements as specified in Section 16710.
5. Responsible for paying plan check, permit, and inspection fees as necessary.
6. Responsible for coordinating inspections of fire sprinkler system by authority having jurisdiction.
7. Upon completion of the work, provide the OWNER a copy of the "Contractor's Material and Test Certificate" Parts A and B, signed by the authority having jurisdiction, and a copy of the transmittal letter sending the certificate to the insurance carrier.

B. Criteria:
1. Install all work in accordance with NFPA 13, the California Fire Code, the requirements of the authority having jurisdiction, other specified requirements, and as indicated on the Drawings.
2. Connection points for fire sprinklers lines are indicated on the Drawings.
    a. The water source for fire sprinklers is stored water on site.
    b. The water source for hydrants is stored water on site.
3. Install fire protection system lines so as to avoid all existing utility lines, conduit, process lines, and structural components, as well as any new lines or structural components indicated on the Drawings.
    a. Fire protection lines must give way to all gravity lines.
    b. Coordinate with other piping, electrical fixtures, etc., to avoid obstruction of sprinkler heads.
4. Provide provisions to properly drain all parts of the system.
5. Drains in above-grade buildings:
    a. Pipe through walls to hard surfaces such as concrete splash pads.
    b. Show available plumbing fixtures and intended drain outlets on shop drawings.
    c. Do not discharge drains on sidewalks or other pedestrian areas.
6. Install alarm system to sound an audible onsite alarm and to electronically signal the Plant Control Center and a UL listed Central Monitoring Station upon sensing water flow within the sprinkler monitored system, or unauthorized closure of system isolation valves.
7. Protect any sprinkler heads located where they could be accidentally hit with listed heavy wire guards.
    a. Show protective devices on as-built shop drawings.
8. Clearance between sprinklers and walls and sprinklers and structural members in accordance with NFPA 13.
9. Mount adjacent to each main riser a metal box containing extra sprinkler heads and a sprinkler head wrench.
    a. Box contains 6 sprinkler heads if system has less than 300 heads and 12 sprinkler heads if system has more than 300 heads.
10. Locate and install waterflow test connections in accordance with NFPA 13.
11. Where areas to be sprinklered are heavily congested with piping, provide additional sprinkler heads to give complete coverage.

C. Install sprinklers in the following facilities:
1. Administration Building.
2. Maintenance Building.
3. Dewatering Building.

4. Electrical Building.
5. Chemical Facility.

1.04 SUBMITTALS

A. Provide a complete materials list with manufacturer's information for each product as specified in Section 01330.

B. Shop drawings and calculations: Submit detailed shop drawings and hydraulic calculations for any proposed changes to the approved plans or as indicated on the Drawings relative to the sprinkler system.
   1. Shop drawings: Include floor plan layout of sprinklers and elevation of piping changes as well as other information listed elsewhere in this Section.
   2. Calculation worksheet: Contain information in accordance with NFPA 13, Chapter 6.
   3. Following acceptance by the ENGINEER, submit plans for approval by authority having jurisdiction.

C. Applicable operation and maintenance information as specified in Section 01782.

D. Closeout submittals:
   1. As-built drawings: Furnished upon completion of the work, showing any deviation from the approved shop drawings.
      a. Indicate location of drain and shutoff valves and buried and concealed piping, using accurate dimensions to permanent reference points.
      b. Note actual static pressure at the system control valves as specified in Section 01770.

1.05 QUALITY ASSURANCE

A. Approve all materials for use in automatic sprinkler systems and in accordance with NFPA 13.

B. List components in the UL Fire Protection Equipment Directory for use as intended in automatic fire sprinkler applications and be acceptable to the ENGINEER. Material that is pending approval is not acceptable.

1.06 PROJECT CONDITIONS

A. Visit the site of work and examine the premises in order to be completely familiar with the scope of work.

B. Verify any dimensions indicated on the Drawings at site.

C. Notify ENGINEER of any discrepancies found.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide specialty wiring for the interrelated devices. Locate controls, alarm actuating devices, and audible alarm signaling devices as indicated on the Drawings and as specified in this Section.

B. Provide a fire alarm bell mounted on the exterior building wall.
   1. The bell will activate when the water flow switch detects flow, in accordance with NFPA 13.

C. Place an identification sign near each fire alarm bell with wording in accordance with NFPA 13.

2.02 PIPING MATERIALS

A. Unless otherwise specified, provide: piping materials including pipe, gaskets, fittings, connections, joint assemblies, linings, and coatings, from those listed in the Piping Schedule and as indicated on the Drawings.

B. Have a protective coating applied to: piping in laboratories, chemical storage areas, process areas, or other corrosive environments as scheduled below, in accordance with NFPA 13.
   1. Do not coat sprinkler heads after leaving the factory.
   2. Corrosive Environments Schedule. As indicated on the Drawings.

2.03 SPRINKLER HEADS

A. Sprinkler heads: Viking, Reliable, Tyco, or equal as indicated on the Drawings.

B. Sprinkler heads in finished ceiling areas: Semi-recessed type with escutcheons.

C. Sprinkler heads in areas with exposed piping: Standard upright or pendant type as indicated on the Drawings.

D. Sprinkler heads in finished ceiling areas and in corrosive environments: As indicated on the Drawings.

E. Sprinkler heads in all other areas: Standard brass finish.

2.04 VALVES

A. List all valves on connections to water supplies and supply lines to sprinklers indicating valves, OS&Y type, (listed indicating valve assemblies are acceptable).

B. Valves operated at maximum speed: Not close in less than 5 seconds.

C. Provide a warning sign of type specified in Section 10400 at isolation valves controlling the water supply to fire sprinkler system, indicating that an alarm will sound if valve is closed.

D. Flow switch on riser:
   1. Manufacturer: The following or equal:
      a. Potter.

E. Check valves:
   1. Manufacturer: The following or equal:
      a. Viking Easy Riser Check Valve.

F. Water flow detectors:
   1. Manufacturer: The following or equal:
      a. Potter.

G. Fire Department connections:
   1. Lettering "Auto-Spkr".
   2. Manufacturer: The following or equal:
      a. Elkhart.

2.05 HANGERS AND SUPPORTS

A. Hangers and supports in accordance with NFPA 13, Tolco or equal as indicated on the Drawings.

2.06 SEISMIC RESTRAINT

A. Seismic bracing and branch line restraints in accordance with NFPA 13 and as indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Preparation: Coordinate work of this Section with other affected work.

3.02 INSTALLATION

A. Install equipment in accordance with manufacturer’s instructions.

B. Install all buried shut-off valves in valve boxes.
   1. Provide post indicator and tamper switch.

C. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle as indicated on the Drawings.

D. Place pipe runs to minimize obstruction to other work.

E. Place piping in concealed spaces above finished ceilings.

F. Center heads in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements.

G. Place deep escutcheons where required to accommodate sprinkler heads occurring at unavoidable below-ceiling obstructions.

H. Apply masking tape or paper cover to ensure concealed sprinkler heads do not receive field paint finish.

I. Install and connect fire pumps as specified in Section 13920, NFPA 13, and NFPA 20.

J. Flush entire piping system of foreign matter.

K. At various stages of completion as directed by the enforcing authority, and upon completion, hydrostatically test system.

L. Required tests must be witnessed by authority having jurisdiction and ENGINEER.

3.03 WIRING

A. System wiring and installation: As specified in Sections 16123 and 16710 and with the applicable codes, Drawings, and recommendations of the manufacturer.

3.04 TESTING

A. General: Perform testing as specified in Section 01660.

B. Flushing and testing of system: Perform in accordance with NFPA 13.

C. Performs tests in the presence of the ENGINEER and authority having jurisdiction.
   1. Test of system must be approved and signed by authority having jurisdiction prior to acceptance by ENGINEER.

3.05 TRAINING

A. Provide instruction for 8 people.

B. Demonstrate system operation and maintenance**,** and instruct OWNER's personnel in operation, repair, and maintenance of the work of this Section.

C. Provide not less than 4 hours of training on operation and maintenance of fire sprinkler system, conducted by the Fire Protection Contractor, and in accordance with Section 01660.

END OF SECTION