

SPECIFICATIONS FOR CONSTRUCTION OF:
WEAK BASE ANION (WBA)
CHROMIUM REMOVAL DEMONSTRATION FACILITY
4041½ Goodwin Street
Los Angeles, CA

REDUCTION COAGULATION FILTRATION (RCF)
CHROMIUM REMOVAL DEMONSTRATION FACILITY
800 Flower Street
Glendale, CA

Constructed for:

Glendale Water and Power
141 North Glendale Boulevard, Level 4
Glendale, CA 91206

May 2009

100% DESIGN
ISSUED FOR CONSTRUCTION

Prepared By:

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**CONSTRUCTION SPECIFICATIONS
CITY OF GLENDALE, CA
WATER AND POWER
RCF AND WBA FACILITIES**

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DIVISION 1 - GENERAL REQUIREMENTS

Section

- 01010 Summary of Work
- 01200 Project Meetings
- 01300 Submittals and Substitutions
- 01400 Quality Control
- 01500 Temporary Construction Facilities and Controls
- 01700 Contract Closeout

DIVISION 2 - SITEWORK

Section

- 02200 Excavation and Backfill
- 02250 Asphaltic Concrete Paving
- 02300 Waste Management
- 02500 Disinfection of Water Mains and Tanks

DIVISION 3 - CONCRETE

Section

- 3300 Cast-in-Place Concrete
- 3604 Nonshrink Grout

DIVISION 9 – FINISHES

Section

- 09900 Coatings

DIVISION 11 - EQUIPMENT

Section

- 11400 Equipment

DIVISION 15 - MECHANICAL

Section

- 15010 Piping
- 15011 Carbon Steel Pipe
- 15012 Steel Pipe Cement Mortar-Lined and Coated
- 15018 Polyvinyl Chloride (PVC) Pipe
- 15050 Gate Valves
- 15052 Butterfly Valves
- 15054 Ball Valves & Check Valves

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15075 Piping and Equipment Identification
15140 Potable Water Piping

DIVISION 16 - ELECTRICAL

Section

16000 Electrical Work
16060 Grounding and Bonding

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

Reaction Coagulation Filtration (RCF) System
Weak Base Anion (WBA) Facility

1.01 DEFINITIONS

- A. OPERATOR: Camp Dresser McKee (CDM)
- B. CLIENT/OWNER: City of Glendale Water and Power
- C. CONTRACTOR/ENGINEER: Earth Tech AECOM
- D. SUBCONTRACTOR: Construction Subcontractor

1.02 WORK BY OTHERS

- A. CONTRACTOR/ENGINEER will award separate subcontracts for performance of certain construction operations at the Site. These operations will be conducted simultaneously with Work under this Construction Subcontract as follows:
 - 1. Soil compaction testing services.
 - 2. Third party testing services, including structural concrete and grout inspection/testing, and structural steel inspection.

1.03 CONTRACTOR/ENGINEER FURNISHED MATERIALS OR EQUIPMENT

- A. CONTRACTOR/ENGINEER has placed orders with certain supplier(s) for specific equipment or material for the purpose of expediting delivery, and other purposes in CONTRACTOR/ENGINEER's interest.
- B. Materials or equipment furnished by CONTRACTOR/ENGINEER and installed by SUBCONTRACTOR:
 - 1. RCF – All process equipment that is provided by Layne Christensen
 - 2. WBA
 - a. Carbon dioxide storage, refrigeration and feed system, including CO2 tank, carrier water pumps, diffuser, and pH probe.
 - b. Backwash tank
 - c. Two bag filter housings
 - d. Static mixer

D. CONTRACTOR/ENGINEER RESPONSIBILITIES

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1. Arrange for and deliver Shop Drawings and product data to SUBCONTRACTOR.
2. Arrange and pay for delivery of equipment or CONTRACTOR/ENGINEER -supplied materials and equipment to Site in accordance with progress schedule.
3. Deliver supplier's bill of material to SUBCONTRACTOR.
4. Inspect deliveries jointly with SUBCONTRACTOR.
5. Submit claims for transportation damage.
6. Arrange for replacement of damaged, defective, or missing items.
7. Arrange for manufacturer's warranties, bonds, service, and inspections as required.
8. Arrange and pay for soil compaction and deputy inspection services.
9. Approve submittals from SUBCONTRACTOR.

E. SUBCONTRACTOR RESPONSIBILITIES

1. Review proposed delivery dates in Specifications and note or designate delivery date for equipment or material in progress schedule.
2. Review Shop Drawings and product data.
 - a. Submit to CONTRACTOR/ENGINEER with identification of discrepancies or problems anticipated in use of equipment or material.
3. Handle equipment or material at Site, including receiving and unloading, uncrating, and storage in accordance with manufacturer's recommendations.
4. Inspect equipment or material jointly with CONTRACTOR/ENGINEER, record shortages, and damaged or defective items for submittal.
5. Store and protect equipment from exposure to elements and from damage. (See Section 01500 Temporary Storage).
6. Repair or replace items damaged by SUBCONTRACTOR or lower tier subcontractors.
7. Provide temporary security fence.
8. Provide site security.
9. Submit product data.

1.04 SCOPE OF WORK

SUBCONTRACTOR's scope of work is as described on the "Issue for Construction" drawings for the RCF and WBA facilities and as described below:

1. SUBCONTRACTOR is responsible for providing all materials specifically not provided by others, including pipe, valves, and fittings, concrete, fencing, and electrical hardware.
2. SUBCONTRACTOR is responsible for all site work, including all concrete work, all electrical work, and all mechanical work not specifically identified as the responsibility of others.
3. All equipment that is fabricated by others and provided by the CONTRACTOR/ENGINEER will be delivered to the site. SUBCONTRACTOR is responsible for offloading and installing all equipment described above in Section 103B.

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4. Inspections (Coordinate with Site Engineer and Deputy Inspector. CONTRACTOR/ENGINEER will provide third party inspections services).

1.05 SCHEDULE

Schedule is contained in the bidding document.

1.06 SUBCONTRACTORS USE OF PREMISES

- A. OPERATOR will occupy Site and existing facilities during entire period of construction for conduct of normal operations. Cooperate with OPERATOR during construction operations to minimize conflict and facilitate OPERATOR's operations.
- B. SUBCONTRACTOR shall at all times, conduct operations at least inconvenience to OPERATOR, other contractors, general public, and operation of existing well pumps.
- C. COORDINATE use of premises as directed by CONTRACTOR/ENGINEER.
- D. Assume full responsibility for protection and safekeeping of materials and equipment under this Subcontractor.

1.07 WORKING HOURS

- A. CONTRACTOR and SUBCONTRACTOR shall establish normal working hours prior to start of the project. The following schedules are acceptable: eight hours per day five days per week, ten hours per day four days per week, or 9 hours per day 9 days every two weeks. The SUBCONTRACTOR must adhere to the work schedule during the duration of the project.

1.08 WORK OUTSIDE REGULAR HOURS

- A. Notify CONTRACTOR/ENGINEER in writing at least three calendar days prior to conducting work outside of normal work hours, including weekend or holiday work.

* * * END OF SECTION * * *

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SECTION 01200

PROJECT MEETINGS

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED:

- A. CONTRACTOR/ENGINEER will schedule and administer preconstruction conference. Progress meetings will be scheduled throughout progress of Work, as necessary to determine progress and measurement of payment. CONTRACTOR/ENGINEER will:
1. Prepare agenda for meetings.
 2. Distribute written notice of each meeting one to four (1-4) days in advance of meeting date.
 3. Make physical arrangements for meetings.
 4. Preside at meetings.
 5. Record the minutes; include significant proceedings and decisions.
 6. Reproduce and distribute copies within seven (7) days after each meeting to:
 - a. Participants in the meeting.
 - b. Parties affected by decisions made at the meeting.
- B. Representatives of SUBCONTRACTORS and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.

1.02 PRE-CONSTRUCTION CONFERENCE:

- A. Schedule: Meeting will be scheduled prior to start of work at a time and place designated by the CONTRACTOR/ENGINEER.
- B. Attendance:
1. ENGINEER/ CONTRACTOR.
 2. SUBCONTRACTOR.
 3. Lesser Tier Subcontractors (Optional).
 4. CLIENT/OWNER
 5. OPERATOR
- C. Agenda:
1. Responsibilities.
 2. General contract terms.
 3. Supervision.

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4. Schedules and seasonal limitations.
5. Approvals and testing.
6. Clearances and notices.
7. Construction procedures.
8. Payments and estimates.
9. Labor requirements.

1.03 DAILY TAILGATE SAFETY MEETINGS

- A. SUBCONTRACTOR shall hold daily tailgate safety meetings. Meetings shall be adequate in content and duration to cover tasks to be performed that day.

* * * END OF SECTION * * *

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SECTION 01300

SUBMITTALS AND SUBSTITUTIONS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included:

The SUBCONTRACTOR shall make required submittals to the CONTRACTOR/ENGINEER, and revise and resubmit, as necessary, to establish compliance with the specified requirements. Required submittals are described in this and other sections of these specifications.

B. Work not included:

1. Submittals not requested or required by CONTRACTOR/ENGINEER will not be reviewed
2. SUBCONTRACTOR may require his Subcontractors to provide drawings, diagrams, and similar information to help coordinate Work, but such data shall remain between SUBCONTRACTOR and his Subcontractors and will not be reviewed by CONTRACTOR/ENGINEER. SUBCONTRACTOR shall incorporate all pertinent submittals from his Subcontractors into documents required for submittal to CONTRACTOR/ENGINEER.

1.02 QUALITY ASSURANCE

A. Coordination of submittals:

1. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted.
2. Verify that each item and submittal for it conform in all respects with specified requirements.
3. By affixing SUBCONTRACTOR's signature to each submittal, certify that this coordination has been performed.

B. Substitutions:

1. Contract is based on standards of quality established in Contract Documents. Substitutions will be considered only when substantiated by the SUBCONTRACTOR's submittal of required data within five (5) calendar days after award of Contract.
2. Do not substitute materials, equipment, or methods unless such substitutions have been specifically approved in writing for this Work by CONTRACTOR/ENGINEER.

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- C. "Or equal":
1. Where the phrase "or equal," "or approved equal," or "or equal as approved by CONTRACTOR/ENGINEER," occurs in Contract Documents, do not assume that materials, equipment, or methods will be approved as equal unless item has been specifically so approved for Work by the CONTRACTOR/ENGINEER. "Or equal" items will be considered only when substantiated by SUBCONTRACTOR's submittal of required data within five (5) calendar days after award of Contract.
 2. Decision of CONTRACTOR/ENGINEER shall be final.

1.03 SUBMITTALS

- A. Make submittals of shop drawings, equipment, substitution requests, and other items in accordance with provisions of this section.
- B. As appropriate and as needed, identify component, supplier, pertinent Drawing and detail number(s), and Specification Section number.
- C. At, or prior, to preconstruction conference, SUBCONTRACTOR shall submit following items to CONTRACTOR/ENGINEER for review:
1. Construction Schedule: An estimated construction progress schedule indicating the starting and completion dates of the various stages of Work. It shall include as a minimum following information:
 - a. Work Breakdown:
 1. Times projected for submittals, approvals, and procurement
 2. Times for installation and erection
 3. Times for testing and inspection.
 - b. Identification of all critical items that may delay start or completion of work so as to delay completion of whole project.
- D. Closeout Documents
1. Record Drawings: CONTRACTOR/ENGINEER shall submit a set of corrected record drawings to the CLIENT/OWNER conforming to the construction records of the SUBCONTRACTOR. The SUBCONTRACTOR shall be responsible for the accuracy of such information, and for any errors or omissions.
 2. Operation and Maintenance (O&M) Manuals: CONTRACTOR/ENGINEER shall submit a set of O&M manuals provided by equipment vendor for major equipment provided.

PART 2 PRODUCTS

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2.01 SHOP DRAWINGS

- A. Make Shop Drawings accurately to a scale sufficiently large to show all pertinent aspects of item and its method of connection to Work.
- B. Submit three (3) copies of Shop Drawings to CONTRACTOR/ENGINEER.

2.02 MANUFACTURERS' LITERATURE

- A. Where contents of submitted literature from manufacturers include data not pertinent to the submittal, clearly show which portions of the contents are being submitted for review.
- B. Submit number of copies, which are required to be returned, plus three (3) copies, which will be retained by CONTRACTOR/ENGINEER.
- C. When specified in individual specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing.
- D. Identify conflicts between manufacturers' instructions and Contract documents.

PART 3 EXECUTION

3.01 IDENTIFICATION OF SUBMITTALS

- A. Consecutively number all submittals.
 - 1. When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new transmittal number.
 - 2. On resubmittals, cite original submittal number for reference.
- B. Accompany each submittal with a letter of transmittal showing all information required for identification and checking.
- C. On at least first page of each submittal, and elsewhere as required for positive identification, show submittal number in which item was included.
- D. Maintain an accurate submittal log for the duration of Work, showing current status of all submittals at all times. Make the submittal log available to CONTRACTOR/ENGINEER upon request.

3.02 GROUP OF SUBMITTALS

- A. Unless otherwise specified, make submittals in groups containing all associated items to assure that information is available for checking items when it is received.

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1. Partial submittals may be rejected as not complying with provisions of Contract.
2. SUBCONTRACTOR may be held liable for delays so occasioned.

3.03 TIMING OF SUBMITTALS

- A. Unless specifically stated elsewhere in these Specifications, make submittals in advance of ordering materials or contracting with Subcontractors to provide time required for reviews, for securing necessary approvals, for possible revisions and resubmittals and for placing orders and securing delivery.
- B. In scheduling, allow at least three to five (3-5) working days for review and approval by the CONTRACTOR/ENGINEER following receipt of the submittal.

3.04 CONTRACTOR/ENGINEER'S REVIEW

- A. Review by CONTRACTOR/ENGINEER does not relieve SUBCONTRACTOR from responsibility for errors, which may exist in submitted data.
- B. Revisions:
 1. Make revisions required by CONTRACTOR/ENGINEER.
 2. If SUBCONTRACTOR considers any required revision to be a change, he shall so notify the CONTRACTOR/ENGINEER immediately.
 3. Make only those revisions directed or approved by CONTRACTOR/ENGINEER.

* * * END OF SECTION * *

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SECTION 01400

QUALITY CONTROL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality assurance and control of installation.

1.02 QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply fully with manufacturers' assembly and installation instructions.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from CONTRACTOR/ENGINEER before proceeding.
- D. Comply with specified standards as a minimum quality for Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by qualified personnel.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement. Anchorages shall be designed to meet Uniform Building Code Seismic Zone 4 requirements.

1.03 REFERENCES

- A. Conform to reference standard by date of issue current on date of Contract Documents. Should specified reference standards conflict with Contract Documents, request clarification from CONTRACTOR/ENGINEER before proceeding.

* * * END OF SECTION * * *

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SECTION 01500

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary construction facilities and temporary site control measures.

1.02 RELATED SECTIONS

- A. Section 01700 – Contract Closeout: Final cleaning.

PART 2 PRODUCTS

2.01 TEMPORARY ELECTRICITY

- A. 110-volt electricity is available at the site for the Subcontractors use.
- B. If additional power is required for construction activities, the SUBCONTRACTOR will provide power outlets with branch wiring and distribution boxes as required. Provide flexible power cords, as required.

2.02 TEMPORARY WATER SERVICE

- A. SUBCONTRACTOR shall provide and maintain adequate drinking water facilities as may be required by work force employed. Construction water may be available from OPERATOR'S pipeline located on site. SUBCONTRACTOR shall contact OPERATOR prior to using water facilities. Fees and charges for water used shall be responsibility of SUBCONTRACTOR. SUBCONTRACTOR shall also be responsible for backflow preventers, flow meters, and valves as required by OPERATOR.

2.03 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Sanitary facilities shall be provided as required by OSHA regulations for work force employed.

2.04 TEMPORARY STORAGE FACILITIES

- 2 SUBCONTRACTOR may bring on the site, roll-off storage containers, as required for storage of tools and materials being used on the project.

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2.05 BARRIERS

- A. Provide barriers to prevent unauthorized entry into construction areas and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

2.06 PROTECTION OF EXISTING UTILITIES/ INSTALLED WORK

- A. SUBCONTRACTOR shall use one-call telephone number, 1-800-227-2600, of Underground Service Alert in order to have underground installations marked by all potentially affected utilities.
- B. Protect installed work and provide special protection where specified in individual specification Sections. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.

2.07 ACCESS ROADS

- A. Maintain access to fire hydrants, free of obstructions.
- B. Provide means of removing mud and loose soils from vehicle wheels and chassis before entering streets.
- C. SUBCONTRACTOR shall implement dust abatement, if necessary as directed by CONTRACTOR/ENGINEER.

2.08 TEMPORARY PARKING

- A. Coordinate with CONTRACTOR/ENGINEER for temporary surface parking areas to accommodate construction personnel.

2.09 SECURITY

- A. OPERATOR will not provide security. SUBCONTRACTOR shall secure lockable entrances to protect Work from theft, vandalism, and unauthorized entry during non-working hours.
- B. Restrict entrance of persons and vehicles into work areas as directed by CONTRACTOR/ENGINEER.

2.10 TEMPORARY FENCING

- A. Provide temporary chain-link fence around work area, as directed.

2.11 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

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- B. Remove debris and rubbish from pipe chases, plenums, and other closed or remote spaces, prior to enclosing the space.
- C. SUBCONTRACTOR shall, at his expense, provide for all solid waste disposal generated by his operations and dispose of all shipping materials generated from supplied equipment deliveries that are to be installed in scope of Work.

2.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Upon completion of Work, or prior thereto when so directed by CONTRACTOR/ENGINEER, SUBCONTRACTOR shall remove all temporary facilities, structures and installations from Site and return all areas used or occupied to preconstruction state.
- B. Clean and repair damage to existing facilities caused by installation or use of temporary work.

PART 3 EXECUTION

Not Used.

* * * END OF SECTION * * *

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SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Substantial Completion.
- B. Final cleaning.
- C. Final inspection.

1.02 SUBSTANTIAL COMPLETION

- A. When SUBCONTRACTOR considers Work to be substantially complete, provide notice to the CONTRACTOR/ENGINEER, with list of items yet to be completed or corrected.
- B. Within a reasonable time, the CONTRACTOR/ENGINEER will inspect status of completion.
- C. Should CONTRACTOR/ENGINEER determine Work is not substantially complete, SUBCONTRACTOR will be promptly notified in writing, with reasons. SUBCONTRACTOR shall remedy deficiencies and send a second written notice of substantial completion; CONTRACTOR/ENGINEER will re-inspect work.
- D. When CONTRACTOR/ENGINEER determines Work is substantially complete, a Certificate of Substantial Completion with a punch list of items to be completed or corrected prior to a final inspection will be issued.

1.03 FINAL CLEANING

- A. Remove waste and surplus materials, rubbish, and construction facilities from the site.
- B. Clean mechanical and electrical equipment to ensure proper operation.

1.04 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
 - 1. Contract Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other Modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product data.
- B. SUBCONTRACTOR shall submit a redline set of redline drawings at the completion of work for

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preparation of CAD record drawings by the CONTRACTOR/ENGINEER.

C. Record information concurrent with construction progress.

1.05 FINAL INSPECTION

A. When Work is complete, submit to CONTRACTOR/ENGINEER written certification that:

1. Work has been completed in accordance with Contract Documents, and deficiencies listed with Certificate of Substantial Completion have been corrected.
2. Equipment and systems have been tested in presence of the CONTRACTOR/ENGINEER and are operational.
3. Work is complete and ready for final inspection.

B. Within a reasonable time, the CONTRACTOR/ENGINEER will make the final inspection.

C. Should CONTRACTOR/ENGINEER determine that the work is not complete, SUBCONTRACTOR will be promptly notified with a written punch list of items still not acceptable.

D. When CONTRACTOR/ENGINEER determines work is complete, final payment to SUBCONTRACTOR will be made.

PART 2 PRODUCTS

(NOT USED)

PART 3 EXECUTION

(NOT USED)

* * * END OF SECTION * * *

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SECTION 02200

EXCAVATION AND BACKFILL

PART 1 GENERAL

1.01 DESCRIPTION

- A. This section includes the work required for site preparation and excavation and backfill.

1.02 REFERENCES

- A. American Society for Testing and Materials, latest edition (ASTM).

1.03 RELATED WORK

- A. Section 01500 – Temporary Construction Facilities and Controls.
- B. Section 02300 – Waste Management
- C. Section 15010 – Piping

1.04 PROJECT CONDITIONS

- A. Protect Existing Utilities: Coordinate with CONTRACTOR/ENGINEER to locate utilities identified on drawings and via utility surveys as required for determining location.
- B. SUBCONTRACTOR shall be responsible for notifying Underground Service Alert (USA) at least 48 hours prior to beginning excavation.
- C. Protect Persons and Property
 - 1. Barricade open depressions and holes occurring as part of this work, and post barricades with one flasher each on property adjacent to or with public access.
 - 2. Operate warning lights during hours from dusk to dawn each day and as required.
 - 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by operations under this Section.
- D. Dust Control
 - 1. Use means necessary to control dust on and near the work, and on and near off-site areas. Moisten surfaces as required to prevent dust being a nuisance.

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- E. Maintain access to adjacent areas at all times.
- F. Protect improvements on adjoining properties and on the County property.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Pipe Bedding: Backfill around pipes with suitable sand material.
- B. Trench Backfill: Backfill trenches with suitable excavated material.
- C. Structural Fill:
 - 1. Well-graded or poorly graded gravels and gravel-sand mixtures, well graded or poorly graded sands and gravelly sands or other approved granular material, of 2 in. maximum size, free from organic and deleterious materials. Classified as GW, GP, SW, or SP in Unified Soil Classification System.
 - 2. Plasticity Index: ASTM D4318, 6 or less. Plasticity Index shall be performed on fraction of material that passes the No. 40 sieve.
 - 3. Maximum Fines: ASTM D422, 3% passing No. 200 sieve.
 - 4. Uniform Coefficient: 5 or greater.

PART 3 EXECUTION

3.01 DEMOLITION

- A. Remove any sidewalks, curbs, concrete paving, and AC paving, including all base material as indicated on the plans as required to accommodate new construction. Saw cut the full depth of existing sidewalks, curbs, and paving in neat, straight lines to provide uniform, even transition from new to adjacent existing work. Saw cut back existing paving a sufficient distance to permit forming and installation of new work.
- B. Protect all areas that are not to be resurfaced or regraded, and adjacent areas outside contract limits from damage due to site preparation work.

3.02 EXCAVATION

- A. Excavate trenches for piping and electrical conduit as shown on the drawings.
- B. Structural Excavation:
 - 1. Remove loose fill to depth specified in Geotechnical Report and alluvial sediments below the

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existing grade extending laterally to the extent shown on drawings

3.03 BACKFILL AND COMPACTION

- A. Pipe Bedding Area: Compact suitable excavated material to 90% of maximum density.
- B. Trench, Sidewalk, Paving, Piping, Electrical Conduit Backfill Area:
 - 1. Use suitable excavated material and sand bedding around piping and compact to 90% of maximum density per ASTM D1557-00. Fill soils shall be moisture conditioned slightly above optimum moisture content. Lift thickness shall not exceed 12" loose.
- C. Structural Backfill Recompanction:
 - 1. Scarify, moisture condition, and compact the exposed natural subgrade soils after structural excavation to 95% or more as evaluated by ASTM D 1557-00
 - 2. Replace with excavated fill compacted to 95% relative compaction at slightly above optimum moisture content as evaluated by ASTM D 1157-00. Fill soils shall be moisture-conditioned slightly above optimum moisture content. Lift thickness shall not exceed 8" loose.

3.04 SURPLUS EXCAVATED MATERIAL

- A. Excess excavated material shall be transported offsite for disposal per direction of the CONTRACTOR/ENGINEER.

3.05 DISPOSAL OF WASTE MATERIALS (Refer to Section 02300)

3.06 REPAIR

- A. Repair damage to adjacent improvements caused as the result of this work at no cost to CONTRACTOR or OPERATOR.

3.07 MONUMENTS AND MARKERS

- A. If Site has been surveyed and staked prior to start of the work of this Section, SUBCONTRACTOR shall be responsible to protect all benchmarks, survey stakes and monuments.

* * * END OF SECTION * * *

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SECTION 02250

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide asphaltic concrete paving as shown on drawings and as specified. The work includes:
 - 1. Repairing and re-surfacing existing asphaltic concrete paving removed and damaged during construction.
 - 2. Contractor shall be responsible for ensuring that no undermining of the asphalt occurs. If it does, the Contractor shall be responsible to re-sawcut and replace the asphalt in those areas.
 - 3. Pavement Surface Sealer.
 - 4. Pavement Striping and Markings.

- B. Related Work:
 - 1. Section 2200: Excavation and Backfill

1.02 REFERENCES

- A. State of California, Department of Transportation
 - 1. Current Edition Standard Specifications for Road Construction
 - 2. Current Edition State Materials Manual

- B. The Asphalt Institute
 - 1. Manual MS-4 - The Asphalt Handbook.
 - 2. Manual MS-13 - Asphalt Surface Treatment and Asphalt Penetration Macadam
 - 3. Manual MS-8 - Asphalt Paving Manual

- C. American Society for Testing and Materials (ASTM)
 - 1. D1664-80 - Coating and Stripping of Bitumen from Bituminous Paving Mixtures
 - 2. D946 - Penetration-Graded Asphalt Cement for Use in Pavement Construction

1.03 QUALITY ASSURANCE

- A. Testing and inspection of asphalt pavement mixes and testing of coarse aggregate and asphalt pavement will be performed at Engineer's option and will be paid by the Engineer.

- B. Allow testing laboratory access to the mixing plant for verification of weights or proportions, character of materials used and determination of temperatures used in the preparation of asphalt concrete mix.

- C. When and if required, the testing laboratory shall perform laboratory tests on proposed asphalt pavement mixes to determine conformity with requirements.

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- D. The testing laboratory shall perform compaction tests for aggregate base course. Contractor shall pay for costs for additional testing as required due to improper performance of work.
- E. If compaction tests indicate that aggregate base course or asphalt paving do not meet specified requirements, remove defective work, replace and retest at Contractor's expense.
- F. Materials and methods of construction shall comply with the Caltrans Standard Specifications.
- G. Provide material furnished by a bulk asphaltic concrete producer regularly engaged in the production of hot-mix, hot-laid asphaltic concrete paving materials.
- H. Tolerances:
 - 1. In-place compacted thickness:
 - a. Base course: maximum 1/2" plus, minus 0".
 - b. Surface course: maximum 1/4 " plus, minus 0"
 - 2. Finished surface smoothness:
 - a. Base course: maximum 3/8" in 10'-0".
 - b. Surface course: maximum 1/4" in 10'-0", any direction.

1.04 SUBMITTALS

- A. Product Data:
 - 1. Submit complete materials list of items proposed for the work. Identify materials source.
- B. Submit Certificates of Compliance for the following:
 - 1. Class 2 aggregate base
 - 2. Asphaltic concrete

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver manufactured products in manufacturer's original, unopened, and undamaged containers with labels intact and legible.
- B. Store and handle manufactured products to prevent damage and deterioration.

1.06 PROJECT CONDITIONS

- A. Bituminous paving shall not be placed when the ambient temperature is below 50° F or when there is frost or moisture in the aggregate base, or any other time when weather conditions are unsuitable for the type of material being placed. Prime and tack coats to be applied only when ambient temperature is above 50° F. Asphalt loads shall be covered with tarpaulins during transport from plant to the site.
- B. Provide temporary barricades and warning lights as required for protection of project work and public safety.

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- C. Protect adjacent work from damage, soiling, and staining during paving operations.

PART 2 PRODUCTS

2.01 AGGREGATE BASE

Class 2 aggregate base as specified in Caltrans Specifications Section 26, Article 26-1.02B, (3/4" maximum grading).

2.02 ASPHALTIC CONCRETE

Shall conform to the requirements for Type B asphalt concrete in accordance with Section 39 of the Caltrans Standard Specifications. Bituminous binders shall conform to the requirements for steam-refined paving asphalt with a viscosity grade of AR 4000 (AR 8000 for patching) in accordance with Section 92 of the Caltrans Standard Specifications. Aggregate shall conform to the requirements for Type B, 3/8-inch maximum size, medium graded aggregate in accordance with Section 39 of the Caltrans Standard Specifications. Aggregate gradation shall fall within the specified limits and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be uniformly graded from coarse to fine.

2.03 PAINT BINDER

For tack coat, shall conform to the requirements for RS1 or RS2 asphaltic emulsion in accordance with Section 94 of the Caltrans Standard Specifications.

2.04 PRIME COAT

Shall conform to the requirements for MC70 or MC250 liquid asphalt in accordance with Section 92 or 93 of the Caltrans Standard Specifications.

2.05 SEAL COAT

Fog type as defined in Section 37 of the Caltrans Standard Specifications.

PART 3 EXECUTION

3.01 GENERAL

- A. The subgrade shall be scarified immediately before placing the aggregate base. The exposed subgrade shall be scarified to a depth of 6" and re-compacted to at least 95% of the maximum dry density determined by the ASTM D1557 method of compaction.
- B. Proof roll prepared subgrade to check for unstable areas requiring additional compaction. Notify Engineer of any unsatisfactory conditions.

3.02 AGGREGATE BASE

- A. In areas where aggregate base is to be placed, the thickness shall exceed the surrounding thickness by 1" minimum.

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- B. Aggregate base shall be delivered to the site in uniform mixes. It shall be deposited and spread in such a manner as not to form pockets of coarse or fine material.
- C. Aggregate base shall be sufficiently watered and compacted to a relative compaction of not less than 95% as determined by ASTM D1557. The material shall be compacted in equal layers not to exceed 6- inch in compacted thickness.
- D. Prior to construction of pavement on aggregate base, prime coat shall be applied in accordance with Section 39-4 of the Caltrans Standard Specifications, and as modified below, to provide a properly prepared surface.
- E. Sufficient prime coat shall be applied to penetrate and seal, but not flood the surface. Prime coat shall be allowed to cure and dry as required to attain penetration and evaporation of the volatiles before proceeding with construction of pavement.

3.03 ASPHALT CONCRETE

- A. Thickness of asphalt concrete shall exceed the thickness of the existing asphaltic concrete pavement by at least 1”.
- B. Asphalt concrete shall be spread and compacted on the prepared base course (and the existing pavements) in conformance with the lines, grades, and dimensions shown on the drawings and in conformance with the applicable paragraphs of Section 39 of the Caltrans Standard Specifications, except as specified herein.
- C. Spreading equipment shall be asphalt pavers conforming to the Caltrans Standard Specifications.
- D. The vertical surface joints shall be dense, uniform and well bonded. In the formation of joints, provision shall be made for proper bond with adjacent lift for the entire depth of the lift. A tack coat shall be applied to such joints and contact surfaces of previously constructed asphalt or concrete surfaces abutting the work.

Rolled or rounded edges are not acceptable as vertical surfaces for joints. Cutting back such edges and disposing of waste shall be required. Longitudinal and transverse joints shall be trimmed vertical if the exposed joint surface is not dense, uniform, and is in such condition that the quality of the completed joint shall be affected.

- E. Finish paving surfaces true to grade (3/8" in 10'-0" maximum) and slope, unless otherwise shown; free of ruts, bumps, depressions, and irregularities. Any ridges, indentations or other objectionable marks left in the surface of the asphalt concrete by blading or other equipment shall be eliminated either by rolling or other means. Paving shall not vary more than 1/4 inch in 10 feet from a true plane, and/or elevations. In the presence of the Engineer, test for proper drainage by flooding with water in sufficient amount to cover entire area. Should any portion of the paved surface fail to drain properly, correct the condition in a manner acceptable to the Engineer (prior to the application of the seal coat).

3.04 SEAL COAT

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Fog Seal Coat application according to the Caltrans Standard Specifications, Section 37.

3.05 PROTECTION

- A. Protect paving areas from damage done to construction and vehicular traffic until final acceptance.
- B. After final rolling, no vehicular traffic of any kind shall be permitted on paving until it has cooled and hardened, and in no case less than 6 hours. Provide adequate provision for protection of adjacent work including building and paved surfaces.
- C. Protect painted areas from use until completely dry.

3.06 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, debris, and equipment. Repair damage resulting from paving operations.
- B. Sweep pavement and wash free of stains, discoloration, dirt, and other foreign material immediately prior to final acceptance.

END OF SECTION

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SECTION 02300

WASTE MANAGEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Disposal of routine construction debris.
- B. Disposal of excavation debris.
- C. Disposal of soil from excavations.
- D. Disposal of rainwater collected in the excavated areas.

1.02 RELATED SECTIONS

- A. Section 01500 - Construction Facilities and Temporary Controls: Progress Cleaning
- B. Section 02200 - Excavation and Backfill

PART 2 PRODUCTS

2.01 CONTAINERS

- A. All waste containers shall be provided by the SUBCONTRACTOR, and shall conform to applicable state and federal regulations. Containers shall be labeled in accordance with applicable regulations.

PART 3 EXECUTION

3.01 CONSTRUCTION DEBRIS

- A. SUBCONTRACTOR shall be responsible for disposal of all ordinary construction debris including all shipping containers for equipment, scrap produced in construction of system, and all other sanitary debris produced by SUBCONTRACTOR employees, including those of his Subcontractors. This debris shall be collected in appropriate receptacles and removed from Site on at least a weekly basis. If the volume of this debris is unusually large, it shall be removed more frequently so that Site is maintained in an orderly manner.

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3.02 EXCAVATION DEBRIS

- A. SUBCONTRACTOR shall be responsible for disposal of excess concrete, and asphalt material, at non-hazardous disposal facilities.

3.03 RAINWATER

- A. SUBCONTRACTOR shall pump out any rainwater accumulated in the trenches, to areas approved by the CONTRACTOR/ENGINEER.

3.04 SOIL FROM EXCAVATION

- A. SUBCONTRACTOR shall dispose of soils from excavations onsite. The soil must be free of construction debris and spread uniformly around the site to match existing terrain conditions under the direction of CONTRACTOR/ENGINEER.

* * * END OF SECTION * * *

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SECTION 02500

DISINFECTION OF TANKS AND WATER MAINS

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Disinfection work shall be acceptable to state health authority. Requirements of this section in conflict with requirements of authority for disinfection, authority shall govern.

B. Source Quality Assurance:

1. Perform Work in connection with disinfection under direction of experienced supervisor. Use equipment in proper working condition and adequate for specified Work.

C. Section Includes:

Requirements for disinfection of new water mains and existing water mains which have been relocated or contaminated by construction operations.

Requirements for disinfection of new tanks in perchlorate treatment system.

D. Measurement and Payment:

1. Include cost of Work specified in this section in appropriate lump sum or unit prices for disinfection of tanks and water mains in Bid Form.

1.02 SUBMITTALS

- A. Prior to starting disinfection work, furnish detailed outline of proposed sequence of operation, manner of filling and flushing units, source and quality of water to be used, and disposal of wasted water.

PART 2 PRODUCTS

2.01 CHLORINE

- A. Provide chlorine in accordance with requirements of AWWA C651 and C652.
- B. Chlorine gas-water solution or direct chlorine feed is preferred for disinfection.
- C. Use of high-test calcium hypochlorite, sodium hypochlorite, or tablet method of disinfection shall

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be approved by CONTRACTOR/ENGINEER and in accordance with AWWA procedures.

- D. Tablet form calcium hypochlorite or sodium hypochlorite may be used only for water mains up to 12 in. in dia and less than 2,500 ft in length.

PART 3 EXECUTION

3.01 GENERAL

- A. Method of disinfection for water containment devices and piping systems shall conform to AWWA C651-05.
- B. Method of disinfection of tank vessels shall conform to AWWA C652-02.
- C. Method of disinfection of treatment equipment shall conform to AWWA C653-03.

3.02 CHLORINE PREPARATION

A. Liquid Chlorine:

- 1. Apply chlorine gas-water solution by means of solution feed chlorinating device or, if approved by CONTRACTOR/ENGINEER, dry gas may be fed directly through proper devices for regulating rate of flow and providing effective diffusion of gas into water within unit being treated.
- 2. Provide chlorinating devices for feeding solutions of chlorine gas that prevent backflow of water into chlorine cylinder.

B. Calcium or Sodium Hypochlorite:

- 1. Prepare granular calcium or sodium hypochlorite as water mixture before introduction into unit. Make dry powder into paste and thin to approximately 1% chlorine solution.
- 2. To prepare chlorine solution, add 1 lb of calcium hypochlorite (65% to 70% available Cl₂) to 7-1/2 gal of water.

3.03 PIPELINE/VESSEL PREPARATION & CLEANING

- A. After pressure and leakage tests complete, flush units thoroughly to remove foreign material.
- B. Before disinfecting, remove debris and material not part of structural or operating facilities of tank.
- C. Clean using high pressure water jet or other equally effective means to remove dirt and foreign material.
- D. Clean using high pressure water jet or other equally effective means to remove dirt and foreign material.

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- E. Release entrapped air at high points and fill units with disinfecting agent and water to allow disinfecting agent to come in contact with interior surfaces.
- F. If complete venting cannot be accomplished through available outlets, provide necessary corporation cocks and vent piping.

3.04 DISINFECTING TANKS

- A. Disinfect in accordance with AWWA C652, Method 2.

3.05 DISINFECTION OF PIPING

- A. Point of Application:

- 1. Apply chlorinating agent at supply end of unit being disinfected.
- 2. For pipes, apply disinfectant through corporation cock installed in top of pipe.
- 3. Place tablets in accordance with AWWA C651.

- B. Rate of Application:

- 1. Introduce water at controlled rate in order to regulate chlorine dosage.
- 2. Proportion rate of chlorine mixture flow to rate of water entering unit so chlorine dose applied produces at least 25 mg/l chlorine residual after period of 24 hrs.
- 3. Method of determining rate of flow of water into unit being disinfected shall be approved by CONTRACTOR/ENGINEER.

- C. Isolating Systems:

- 1. Keep chlorine gas-water disinfecting solution and contaminated water from flowing into units previously chlorinated and flushed.

- D. Quality:

- 1. Retain chlorinated water in unit long enough to destroy nonspore-forming bacteria.
- 2. Minimum retention period shall be 24 hrs with chlorine residual at end of this period of not less than 25 mg/l (ppm).

- E. Disinfecting Valves:

- 1. Operate valves and appurtenances while line or unit is being disinfected to ensure surfaces of valves are disinfected.

- F. Swabbing:

- 1. Flush and swab pipe, fittings or valves that must be placed in service immediately with 5% solution of calcium hypochlorite immediately prior to assembly.

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2. Secure approval from CONTRACTOR/ENGINEER before using this method of disinfection.

G. Valve Operation: Performed by SUBCONTRACTOR.

3.06 FINAL FLUSHING AND TEST

- A. Following chlorination, flush unit or system until replacement water in system is proven to be comparable in quality to water, which will enter unit or system.
- B. Above acceptable condition of water delivered by each unit or system shall continue for at least 2 days, as demonstrated by laboratory examination of samples. Laboratory tests shall show chlorine residual, after final flushing, of less than 1 mg/l (ppm).
- C. Repetition of Flushing and Testing:

If initial treatment results in unsatisfactory bacterial test, repeat disinfection until satisfactory results obtained.
- D. Prevent entry of contaminated water into previously disinfected units or systems.

3.07 FIELD QUALITY ASSURANCE

- A. OWNER will obtain samples for and submit to laboratory for analysis before reservoir placed in service.
- B. If safe samples not obtained using above procedure, SUBCONTRACTOR shall, at his expense, add additional chlorine in amounts necessary to obtain safe samples.
- C. Costs of water for rechlorination of tank if first attempt does not test safely shall be paid by SUBCONTRACTOR.

* * * END OF SECTION * * *

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cast-in-place concrete.
- B. Grout and drypack.

1.02 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 302 - Guide for Concrete Floor and Slab Construction.
- C. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
- D. ACI 318 - Building Code Requirements for Reinforced Concrete.
- E. ASTM – American Society for Testing and Materials.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Submit to CONTRACTOR/ENGINEER the concrete mix design from the concrete supplier or batching plant. Pour no concrete until written approval from CONTRACTOR/ENGINEER has been received.
- C. Manufacturer's Certificate of Compliance:
 - 1. Cement
 - 2. Aggregates
 - 3. Admixtures
 - 4. Reinforcement

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type II - Portland type, as specified on drawings.

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- B. Water: Potable and not detrimental to concrete.
- C. Fine and Coarse Aggregates: ASTM C33.

2.02 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Do not use any other admixtures unless approved in advance by CONTRACTOR/ENGINEER.

2.03 JOINT DEVICES AND COATINGS

- A. Expansion Joint Filler: ASTM D1751 or ASTM D1752; Asphalt impregnated fiberboard or felt, ½ inch thick.

2.04 CONCRETE MIX

- A. Mix and deliver concrete in accordance with ASTM C94.
- B. Provide concrete to the following criteria:

<u>Unit</u>	<u>Measurement</u>
<i>Structural Concrete:</i>	
Compressive Strength (28 day)	4,000 psi
Minimum Cement Content	5½ sacks
Water/Cement Ratio (maximum)	0.5 by weight
Aggregate Size (maximum)	1 ½ inch
Air Entrainment	4.5 percent
Slump	4 inches, maximum

2.05 GROUT

- A. Grout beneath column base plates and equipment skids shall be premixed, non-shrink grout consisting of non-metallic aggregate, cement, water, reducing and plasticizing agents: capable of developing minimum compressive strength of 7,000 psi in 28 days. Conform to ASTM 1107, Grade B.

2.06 MATERIALS FOR CURING CONCRETE

- A. Impervious sheeting: ASTM C171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.07 REINFORCEMENT MATERIAL

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- A. Reinforcing Steel: ASTM A615, Grade 60 deformed bars.

2.08 REINFORCEMENT ACCESSORY MATERIALS

- A. Tie Wire: Minimum 16 gage annealed type.
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.09 REINFORCEMENT FABRICATION

- A. Fabricate concrete reinforcing in accordance with ACI 318 and ACI Detailing Manual-1994 (Publication SP-66).
- B. Do not weld reinforcement.
- C. Locate reinforcing splices not indicated on drawings, at point of minimum stress. Review location of splices with CONTRACTOR/ENGINEER. Do not splice more than 50% of the reinforcement at one location. Lap splice lengths shall be in accordance with the 1997 Uniform Building code. Show all splice lengths and locations on the shop drawings.

2.10 FORMWORK MATERIAL

- A. Form material shall be at the discretion of the Contractor.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify site conditions for conformance with the drawings.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.02 PREPARATION

- A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

3.03 PLACING CONCRETE

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- A. Place concrete in accordance with applicable provisions of ACI 301, ACI 304 and ASTM C94, ACI 305, ACI 306, and ACI 318.
- B. Notify CONTRACTOR/ENGINEER a minimum of 24 hours prior to commencement of operations.
- C. Ensure reinforcement, inserts and embedded parts are not disturbed during concrete placement.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Place concrete continuously between predetermined construction joints.
- F. Do not interrupt successive placement; do not permit cold joints to occur.

3.04 CONCRETE FINISHING

- A. Provide floated finish for surfaces to receive water and pure hydrocarbon-repellent coating.
- B. Flat walking surfaces shall have light broom finish.
- C. All other surfaces shall have rough form finish.

3.05 CURING AND PROTECTION

- A. Curing of concrete shall conform to the requirements of Chapter 12 of ACI 301. Fresh concrete shall be cured for 7 days minimum.
- B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.06 PATCHING

- A. Allow CONTRACTOR/ENGINEER to inspect concrete surfaces immediately upon removal of forms.
- B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify CONTRACTOR/ENGINEER upon discovery.
- C. Patch imperfections in accordance with ACI 301.

3.07 DEFECTIVE CONCRETE

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- A. Defective concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Repair or replacement of defective concrete will be determined by CONTRACTOR/ENGINEER.
- C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of CONTRACTOR/ENGINEER for each individual area.

3.08 PLACING GROUT

- A. Grout shall be placed in a fluid consistency, with an efflux time of 25 to 30 seconds through a standard flow cone as defined by ASTM C939. The Contractor shall have a standard flow cone on-site to verify grout consistency prior to placement.
- B. Contractor shall not mix more grout than can be placed in approximately 10 minutes. Contractor shall not attempt to retemper grout by adding water or remixing after it stiffens.
- C. All grout used for filling under equipment skids and base plates shall be placed from one side using a form around the grouted area. A beveled form edge shall be provided on one side to help direct the grout flow under the base plate. Do not vibrate grout. Immediately after placement, trim the surfaces with a trowel and cover the exposed grout with clean, wet rags, and maintain this moisture for 4 to 6 hours.
- D. Forms and excess grout shall be removed after grout has achieved initial set. The grout should offer stiff resistance to penetration with a pointed mason's trowel prior to removing the grout forms. Exposed shoulders shall be finished and wet cured immediately after form removal, and until grout has reached final set, but not less than 48 hours, followed by two coats of curing compound.

3.09 SCHEDULE - CONCRETE TYPES

- A. Foundation slab, sumps, and curbs for mechanical equipment: 4,000 psi, 28 day concrete.
- B. Drypack and Grout: 7,000 psi, 28-day grout.

3.10 SAMPLING AND TESTING (Service provided by CONTRACTOR/ENGINEER and performed by impartial party)

- A. Sampling and testing shall be performed by CONTRACTOR/ENGINEER
- B. Slump Test: One slump test shall be performed for each mixer load of concrete.
- C. Compressive Strength Test: One compressive strength test shall be performed for each 50 cubic yards of concrete, or for each day's placement, whichever is less. Four test cylinders shall be collected for every compressive test. First cylinder shall be tested at 7 days, second and third

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cylinder at 28 days. Fourth cylinder – spare.

3.11 FORMWORK ERECTION

- A. Erect formwork, shoring, and bracing in accordance with the requirements of ACI 301.

3.12 REINFORCEMENT INSTALLATION

- A. Place, support, and secure reinforcement against displacement. Do not deviate from required position.
- B. Accommodate placement of formed openings and inserts.
- C. Maintain concrete cover around reinforcing as follows:
 - 1. Concrete cast against and permanently exposed to earth – minimum 3 inches.
 - 2. Concrete exposed to earth or weather – minimum 2 inches.

* * * END OF SECTION * * *

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SECTION 03604

NONSHRINK GROUT

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's literature.
- B. Submit in accordance with Section 01300

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturers:
 - 1. Final Grout 100, Five Star Products, Inc.
 - 2. Masterflow 713 Grout. Master Builders.
 - 3. Euco N-S Grout, Euclid Chemical Company.
 - 4. Crystex, L&M Construction Materials, Inc.
 - 5. Sika Grout 212-6 by Sika Corporation.
- B. Grout:
 - 1. Cement base, nonmetallic, nongas forming, nonshrink, preblended and ready-to-use requiring only addition of water at Project site.
 - 2. Comply with ASTM C1107 and CRD C621, Grade B.
 - 3. Of moderate fluidity with minimum compressive strength of 5,000 psi at 28 days and shall not bleed.
- C. Water:
 - 1. Clean and free from injurious chemicals and deleterious materials.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean grout contact surfaces of oil, grease, scale, and other foreign matter. Chip away unsound concrete leaving surface level but rough.
- B. Underside of base plates of machinery, rails, and bolts shall be free of grease, oil, dirt or coatings.

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3.02 MIXING AND PLACING

- A. Mix and place in accordance with manufacturer's written instructions.
- B. Provide sealing materials where necessary to retain grout until hardened.
- C. Work grout from one side to other. Avoid trapping air under base plates.
- D. Remove plastic anchor bolt sleeve tops where used, and fill with grout at same time base plates are grouted.

3.03 CURING

- A. Cure with curing compound or as recommended by grout manufacturer.

* * * END OF SECTION * * *

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SECTION 09900

COATINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Coating for piping, structural steel, and traffic bollards:
2. Labeling and directional arrows on piping, equipment with valves or electrical connections, valves, and ducts whether coated or not.
3. Do not coat unless specifically noted otherwise:
 - a. Factory-finished electrical motor control panels (MCC) and local control panels (LCP), flow indicators, and related equipment.
 - b. Underground equipment and underground piping except in vaults
 - c. Factory-finished trim.
 - d. Stainless steel.
 - e. PVC or reinforced plastic piping.
 - f. Galvanized surfaces.
4. Do not coat over any code-required labels such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
5. All coatings on wetted surfaces in contact with raw or treated water shall be approved per NSF-61.

- B. Equipment manufacturer is responsible for surface preparation and coatings of equipment, motors, and appurtenances. Equipment to be coated and coating system are identified in equipment Specification section(s).**

1.02 DEFINITIONS

A. Definitions as used in schedules.

1. Coatings: Heavy duty finishes for use on any surfaces, especially surfaces subject to submerged, high moisture, splash or chemical environment.
2. Ambient Conditions:
 - a. Chemical: Surface subject to corrosive chemical splash or fumes.
 - b. Moist: Surface subject to wet areas such as shower rooms and rooms with open tanks.
 - c. Normal: Surface subject to normal temperatures and humidity such as found in

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offices and corridors.

3. Splash: Surface subject to frequent washing and chemical splash.
4. Submerged P: Surface submerged in potable water plus 1 ft 0 in. above high liquid level.
5. Submerged NP: Surface submerged in nonpotable liquid such as sewage and sludge plus 1 ft 0 in. above high liquid level.

B. First Coat: Field prime, factory prime, or shop prime. When only one coat is required, first coat is finish coat.

C. Second or Third Coats: Successive finish coats applied over first coat.

1.03 SUBMITTALS

A. Product Data:

1. Submit manufacturer's literature stating application recommendations and generic makeup of each type of coating scheduled.
2. Substitutions: For coatings not specified, provide substitute manufacturer's literature with specified coating literature for CONTRACTOR/ENGINEER to make proper evaluation.

B. Samples:

1. Actual color samples available for each type of coating scheduled.
2. Two 4 in. by 4 in. steel panels for each method of metal preparation specified. Panel shall be representative of steel used and prevented from deterioration of surface quality. Upon acceptance by CONTRACTOR/ENGINEER, panel shall be preserved as reference source for inspection.

C. Miscellaneous:

1. Letter of Certification/Shop Painting:

- a. SUBCONTRACTOR has option of shop coating materials and equipment partially or totally.
- b. If SUBCONTRACTOR applies coatings in factory submit following:
 - 1) Coatings used.
 - 2) Manufacturer's written certificate factory-applied coating system is identical to, or exceeds, specified requirements.
 - 3) Requirements for touch-up or coating.
 - 4) History of coating performance in same environment.
- c. Submit following for factory-applied first coat.
 - 1) First coat used.

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- 2) CONTRACTOR'S certification factory-applied first coat is compatible with field-applied finish coats.
- 2. Certification:
 - a. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- 3. Schedules:
 - a. Submit schedule of proposed coating systems within 30 calendar days of Award of Subcontract.
 - b. Schedule of proposed coating systems shall identify same information as shown in coating schedule.
- D. Submit in accordance with Section 01300.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications:
 - 1. Engage an experienced applicator who has successfully completed coating system applications similar in material and extent to those indicated for Project.
- B. Single-Source Responsibility:
 - 1. Provide coating material produced by same manufacturer for each system. Use only thinners recommended by manufacturer and only within recommended limits.
- C. Manufacturer shall supply products that comply with local restrictions controlling use of volatile organic compounds (VOC's).

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in original, sealed, unopened packages and containers bearing manufacturer's name. Each container shall have manufacturer's printed label stating type of coating, color of coating, instructions for reducing, and spreading rate.
- B. Protect and heat or cool material storage location to maintain temperature ranges recommended by coating manufacturer for most sensitive coating, but not less than 55°F.
- C. Keep storage area neat and clean and replace or repair damage thereto or to its surroundings.
- D. Avoid danger of fire. Deposit cleaning rags and waste materials in metal containers having tight covers or remove from building each night. Provide fire extinguishers of type recommended by coating manufacturer in areas of storage and where finishing is occurring. Allow no smoking or

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open containers of solvents. Store solvents in safety cans.

- E. Empty containers shall have labels canceled and be clearly marked as to use.
- F. Upon Substantial Completion, remaining material will become property of OWNER. Seal material as required for storage, marked as to contents and shelf life, and store where required by CONTRACTOR/ENGINEER.

1.06 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

- 1. Do not apply exterior coating in cold, foggy, damp or rainy weather.
- 2. Do not apply exterior coating when temperature is lower than 50°F or as required by manufacturer.

B. Protection:

- 1. Cover materials and surfaces, including floors, adjoining or below Work with clean drop cloths or canvas.
- 2. Maintain manufacturer's environmental requirements while coating dries.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Coatings:

- 1. Tnemec.
- 2. AMERON Protective Coatings Division.

2.02 MATERIALS

A. Coatings:

- 1. Color shall be formed of pigments free of lead, lead compounds or other materials which might be affected by presence of hydrogen sulfide or other gases likely to be present at Project.
- 2. Coatings shall meet surface burning characteristics as required by code and established by ASTM E84.

2.03 COLORS

- A. Color shall match existing equipment, piping and structures.

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- B. Prior to beginning work, CONTRACTOR/ENGINEER will provide color coordinating schedule.
- C. Equipment Colors:
 - 1. Equipment includes equipment, motors, and structural supports, fasteners, and attached portions of electrical conduit.
 - 2. Coat equipment same color as piping equipment serves.
 - 3. Coat traffic bollards yellow to match existing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. If surfaces to be finished cannot be put into proper condition for finishing by customary cleaning, sanding, and puttying operations or if surfaces were improperly primed by others, report defects to CONTRACTOR/ENGINEER, in writing, or assume responsibility and correct unsatisfactory finish resulting from improper surfaces. Commencement of Work indicates acceptance of surfaces.
- B. Materials removed and replaced to correct defects due to Work placed on unsuitable surfaces shall be at SUBCONTRACTOR'S expense.
- C. Where surface dryness is questioned, test with dampness indicating instrument. Do not apply coatings over surfaces where moisture content exceeds that permitted in manufacturer's printed instructions.
- D. Provide coats compatible with the surface and prior coats.

3.02 SURFACE PREPARATION AND TOUCH-UP

- A. General:
 - 1. Surfaces, including floors shall be clean, dry, and free of loose dirt, dust, and foreign matter before applying coating.
 - 2. Comply with coating manufacturer's recommendations for surface preparation.
- B. Ungalvanized Ferrous Metal:
 - 1. General:
 - a. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
 - b. Prepare welds and adjacent areas to remove undercutting or reverse ridges on weld bead, weld spatter on or adjacent to weld or area to be coated, and sharp peaks or ridges along weld bead. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

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- c. Coat surfaces same day prepared. Reprepare surfaces starting to rust before coating.
 - 2. Cleaning Methods:
 - a. Workmanship for metal surface preparation as specified shall conform with SSPC specifications as follows:
 - 1) SP-1: Solvent Cleaning
 - 2) SP-2: Hand Tool Cleaning
 - 3) SP-3: Power Tool Cleaning
 - 4) SP-5: White Metal Blast Cleaning
 - 5) SP-6: Commercial Blast Cleaning
 - 6) SP-7: Brush-off Blast Cleaning
 - 7) SP-8: Pickling
 - 8) SP-10: Near-White Blast Cleaning
 - b. Wherever “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning,” or similar words of equal intent used in Specifications or coating manufacturer’s specifications, they shall be understood to refer to applicable SSPC specifications listed above.
 - c. Use hand tools to clean areas that cannot be cleaned by power tools.
 - 3. Shop Preparation: Equipment, structural steel, metal doors and frames, metal louvers, and similar items may be shop-prepared and first coat applied at SUBCONTRACTOR’S option. Centrifugal wheel blast cleaning is acceptable alternate to shop blast cleaning. Clean and prime in accordance with this section.
 - 4. Field Touch-Up: Sandblast items and equipment as specified to restore damaged surfaces previously shop or field blasted and first coat applied. Materials, equipment, procedures, and safety equipment for personnel shall conform to SSPC.
- C. Existing Surface Preparation:
- 1. General:
 - a. Remove and replace or mask attachments if attachments are not to be coated.
 - b. Remove surface contamination such as oil, grease, loose or otherwise defective paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers to assure sound bonding to tightly adhering old paint. Glossy surfaces of old paint films shall be clean and dull before repainting.
 - c. Sand surfaces and feather edges where chipped surfaces occur.
 - d. Cut out and fill cracks or other defects in existing surface to match adjoining surfaces.
 - e. Where sandblasting of existing coated concrete surfaces causes imperfections such as bugholes and holidays, fill imperfections with patching mortar before applying finish coatings.

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- f. Exact nature of existing coatings is not known in all cases. While it is assumed they have oxidized sufficiently to prevent lifting or peeling when overcoated with coatings or paints specified, check compatibility by application to small area prior to starting coating. If lifting or other problems occur, notify CONTRACTOR/ENGINEER for direction.
 - g. Comply with new coating manufacturer's recommendations for preparation of previously painted or coated surfaces.
- 2. Existing ferrous metal surfaces subject to chemical, submerged NP or splash conditions: As specified for ferrous metals.
 - 3. Existing masonry surfaces subject to chemical, submerged NP or splash conditions: As specified for masonry.
 - 4. Existing concrete and precast concrete surfaces subject to chemical, submerged NP or splash conditions: As specified for concrete and precast.

3.03 APPLICATION

A. General Requirements:

- 1. Spread evenly and flow on smoothly without runs, lumps or sags.
- 2. Make edges of coating adjoining other materials or colors sharp and clean without overlapping.
- 3. Number of coats and film thickness required is same regardless of application method. Do not apply succeeding coats until previous coat has cured as required by manufacturer. Where sanding is required, according to manufacturer's direction, sand between applications to produce smooth, even surface.
- 4. Manufacturer-Applied Coating Systems:
 - a. Repair abraded areas on factory-finished items in accordance with manufacturer's directions.
 - b. Blend repaired areas into original finish.
- 5. Application Procedures:
 - a. Apply coatings by brush, roller, spray, or other applicators according to manufacturer's instructions.

B. Priming and Sealing:

- 1. Refer to Coating Schedule for specific coating material.
- 2. Shop:
 - a. Shop first coat for ferrous metal shall comply with SSPC guidelines, and as specified in Coating Schedules of this Specification.
 - b. Hand or power sand chipped, peeled or abraded first coat and feather edges. Spot coat areas with specified first coat.

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- c. Prior to application of finish coats, clean shop-first coat surfaces free of dirt, oil, and grease.
- d. Prepare and prime holdback areas as required for specified coating system.

3.04 FIELD QUALITY CONTROL

A. Sampling of Materials:

- 1. CONTRACTOR/ENGINEER reserves right to select unopened containers of materials furnished for project and have materials tested at an independent testing laboratory. OWNER will pay for first tests.
- 2. Retests of rejected materials and tests of replacement materials shall be paid for by SUBCONTRACTOR.
- 3. Remainder of contents of containers not required for testing will be returned to SUBCONTRACTOR.

B. Coverage:

- 1. If coverage is not acceptable to CONTRACTOR/ENGINEER, CONTRACTOR/ENGINEER reserves right to require extra application of paint at no extra cost to OWNER.
- 2. Work at site where coat of material is applied will be inspected by CONTRACTOR/ENGINEER before application of succeeding specified coat, otherwise no credit for coat applied will be given and SUBCONTRACTOR automatically assumes responsibility to recoat Work in question. Furnish CONTRACTOR/ENGINEER report of particular coat applied and when completed for inspection to comply with above.

3.05 COATINGS SCHEDULE

A. General:

- 1. Unless otherwise noted, Tnemec and Ameron products are identified in this schedule to establish quality and type desired only.
- 2. Scheduled thickness or coverage rate is as recommended by Tnemec and Ameron. If other manufacturers are proposed and accepted, manufacturer's requirements shall be followed, but in no case may thickness or coverage rate be less.
- 3. DFT = dry film thickness (mils/coat). DFT shown is for spray application. Additional coats may be required if brushed and rolled.
- 4. sfpg = sq ft/gal (per coat).
- 5. Examples of surfaces to be coated are not all inclusive.

B. Standard Coating Schedule:

Example Surfaces	Surface Preparation	Tnemec Coating	Ameron Coating
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Example Surfaces	Surface Preparation	Tnemec Coating	Ameron Coating
SYSTEM 4-C (FERROUS METALS, EXTERIOR NORMAL TO SPLASH, GLOSS OR SEMI-GLOSS SHEEN, MAX. TEMP. 250°F, 3-COAT SYSTEM)			
Equipment, Pipe, Structural Members	SP6	First Coat – 3.0 to 5.0 DFT/"Series N69 Epoxoline or N140 Pota-Pox Plus" polyamidoamine epoxy. Second Coat – 3.0 to 5.0 DFT/"Series N69 Hi-Build Epoxoline" polyamidoamine epoxy. Third - Coat – 3.0 to 4.0 DFT/"Series 73 Endura-Shield" aliphatic acrylic polyurethane.	First Coat – 3.0 to 5.0 mils DFT/"Amercoat 385" epoxy. Second Coat – 3.0 to 5.0 mils DFT/"Amercoat 385" epoxy. Third Coat – 3.0 to 4.0 DFT/"Amershield" polyurethane.

3.06 FINAL TOUCH-UP

- A. Prior to Substantial Completion, examine coated surfaces and retouch or refinish to leave surfaces in condition acceptable to CONTRACTOR/ENGINEER.

3.07 CLEANING

- A. Before Substantial Completion, remove masking, temporary coatings, and other material from surfaces and remove rubbish and accumulated materials of whatever nature from premises and leave in clean, orderly condition.

* * * END OF SECTION * * *

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SECTION 11400

EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes equipment furnished by CONTRACTOR/ENGINEER and installed by SUBCONTRACTOR.

PART 2 PRODUCTS (BY CONTRACTOR/ENGINEER)

2.01 WBA

- A. CONTRACTOR/ENGINEER will provide delivery, shop drawings and product data.

1. Prefilter skid
 - a. Manufacturer: Filtrek
 - b. Type: bag filter housings
 - c. 2 –filter housings, each containing 6 - #2 filter bags
 - d. Design flow per housing – 600 gpm
 - e. Materials of construction: 304 stainless steel
 - f. Vessel diameter: 22-5/16” ID
 - g. Lids secured by wing nuts, davit opening
 - h. Nominal filter bag rating: 10 micron
2. CO2 system
 - a. Manufacturer: Tomco Equipment Company
 - b. CO2 storage capacity: 28,000 lb
 - c. Delivery capacity: 86 lb/hr
 - d. pH probe: insertion type
 - e. pH setpoint: 6.0
3. CO2 carrier water pumps (2)
 - a. Model 4SH2L42B5
 - b. Type: End suction centrifugal
 - c. 10 HP each
 - d. 86 gpm @138 ft TDH
4. Backwash tank
 - a. Manufacturer: Snyder
 - b. Type: Covered cone bottom
 - c. Materials of construction: XLPE
 - d. Capacity: 3,000 gallons
 - e. Height: 167 inches
 - f. Diameter: 90”
 - g. Access manway diameter: 15”

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5. Backwash influent flow meter
 - a. Manufacturer: Sparling
 - b. Type: Magnetic flow meter
 - c. Size: 4"

2.02 RCF

A. CONTRACTOR/ENGINEER will provide delivery, shop drawings and product data (as supplied by Layne Christensen Company).

1. Scale (ferrous sulfate)
 - a. Manufacturer: A and A Scales, LLC
 - b. Capacity: 5,000 lb
 - c. Size: 4' x 4'
2. Polymer pump (backwash)
 - a. Manufacturer: LMI
 - b. Model C781-36
 - c. Output: 25 gpm max
3. Polymer pump (rapid mix tank)
 - a. Manufacturer: LMI
 - b. Model No.: 6135.150
 - c. Output: 18 gpd max
4. Granular activated carbon vessels (2)
 - a. Manufacturer: Siemens Water Technologies
 - b. Model: VSC-200
 - c. Capacity: 200 pounds granular activated carbon, each
 - d. Diameter: 22"
 - e. Height: 34"
5. Rapid mix tank
 - a. Manufacturer: Core-Rosion
 - b. Capacity: 685 gallons
 - c. Materials of construction: Black HDPE
 - d. ½-HP mixer w/460-volt inverter duty motor
 - e. Propeller diameter: 13.5"
 - f. 350 RPM maximum (VFD-speed controlled)
6. Mixing tanks (3)
 - a. Manufacturer: Core-Rosion
 - b. Capacity: 1,700 gallons
 - c. Materials of construction: Black HDPE
 - d. ½-HP mixer w/460-volt inverter duty motor
 - e. Propeller diameter: 12"
 - f. 350 RPM maximum (VFD-speed controlled)
7. Drawdown pump
 - a. Manufacturer: Grundfos
 - b. Model No.: 96081401
 - c. Pump type: Centrifugal
 - d. 0.33 HP

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- e. Wetted parts: 304 stainless steel
- f. 4.4 gpm @ 40 ft TDH
- 8. Decant pump
 - a. Manufacturer: Grundfos
 - b. Model No.: 96523020
 - c. Pump type: Centrifugal
 - d. 0.33 HP
 - e. Wetted parts: 304 stainless steel
 - f. 53 gpm @ 72.3 ft TDH
- 9. Backwash tank
 - a. Manufacturer: Ryan Herco, Inc.
 - b. Type: Conical
 - c. Capacity: 7,400 gallons
 - d. Height: 179 inches
 - e. Diameter: 142 inches
 - f. Manway diameter: 15 inches
 - g. Materials of construction: HDPE
- 10. Polymer scale
 - a. Vendor: A&A Scales
 - b. Model No.: 800-481-4114
 - c. 24" x 24" platform
 - d. Capacity: 1,000 lb
- 11. Polymer mixer
 - a. Vendor: General Laboratory Supply
 - b. Model: F37118 series
 - c. Type: Magnetic stirrer
 - d. Size: 19" x 19" x 8"
 - e. Motor type, size: DC motor, 50 Watts
- 12. Polymer injector
 - a. Manufacturer: Westfall Manufacturing
 - b. Model No.: Westfall 2800
- 13. Polymer tank
 - a. Manufacturer: Ryan Herco, Inc.
 - b. Product No.: 0275-145
 - c. Capacity: 30 gallons, cylindrical
 - d. Height: 28.5 inches
 - e. Diameter: 18"
 - f. Materials of construction: White HDPE
- 14. Progressive cavity pump
 - a. Manufacturer: Cortech Engineering
 - b. Model No.:SEEPXBN35-6A6-A7-A7-R1-GA-X
 - c. 10 HP
 - d. 108 gpm
 - e. Wetted parts: 316 stainless steel
- 15. Sludge dewatering box
 - a. Capacity: 2 cubic yards

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- 16. b. Materials of construction: carbon steel with NSF 61 coating
Aeration tank supply blower
 - a. Manufacturer: Rotron
 - b. Model No.: DR513R72
 - c. Type: Regenerative
 - d. 1.5 HP
 - e. 78 SCFM Max, 88 in H2O pressure max
- 17. Aeration tank exhaust blower
 - a. Manufacturer: Rotron
 - b. Model No.: 353MBR72M
 - c. Type: Regenerative
 - d. 0.75 HP
 - e. 106 SCFM Max. 43 in H2O vacuum max
- 18. Filter vessels
 - a. Manufacturer: Quick Tanks
 - b. Model No.: LCCF7896LC
 - c. Size: 78" diameter x 96 inch size shell
 - d. Materials of construction: Epoxy lined carbon steel
 - e. Maximum pressure rating: 75 psig
- 19. Turbidimeter (3)
 - a. Manufacturer: Hach Company
 - b. Model No.: 1720E with SC100 controller model 60101-00
- 20. Calibration standard
 - a. Manufacturer: Hach Company
 - b. Model No.: 44156-00
 - c. 4000 NTU standard
- 21. Turbidimeter
 - a. Manufacturer: Hach
 - b. Model No.: Hach Solitax #6940300
 - c. Insertion type, 0.001 to 4000 NTU
- 22. ORP sensor
 - a. Manufacturer: Hach Company
 - b. Model No.: DRD1P5
 - c. Transmitter: Hach SC-100

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.

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APPENDIX TO SECTION 11400

EQUIPMENT CUT SHEETS

*** * * END OF SECTION * * ***

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SECTION 15010

PIPING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Provide all labor, equipment, and material necessary to install piping system indicated on Drawings. Piping system shall be complete, with all necessary fittings, supports or hangers, anchors, valves, expansion joints, accessories, testing, and cleaning, to provide a fully functional installation.
- B. Drawings are intended to define general layout, configuration, routing, method of support, pipe size, and pipe type. Drawings are not intended as pipe construction or fabrication drawings. It is responsibility of the SUBCONTRACTOR to develop details necessary to construct piping system in accordance with Drawings. Deviations from Drawings will require prior approval from CONTRACTOR/ENGINEER.
- C. RELATED SECTIONS
 - 1. Section 15011 – Carbon Steel Pipe
 - 2. Section 15075 – Piping and Equipment Identification

1.02 SUBMITTALS

- A. Submit under provisions of Section 01300
- B. Product Data: Provide data on pipe materials, pipe fittings, pipe supports and hangers, and accessories. Provide manufacturer's catalog and installation information.

1.03 PROJECT RECORD DRAWINGS

- A. Submit under provisions of Section 01700.
- B. Record actual locations of all pipes and/or equipment if changes from Drawings have been made.

1.04 QUALITY ASSURANCE

- A. Submit under provisions of Section 01400.
- B. Pipe: Manufacturer's name, pipe pressure rating, and classification marked on each length of pipe.
- C. Pipe fittings: Manufacturer's name, fitting pressure rating, and classification marked on fitting.

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- D. Testing: All material used in the manufacture of the pipe and fittings shall be tested in accordance with applicable specifications.
- E. SUBCONTRACTOR shall perform any operating tests as specified. SUBCONTRACTOR shall perform tests at no additional cost to CONTRACTOR/ENGINEER. SUBCONTRACTOR shall perform all work required to locate and repair leaks, and to correct other deficiencies which may be detected under tests. Any coating, painting, backfill, or other permanent work removed or damaged in locating or repairing leaks and correcting defective piping or pipe fittings, shall be replaced at no additional cost by SUBCONTRACTOR

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to protect pipe from prolonged exposure to sunlight.
- B. Accept fittings on-site in shipping containers with labels intact. Inspect for damage and conformance to specifications.

1.06 EXTRA MATERIALS

- A. Furnish under provisions of Section 01700.
- B. Provide two pairs of gaskets for each size of flange used in the piping system.

PART 2 PRODUCTS

2.01 ABOVEGROUND PIPING (REFER TO SECTION 15011)

2.02 UNDERGROUND PIPING (REFER TO SECTION 15012)

2.03 PIPE SUPPORTS

- A. Pipe support shall be constructed of materials such that requirements of the Uniform Building Code (current edition) are met for Seismic Zone 4, as shown on Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. SUBCONTRACTOR shall have a copy of manufacturer's instructions available at Site at all times. Pipe and fittings shall be installed in strict accordance with manufacturer's instructions in order to ensure compliance with guarantee and/or warranty provisions.
- B. Before proceeding with installations, inspect all pipe and fittings for damage during storage. Ream pipe and tube ends. Remove burrs. Remove scale and dirt, both inside and outside, before assembly.

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- C. Piping shall be routed in an orderly manner, parallel with vertical or horizontal axes of reference, unless otherwise indicated on Drawings.
- D. Pipe shall be joined together so as to relieve any and all parts of stationary equipment without undue stress and strain resulting from the weight, misalignment or closure of joints.
- E. Provide clearance for access to valves and fittings, instrumentation, and control devices. Sufficient clearance shall be provided for operation, removal, and maintenance. Pinch points on moving parts shall be avoided.
- F. Valves shall be installed with stems upright or horizontal, not inverted. Manually actuated valves shall be accessible without use of ladders.
- G. Piping and pipe fittings shall firmly support pipe to line and elevations shown in Drawings.
- H. Protect piping systems from entry of foreign materials by use of temporary covers, completing sections of Work and isolating parts of completed system.
- I. Perform hydrostatic pressure test as specified in Section 3.02. Remake any faulty joints with all new materials. Use of cement or caulking to seal leaks is absolutely prohibited.
- J. Aboveground piping shall be identified in accordance with Section 15075.
- K. Support aboveground piping as shown on Drawings.

3.02 TESTING

- A. SUBCONTRACTOR shall notify CONTRACTOR/ENGINEER at least two days in advance of testing.
- B. All piping shall be tested at the pipe class plus 50 psi for a minimum of two hours. Vessels shall be tested at a pressure no higher than 100 psi. Media filters shall be tested at a pressure no higher than 75 psig.
- C. All gauges and control devices on lines being tested shall be disconnected for duration of test.
- D. Liquid piping system shall be purged of air prior to pressurization.
- E. Piping system shall be gradually brought to maximum required pressure using a pressure bypass valve to avoid excessive pressure.
- F. Aboveground piping sections will be inspected for leaks during system startup and testing. No leakage will be allowed.
- G. Pressure testing shall be considered successful if the test pressure is maintained for at least two

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hours.

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SECTION 15011

CARBON STEEL PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This section applies to ABOVEGROUND PIPING. Provide steel piping, fittings, flanges, specials, and other items as shown on Drawings and specified herein.
- B. Extent of piping and piping products specified in this section is indicated on Drawings and specified in Section 15010.
- C. ABOVEGROUND PIPING shall have internal epoxy lining in accordance with AWWA C210 or C213 and exterior coating in accordance with Section 09900 System 4C.
- D. UNDERGROUND PIPING shall be in accordance with Section 15012.

1.02 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit coating and lining system for approval.
 - 2. Submit piping schedule showing manufacturer, pipe weight or schedule, fitting type, flange class and joint type for each piping system.
- B. Submit in Accordance with Section 01300.

1.03 QUALITY ASSURANCE

- A. Manufacturers: Firms regularly engaged in manufacture of pipe, tube, and fittings of types and sizes required.
- B. Welding: Qualify and certify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for shop and project site welding of piping work.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-applied end caps on each length of pipe. Maintain end caps through shipping, storage, and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe.
- B. Where possible, store pipe and specials inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

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- C. Protect pipe flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.05 PROJECT/SITE CONDITIONS

- A. Coordinate dimensions and drillings of flanges furnished with flanges for valves, pumps, and other equipment to be installed in piping.

PART 2 PRODUCTS

2.01 MATERIALS

A. Carbon Steel Pipe:

- 1. 24 in. and Smaller: Seamless carbon steel, ASTM A106, Grade B.
- 2. Larger than 24 in.: Straight seam fusion welded plate in accordance with ASTM A134 Grade A238C or API-5L Grade B.
- 3. Wall Thickness:
 - a. 2 in. and smaller: Schedule 80.
 - b. 2-1/2 in. through 10 in.: Schedule 40.
 - c. 12 in. and larger: 3/8 in. standard weight.

B. Fittings:

- 1. 2 in. and Smaller: Socket weld end type, forged carbon steel, ASTM A105, Class 300.
- 2. 2-1/2 in. Through 12 in.: Factory-made, wrought steel butt-welding type to match pipe wall thickness, ASTM A234, Grade WPB.
 - a. Fittings shall conform to ANSI B16.9 standards, except for short radius elbows which shall conform to ANSI B16.28 standards.
 - b. Provide long radius elbows unless otherwise noted on Drawings.
- 3. 14 in. and Larger: Fabricate from pipe material in accordance with AWWA C208.

C. Flanges:

- 1. Forged steel, ASTM A105.
- 2. 24 in. and smaller: Slip-on or welding neck type Class 150, flat face, conforming to ANSI B16.5 standard except as otherwise indicated.
- 3. Larger than 24 in.: AWWA C207, Class F, steel hub type.
- 4. Provide welding neck flanges when abutting butt-welded fittings.
- 5. Machine off raised face of steel flanges when mating with piping components with flat faced flanges.

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6. For sizes 24 in. and smaller, when mating with piping components with 250 or 300 lb flanges, use welding neck flanges conforming to 300 lb ANSI B16.5 standards.
7. When mating with cast iron 250 lb raised face flanges, mating steel 300 lb flanges shall have flat faces or raised faces of outside diameter at least as large as those of cast iron flanges, in accordance with ANSI B31.1.

D. Flange Bolting:

1. Provide carbon steel, ASTM A307 Grade B bolting unless otherwise noted.
2. When 1/8 in. undersized bolting material is used for insulating flanges, use ASTM A193, Grade B7 alloy stud bolts and ASTM A194, Grade 2H carbon steel heavy hex nuts.

E. Gaskets:

1. Pipe Sizes 24 in. and Smaller: 1/16 in. thick compressed synthetic fiber, flat ring type with full face type with flat face flanges.
2. Pipe Sizes Larger than 24 in.: 1/8 in. thick cloth inserted rubber.
3. Provide material compatible with fluid in pipe.

2.02 FABRICATION

A. Pipe:

1. Fabricate to sizes, dimensions, and shapes indicated on Drawings.
2. Pipe size shall be nominal inside diameter of pipe, fitting or special in inches where 12 in. and smaller in size and actual outside diameter where 14 in. and larger in size.

B. Joints:

1. 2 in. and Smaller: Socket weld except use screwed joints where required to connect to valves and equipment.
2. 2-1/2 in. and Larger: Butt weld except use flanged joints where required to connect to valves, equipment, and other piping systems.
3. Use flanged joints, mechanical couplings, flanged coupling adapters, or expansion joints where shown on Drawings.

C. Fittings:

1. Fabricate in accordance with AWWA C208.
2. Fabricate elbows with radius of 1-1/2 times nominal dia.
 - a. 2-piece: 0 to 22-1/2°.
 - b. 3-piece: 23 to 45°.
 - c. 4-piece: 46 to 67-1/2°.
 - d. 5-piece: 68 to 90°.

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3. Reinforce tees, laterals, and outlets in accordance with ASME Pressure Vessel Code, Section VIII, Paragraph G-37 or AWWA M11, Section 19.4 and 19.5.
4. Shell thicknesses of reducing sections shall be same as required thicknesses for larger ends.
5. Special Sections: Provide fittings and specials with ends as required and fabricate to shapes, sizes, and dimensions shown on Drawings.
6. Small Branch Connections:
 - a. Make branch connections 2-1/2 in. and smaller with welding fittings with threaded outlets.
 - b. Make branch connections 3 in. through 12 in. in size with pipe nipples or welding fittings.
 - c. Weld pipe nipples and welding fittings to pipe shell and reinforced as required to meet design and test requirements.
 - d. Pipe nipples shall be seamless carbon steel pipe in accordance with ASTM A120 and as specified in Subparagraph 2.01.A.3.a.
 - e. Threaded and Welded Outlets shall be Porter "W-Steelets," Vogt "Weld Couplets" or equal.
 - f. Locate small branch connections so as not to interfere with joints, supports or other details.

D. Flanges:

1. Attach flanges normal to axis of pipe so alignment satisfactory.
2. After attachment to pipe, maximum layback from inside edge of flange to outside edge of flange shall not exceed 1-1/2°.
3. Test flanges, after welding to pipe, for true plane and reface if necessary to bring them within specified tolerances.

2.03 MISCELLANEOUS PIPING MATERIALS/PRODUCTS

- A. Welded Materials: Except as otherwise indicated, provide welding materials as determined by installer to comply with installation requirements.

1. Comply with ANSI B31.1.

- B. Thread Lubricant: Teflon tape.

2.04 FLEXIBLE MECHANICAL COUPLINGS (See Section 250-11.1 Flexible Couplings)

2.05 FLANGED COUPLING ADAPTERS

- A. Manufacturers (See Section 250-11.1 B)

- B. Restrain flanged coupling adapters.

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C. Provide tie rods of sufficient number and strength to restrain coupling at test pressure as listed in Pipe Schedule and piping detail plan.

D. Use minimum of two 5/8 in. dia tie rods at connections.

2.06 EXPANSION JOINTS

A. Manufacturers:

1. Sliding Expansion Joints:

- a. Dresser "Style 63."
- b. Rockwell.

2. Flexible Connectors and Expansion Joints:

- a. Garlock.
- b. General Rubber.
- c. Goodall.
- d. Mercer.
- e. Unaflex.

B. Materials:

- 1. Joints shall allow minimum of 0.4375 in. pipe expansion (joint compression), 0.250 in. pipe compression (joint expansion). Design in accordance with Fluid Sealing Association, Series B.
- 2. Provide flexible connectors and expansion joints at equipment for isolation design in accordance with Fluid Sealing Association, Series B.
- 3. Provide tie rods at flexible connectors and expansion joints of sufficient number and strength to restrain connection at test pressure as listed in Section 15200. Use minimum of two 5/8 in. dia tie rods at connections.
- 4. Support flexible connectors and expansion joints adequately. Locate vertical supports within 3 pipe diameters of connection and provide on each side of connection.

2.07 PROTECTIVE COATINGS

A. Steel pipe, fittings, specials, and wall fittings shall be prepared, primed, lined, coated, painted or wrapped as hereinafter specified.

B. UNDERGROUND PIPING shall be in accordance with Section 15012.

C. Lining of ABOVEGROUND PIPING and fittings shall be epoxy coated in accordance with AWWA C210 or AWWA C213.

D. Exterior Surfaces of ABOVEGROUND PIPING:

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1. Thoroughly clean by sandblasting and prime coat exterior surfaces, except machined surfaces, of pipe, fittings, specials, flanges, anchors, pipe supports, and blocking exposed in interior or exterior locations as specified in Section 09900 and applied in shop.
 2. Field coat as specified in Section 09900, System 4-C.
- E. Machined Surfaces as applicable:
1. Shop coat machined surfaces with rust preventive compound Dearborn Chemical "No-Ox-Id 2W," Houghton "Rust Veto 344," Rust-Oleum "R-9" or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with approved submittals.
- B. Install pipe, fittings, and specials in accordance with recognized industry practices achieving permanently leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum of joints. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections.
- C. Comply with ANSI B31.1.

3.02 WELDED JOINTS

- A. Welds shall be sound and free from embedded scale of slag, have tensile strength across weld not less than that of thinner of connected sections, and be watertight.
- B. Use butt welds for welded joints in line pipe assemblies and fabrication of bends and other specials.
- C. Use filled welds for flange attachment in accordance with AWWA C207.
- D. Conform field welding of joints and preparation of pipe ends to AWWA C206 and ASTM A139.
 1. Yield point determination of field welded joint shall be made by independent testing laboratory at beginning of Work at request of CONTRACTOR/ENGINEER.
 2. Furnish specimens for weld tests to CONTRACTOR/ENGINEER for testing by independent testing laboratory whenever, in judgment of CONTRACTOR/ENGINEER, unsatisfactory weld is being made. Costs for laboratory testing for unsatisfactory welding shall be paid for by SUBCONTRACTOR.
 3. Use of back-up welding strips or rings for welds not permitted.

3.03 CLEANING AND COATING

- A. After installation of pipe, fittings, and specials, uncoated ends adjacent to field welded joints, including weld proper, shall be cleaned, primed, lined, and coated as specified for pipe adjacent to weld.

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- B. Preparation of surfaces to be lined and coated shall be as stipulated for shop application of coal tar primers and enamels, except foreign matter, including damaged coating materials, shall be removed by scraping, chipping or brushing, and surfaces cleaned to bright metal free of all rust, slag, and scale by means of wire brushing or sandblasting.

3.04 TESTING

- A. Test piping system in accordance with 15010.

* * * END OF SECTION * * *

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SECTION 15012

STEEL PIPE CEMENT MORTAR-LINED AND COATED

PART 1 GENERAL

1.01 SUMMARY

- A. CONTRACTOR shall furnish and install mortar-lined and mortar-coated steel piping, complete in place, all in accordance with requirements of Contract Documents.

1.02 SUBMITTALS

A. Product Data:

1. Submit product data for pipe and fittings in accordance with Section 01300.

B. Certifications:

1. Furnish certification of compliance for all pipe and other products materials as specified in ANSI/AWWA C200 and C205, respectively, and following supplemental requirements:
- a. Physical and chemical properties of all steel.
 - b. Hydrostatic test reports.
 - c. Results of any production weld tests.

1.03 QUALITY ASSURANCE

- A. Welding Requirements: All welding procedures used to fabricate pipe shall be pre-qualified under provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.
- B. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in methods and materials to be used. Welders shall be pipeline certified under provisions of ANSI/AWWA D1.1 by an independent local, approved testing agency not more than six (6) months prior to commencing work on pipeline. Machines and electrodes similar to those used in Work shall be used in qualification tests. Contractor shall furnish all material and bear expense of qualifying welders.

PART 2 PRODUCTS

2.01 GENERAL

- A. Mortar-lined and mortar-coated steel pipe shall conform to ANSI/AWWA C200 and C205

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1. Pipe shall be of diameter and class shown.
2. Welded joints, as indicated in Contract Document.,
3. Specials and bends shall be provided as required under Contract Documents.
4. All mortar-lined and coated steel pipe over 12-in. in diameter shall be fabricated, hydrostatic tested, lined and coated at same facility or complex, under supervision of manufacturer of mortar-lined and coated pipe in a continuous sequence, and without commercial transport. Steel plate specials over 12-in. in diameter shall be subject to same requirement as mortar-lined and coated steel pipe.

B. Handling and Storage:

1. Pipe shall be handled by use of wide slings, padded cradles, or other devices acceptable to ENGINEER, designed and constructed to prevent damage to pipe coating/exterior.
2. Use of chain, hook, or other equipment, which might inure pipe coating/exterior, will not be permitted.

C. CONTRACTOR shall be fully liable for cost of replacement or repair of pipe, which is damaged.

D. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding 3-inches in diameter. Pipe shall not be rolled and shall be secured to prevent accidental rolling.

E. Laying Lengths: Maximum pipe laying lengths shall be 40 ft with shorter lengths provided as required by Drawings.

F. Offset Tolerances: For pipe wall thicknesses of 3/8-in. or less, maximum radial offset (misalignment) for submerged arc and gas metal arc welded pipe shall be 0.1875 times pipe wall thickness or 1/16-in. whichever is larger.

G. Finish: pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

H. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in pipe laying operation and so that correction may be made to adjust pipe laying to conform to pipe stationing shown on Drawings. Lots of correction pieces and closure assemblies are shown on Drawings. ENGINEER must approve any change in location or number of said items.

2.02 PIPE DESIGN CRITERIA

A. Cylinder Thickness: Thickness of steel pipe cylinder shall be as shown on plans. Where pipe cylinder thickness is not shown or spelled out, thickness shall conform to requirements of AWWA M-11. Mortar-lined and coated steel pipe shall have a minimum wall thickness as follows:

Design Pressure (psi)	Surge Pressure	Pipe Diameter	Minimum Wall Thickness(in.)
150	225 psi	0 - 24 in.	0.25 (1/4 in.)

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- B. Steel pipe and appurtenance shall be designed for a maximum deflection of 2% under external loads.
- C. All joints shall be made with full penetration welds.

2.03 MATERIALS

- A. Cement: Cement for mortar shall conform to requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be Type V, and mortar lining shall be Type V. Fly ash or pozzolan shall not be used as a cement replacement.
- B. Steel for Cylinders and Fittings: Pipe manufactured under ANSI/AWWA C200 shall be fabricated from sheet conforming to requirements of ASTM A 570, Grade 33, or from plate conforming to requirements of ASTM A 283, Grade D. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process. (Minimum yield strength shall be 33,000 psi.)
- C. All steel used for fabrication of pipe shall have a maximum carbon content of 0.25 percent and shall have a minimum elongation of twenty two percent (22%) in a 2-inch gage length.

2.04 SPECIALS AND FITTINGS

- A. Unless otherwise required under requirements of Contract Documents, all specials and fittings shall be in accordance ANSI/AWWA C208.

2.05 DESIGN OF PIPE

- A. General: Pipe shall be steel pipe, mortar-lined and mortar-coated, with field welded joints as shown. Pipe shall consist of a steel cylinder, shop-lined with portland cement-mortar and an exterior coating of cement-mortar.
- B. Pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and except as hereinafter modified, shall conform to ANSI/AWWA C200.
- C. Pipe Dimensions: pipe shall be of diameter and class shown. Minimum steel cylinder thickness for each pipe size shall be as specified or shown.
- D. Fitting Dimensions: fittings shall be of diameter and class shown.
- E. Joint Design: standard field joint for steel pipe shall be single-welded full penetration lap joint for all pipe sizes. Flanged joints shall be required where shown. Butt-strap joints shall be used only where required for closures or where shown. Joints furnished shall have same or higher pressure rating as abutting pipe.
- F. Lap joints prepared for field welding shall be in accordance with ANSI/AWWA C200. Method used to form, shape, and size bell ends shall be such that physical properties of steel are not substantially altered. Unless otherwise approved by ENGINEER, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch steel plate beyond its elastic limit to form a truly

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round bell of suitable diameter and shape. No process will be permitted in which bell is formed by rolling. Faying surfaces of bell and spigot shall be essentially parallel, but in no case shall bell slope vary more than 2 degrees from longitudinal axis of pipe.

- G. Shop-applied interior linings and exterior coatings shall be held back from ends of pipe as shown on Drawings or as otherwise acceptable to ENGINEER.
- H. Hand holes shall be provided at each joint for pipe sizes less than 24-inches in diameter to apply mortar to line inside joint in accordance with Paragraph 2.06 of this section. Liner shall be applied to joints only after full penetration weld is complete and cooled to ambient temperature.

2.06 CEMENT-MORTAR LINING

- A. Cement-Mortar Lining for Shop Application: except as other wise provided herein, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During lining operation and thereafter, pipe shall be maintained in a round condition by suitable bracing or strutting. Lining machines shall be of a type that has been used successfully for similar work and shall be approved by ENGINEER. Every precaution shall be taken to prevent damage to lining. If lining is damaged or found faulty at delivery site, damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to OWNER.
- B. Minimum lining thickness shall be as follows:

Pipe Diameter (inches)	Lining		Coating	
	Thickness (inches)	Tolerance (inches)	Thickness (inches)	Tolerance (in.) (No minus tolerance)
4 thru 12	5/16	±1/16	3/4	+1/4
14 thru 18	3/8	±1/16	3/4	+1/4
20 and Larger	1/2	±1/16	3/4	+1/4

- C. Pipe shall be left bare where field joints occur. Ends of linings shall be left square and uniform. Feathered or uneven edges will not be permitted.
- D. Defective linings, as determined by ENGINEER, shall be removed from pipe wall and shall be replaced to full thickness required. Defective linings shall be cut back to square shoulder in order to avoid feather edged joints.
- E. Progress of application of mortar lining shall be regulated in order that all handwork, including repair of defective areas, is cured in accordance with provisions of ANSI/AWWA C205. Cement-mortar for patching shall be same materials as mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve finished lining of pipe.

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- F. Cement-Mortar Lining for Field Application: Materials and design of in-place cement-mortar lining shall be in accordance with ANSI/AWWA C602 and following supplementary requirements:
1. Portland cement shall conform to Type V of ASTM C150.
 2. Fly ash or pozzolanic material shall not be used in mortar mix.
 3. Admixtures shall contain no calcium chloride.
 4. Minimum lining thickness shall be as specified for shop-applied cement-mortar lining and finished inside diameter after lining shall be as shown on Drawings.
 5. Field application of lining at joint shall be through hand hole for pipe sizes less than 24-inches.
- G. Protection of Pipe Lining/Interior: For pipe and fittings with plant-applied concrete or cement mortar linings, CONTRACTOR shall provide a polyethylene or other suitable bulkhead on ends of pipe and on all special openings to prevent drying out of lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until pipe is installed.

2.07 EXTERIOR COATING OF PIPE

- A. Exterior Coating of Exposed Piping: Exterior surfaces of pipe which will be exposed to atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer and a finish coat conforming to requirements of Section 09900.
- B. Exterior Coating of Buried Piping: All pipe for buried service, including bumped heads, shall be coated with a 1-1/4 in. thickness of reinforced cement-mortar coating. Unless otherwise indicated, exterior surfaces of pipe or fittings passing through structure walls shall be cement-mortar coated from center of wall or from wall flange to end of underground portion of pipe or fitting. Coating shall be reinforced with a spiral wire reinforcement or welded wire fabric in accordance with ANSI/AWWA C205. Welded wire fabric shall be securely fastened to pipe with welded clips or strips of steel. Wire spaced 2 in. on centers shall extend circumferentially around pipe. Ends of reinforcement strips shall be lapped 4 in. and free ends tied or looped to assure continuity of reinforcement.

2.08 PIPE APPURTENANCES

- A. Flanges:
1. Conform to AWWA C207, Class E flanges (matching ANSI/ASME B16.5 Class 150 or ANSI/ASME B16.1, Class 125 flanges for bolt hole size and drilling), unless otherwise shown.
 2. Flanges shall have a pressure rating of 200 psi.
 3. Flanges shall have flat faces and shall be attached with boltholes straddling vertical axis of pipe, unless otherwise shown.
 4. Segmented flanges shall not be used.
 5. Attachment of flanges to pipe shall conform to ANSI/AWWA C207.
- B. Machined faces of all flanges shall be shop-coated with rust-preventative compound, Houghton "Rust-Veto 344" Rust-Oleum "R-9 or approved equal." Edges and back faces of attached flanges shall be shop-coated with Kopper's "Bitumastic Mill Undercoat." All surfaces of blind flanges, except machined

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surfaces and surfaces exposed to water during pipeline operation shall be shop-coated with Kopper's "Bitumastic Mill Undercoat." Inside of blind flanges shall be cement-mortar coated, thickness to be same as cement-mortar lining for pipe as stated herein.

- C. Blind flanges shall be in accordance with ANSI/AWWA C207.
- D. Gaskets for flanges shall comply with AWWA C207. Flange gaskets shall be 1/8-in., unless otherwise specified on Drawings, full-face type with pre-punched holes or ring-type extending to inner edge of bolt circumference of flange. Gaskets shall be Garlock No. 3200 "Bluegard", Klinger "Klingersil C4400" or approved equivalent suitable for potable water.
- E. Flange Bolts: All-thread studs shall be used only on valve flange connections where space restrictions preclude use of machine bolts and shall have heavy hex nuts. Machine bolts shall be used on all other flanged connections and shall be stainless steel with hex nuts. Studs and bolts shall extend through nuts a minimum of 1/4-in. All nuts and bolts shall be stainless steel. Anti-galling compound shall be applied to threads.
- F. Washers: Washers shall be provided for each nut. Washers shall be of same material as nut.
- G. Followers: Followers shall be single-piece contoured mill section welded and cold expanded as required for middle rings. They shall be of sufficient strength to accommodate number of bolts necessary to obtain adequate gasket pressures without excessive rolling. Shape of follower shall be of such design as to provide positive confinement of gasket.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPE

- A. Handling and Storage: All pipe fittings, and any other components of piping system shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, impact shocks, and free fall. All pipe handling equipment shall be acceptable to ENGINEER. Pipe shall not be placed directly on rough ground but shall be supported in a manner, which will protect pipe against injury whenever stored at trench site or elsewhere. Pipe shall be handled and stored at trench site in accordance with Paragraphs 2.1C and 2.1E, herein. No pipe shall be installed where lining or coating/interior or exterior surfaces show cracks that may be harmful as determined by ENGINEER. Such damaged lining and coating/interior and exterior surfaces, shall be repaired, or a new undamaged pipe shall be furnished and installed.
- B. All pipe damaged prior to project completion shall be repaired or replaced by CONTRACTOR. Damaged pipe that can be repaired shall be repaired prior to laying in pipe trench, using materials and methods acceptable to ENGINEER.
- C. CONTRACTOR shall inspect each pipe and fitting to ensure that there are no damaged portions of pipe. CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter or small defects prior to laying pipe.

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- D. Before placement of pipe in trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, openings of pipes and fittings in trench shall be closed during any interruption to Work.
- E. Pipe shall be laid directly on bedding material. No blocking will be permitted, and bedding shall be such that it forms a continuous, solid bearing for full length of pipe. Excavations shall be made as needed to facilitate removal of handling devices after pipe is laid. Bell holes shall be formed at ends of pipe to prevent point loading at bells or couplings. Excavation shall be made as needed outside normal trench section at field joints to permit adequate access to joints for field connection operations and for application of coating on field joints.
- F. Each section of pipe shall be laid in order and position shown on laying schedule. In laying pipe, it shall be laid to set line and grade, within approximately one inch plus or minus.
- G. Where necessary to raise or lower pipe due to unforeseen obstructions or other causes, ENGINEER may change alignment and/or grades. Such change shall be made by deflection of joints, by use of bevel adapters, or by use of additional fittings. However, if joint deflection is selected, in no case shall deflection in joint exceed maximum deflection recommended by pipe manufacturer. No joint shall be misfit any amount which will be detrimental to strength and water tightness of finished joint. In all cases securing joint shall be controlling factor; before finishing with protective mortar inside pipe or prior to applying in-place mortar lining.
- H. Except for short runs, which may be permitted by ENGINEER, pipes shall be laid uphill on grades exceeding 10%. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by following pipe to prevent movement.
- I. After backfill has been placed, struts shall be removed and shall remain property of CONTRACTOR.
- J. Pipe Cleaning: As pipe laying progresses, CONTRACTOR shall keep pipe interior free of all debris. CONTRACTOR shall completely clean interior of pipe of all sand, dirt, mortar splatter and any other debris following completion of pipe laying, pointing of joints and any necessary interior repairs prior to testing.

3.02 WELDED JOINTS

- A. General: Field welded joints shall be in accordance with ANSI/AWWA C206.
- B. Where exterior welds are performed, adequate space shall be provided for welding and inspection of joints.
- C. During installation of welded steel pipe in either straight alignment or on curves, pipe shall be laid so that lap joint clearance, at any point around circumference of joint, shall comply with requirements of AWWA C206. Unless double fillet welds are indicated, field-welded lap joints will be made on outside of pipe and shall be a full penetration weld.

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- D. Butt straps, where used or required, shall be a minimum of 10 inches wide, same thickness as pipe wall and shall provide for a minimum of 2-inch lap at each pipe joint. Butt straps shall be same thickness as pipe wall but not less than 10 gage, rolled to fit outside cylinder diameter and shall be centered over plain ends of pipe sections they are to join. Where a 5-inch hand hole is required, a standard 5-inch pipe half coupling or couplings shall be welded to butt strap, as shown on Drawings to permit access for mortar lining inside of joint. Thread a plug into coupling on completion and seal weld.
- E. After pipe and pipe joint are properly positioned in trench, length of pipe between joints shall be backfilled to at least 1-ft above top of pipe. Care shall be exercised during initial backfilling to prevent movement of pipe and to prevent any backfill material from being deposited on joint.
- F. To control temperature stresses, un-backfilled joint areas of pipe shall be shaded from direct rays of sun by use of properly supported awnings, umbrellas, tarpaulins, or other suitable materials for a minimum period of 2 hrs prior to beginning of welding operation and until weld has been completed. Shading materials at joint area shall not rest directly on pipe but shall be supported to allow air circulation around pipe. Shading of pipe joints need not be performed when ambient air temperature is below 45 degrees F.
- G. Prior to beginning of welding procedure, any tack welds used to position pipe during laying shall be removed. Any annular space between faying surfaces of bell and spigot shall be equally distributed around circumference of joint by shimming, jacking, or other suitable means. Weld shall then be made in accordance with ANSI/AWWA C206. Where more than one pass is required, each pass except first and final one shall be opened to relieve shrinkage stresses; and all dirt, slag, and flux shall be removed before succeeding bead is applied.
- H. As soon as practicable after welding of each joint, all field-welded joints shall be tested by liquid penetrant inspection procedure conforming to requirements of ANSI/ASTM E 165 under Method "B" and "Leak Testing." All defects shall be chipped out, rewelded and retested. Upon retest, repaired area shall show no leaks or other defects.
- I. Following tests of joint, exterior joint spaces shall be coated in accordance with these Specifications after which backfilling may be completed.
- J. Joints: pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as shown on Drawings.

3.03 JOINT COATING AND LINING

- A. General: interior and exterior joint recesses shall be thoroughly wiped clean and all water, loose scale, dirt and other foreign material shall be removed from inside surface of pipe. Cement for joint grout and mortar shall be portland cement acceptable under ASTM C150 and shall be of same type used for pipe coating.
- B. Grout Annular Space: After pipe has been laid and after sufficient backfill has been placed between joints to hold pipe securely in place, outside annular space between pipe sections shall be completely filled with grout formed by use of polyethylene foam-lined fabric bands. Grout shall be composed of one part cement to not more than 2 parts sand, thoroughly mixed with water to a consistency of thick cream. Grout

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space prior to filling shall be flushed with water so that surface of joint to be in contact with grout will be thoroughly moistened when grout is poured. Joint shall be filled with grout by pouring from one side only, and shall be rodded with a wire or other flexible rod or vibrated so that grout completely fills joint recess by moving down one side of pipe, around bottom of pipe and up opposite side. Pouring and rodding grout shall be continued to allow completion of filling of entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of outside joint spaces shall be kept as close behind laying of pipe as possible except that in no case shall grouting be closer than three joints of pipe being laid.

- C. Grout Bands (Diapers): Grout bands or heavy-duty diapers shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold fresh mortar, resist rodding of mortar and allow excess water to escape. Foam plastic shall be one hundred percent (100%) closed cell, chemically inert, insoluble in water and resistant to acids, alkalis and solvents.
1. Fabric backing shall be cut and sewn into 9-in. wide strips with slots for steel strapping on outer edges.
 2. Heavy-duty diaper shall be centered over joint space with approximately equal widths extending over each pipe end and securely attached to pipe with steel straps. After filling exterior joint space with cement grout, flaps shall be closed and overlapped in a manner that fully encloses grout. Grout band shall remain in position on pipe joint.
- D. Joint Lining: interior joint recess shall be filled with mortar of stiff consistency mixed in proportions of one part cement to 2 parts sand. Mortar shall be tightly packed into joint recess and troweled flush with interior surface, and all excess shall be removed. At no point shall there be an indentation or projection of mortar exceeding 1/16-in. For pipe smaller than 24 in. in diameter, insert spigot into bell weld joint, open handhole, and line interior of pipe joint, plug handhole, weld and coat handhole in accordance with Detail. First 4 joints of pipe to be laid at start of project shall be photographed for compliance with joint lining requirement and reviewed ENGINEER for compliance to establish an acceptable precedent for piping installation. CONTRACTOR shall backfill to final grade after acceptance by ENGINEER.

3.04 INSTALLATION OF PIPE APPURTENANCES

- A. Protection of Appurtenances: Where joining pipe is concrete or coated with cement mortar, buried appurtenances shall be coated with a minimum thickness of one-inch of cement mortar having one part cement to not more than 2 parts plaster sand.
- B. Installation of Valves: All valves shall be handled in a manner to prevent any injury or damage to any part of valve. All joints shall be thoroughly cleaned and prepared prior to installation. CONTRACTOR shall adjust all stem packing and operate each valve prior to installation to insure proper operation.
- C. All buried valves shall be coated and protected in accordance with Section 09900.
- D. All valves shall be installed so that valve stems are plumb and in location indicated.
- E. Installation of Flanged Joints: Before joint is assembled, flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. Gasket shall be centered and connecting flanges drawn up

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watertight without unnecessarily stressing flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to nuts only use anti-galling compound on threads. All insulated flange joints shall be coated and protected.

- F. All buried flanges shall be coated and protected in accordance with Section 09900.

- G. Flexible Coupled Joints: When installing flexible couplings, care shall be taken that connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to contact surfaces of pipe, gaskets and couplings. Couplings shall be assembled and installed in conformity with recommendation and instruction of coupling manufacturer.

- H. Wrenches used in bolting couplings shall be of a type and size recommended by coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between follower rings and body of pipe with all bolts tightened approximately same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for torque recommended by coupling manufacturer. All clamping torque shall be applied to nut only.

- I. Hand holes at lap joints shall be provided for mortaring pipe joints for pipe sizes smaller than 24-inches in diameter. CONTRACTOR shall tap outlets for standard pipe thread, weld to pipe and weld close after use with solid forged steel plugs.
 - 1. Plugs shall not project beyond inner surface of pipe shell. Re-tap pipe thread into outlet to correct any distortion caused by welding. Apply a seal weld made by at least two passes around inside or outside of plug after it has been inserted in final position in field.
 - 2. Place 2 in. x 4 in. W0.5 wire mesh in accordance with ASTM 4185 reinforcement all around pipe.
 - 3. Coat outlets, plugs, and closures inside and outside to match adjacent coated surfaces in same manner as specified for outlets and as required at field joints in pipe.

*** END OF SECTION ***

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SECTION 15018

POLYVINYL CHLORIDE (PVC) PIPE

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data:

1. Product data for pipe, fittings, flanges, gaskets, and bolting.
2. Proposed gasket material for each service. Submit document confirming gasket material selection is appropriate for fluid carried in system.

B. Shop Drawings:

1. Layout for PVC piping systems in accordance with and transmitted under appropriate piping system Specification section.

C. Submit in accordance with Section 01300.

PART 2 PRODUCTS

2.01 PVC MATERIAL

- A. Type 1, Grade 1 conforming to ASTM D1784.**

2.02 PIPE

- A. Schedule 80 PVC conforming to ASTM D1785.**

2.03 FITTINGS

- A. Schedule 80 PVC.**

1. ASTM D2464 for threaded joint type.
2. ASTM D2467 for socket joint type.

2.04 JOINTS

- A. Provide socket type at all locations except unions, valves, and equipment with threaded or flanged end connections.**
- B. Threaded connections are not acceptable for nominal piping size greater than 2 in.**
- C. Do not provide threaded joints for piping systems identified on Drawings.**

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2.05 FLANGES

- A. PVC, 1 piece socket type, flat faced, conforming to ANSI B16.5 150 lb bolt hole drilling pattern.

2.06 GASKETS

- A. Full-face, 1/8 in. thick flat type.
- B. When mating flange has raised face, use flat ring gasket and provide filler gasket between outside dia of raised face and flange outside dia to protect flange from bolting moment.
- C. Material compatible with fluid carried in system.

2.07 BOLTING

- A. Type 316 Stainless Steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M hex head nuts.
- B. Bolts shall conform to ANSI B.1.20.1.
- C. Provide washers same material as bolts.

2.08 SOLVENT CEMENT

- A. Join socket connections with PVC solvent cement conforming to ASTM D2564.
- B. As recommended by pipe and fitting manufacturer to assure compatibility.

2.09 THREAD LUBRICANT

- A. Teflon tape.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products as shown on Drawings, and as specified in applicable piping system Specification section(s).
- B. Install products in accordance with manufacturer's written instructions.

* * * END OF SECTION * * *

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SECTION 15050

GATE VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Resilient seat gate valves on exposed piping and buried piping.

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. 3 in. through 12. in.: 175 psi.
2. 14 in. through 48 in.: 150 psi.

1.03 SUBMITTALS

A. Product Data:

B. Operation and Maintenance (O&M) Data:

C. Submit in accordance with Section 01300.

PART 2 PRODUCTS

2.01 MANUFACTURERS (See section 250-5.2.3 for approved manufacturers)

2.02 CONSTRUCTION

A. Comply with AWWA C509.

B. Provide with clear water way equal to full nominal diameter of valve.

C. For interior or exposed installations, provide handwheel with arrow cast in metal to indicate direction of opening. Opening effort shall not exceed 80 lbs. Provide enclosed spur or bevel gearing as required with gear cases.

D. End Connection:

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1. Buried Installations: Mechanical joints in accordance with AWWA C111.
 2. Interior or Exposed Installations: Flanged joint end connections in accordance with AWWA C115.
- E. Stuffing Boxes:
1. Provide O-ring seal type with two rings.
 2. Upper ring serving as dust seal and lower ring as pressure seal.
- F. Bolts and Nuts: ASTM A307, galvanized.
- G. Non-Rising Stems: cast integral stem collar.
- H. Gates and Gate Rings for AWWA C509 Valves.
1. Construct of high strength cast iron or bronze.
 2. Apply resilient seat to body and/or gate.
 3. Resilient seat shall seal against corrosion resistant surface.
 4. Bond rubber material seats in accordance with ASTM D429.
 5. Use noncorrosive hardware for mechanically attached resilient seats.
 6. Epoxy line valves in accordance with AWWA C550.
- I. Valve Boxes:
1. 3 piece assembly.
 2. Provide 5-1/4 in. valve box dia.
 3. Construct box and cover of cast iron in accordance with ASTM A48, Class B.
 4. Provide valve with extended stem.
 5. Stop stem 12 in. below box cover.
 6. Provide one 4 ft long tee wrench for operating valve.

PART 3 EXECUTION

3.01 INSTALLATION

- A. SUBCONTRACTOR shall have a copy of the manufacturer's instructions available at construction site at all times. Valves shall be installed in strict accordance with manufacturer's instructions in order to ensure compliance with guarantee and/or warranty provisions.
- B. Before proceeding with installation, inspect all valves for damage during storage.
- C. Valves shall be oriented parallel with vertical or horizontal axes of reference, unless otherwise indicated on the drawings.
- D. Valves shall be installed with stems upright or horizontal, not inverted.

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- E. Valves shall be firmly supported to avoid undue stresses on piping system.
- F. All valves shall be installed to provide for easy access during operation, removal, and maintenance.
- G. Valves shall be joined to the piping system in accordance with provisions of Section 15010 and Section 02000.
- H. Valves shall be cleaned and tested with piping system in accordance with provisions of Section 15010.

* * * END OF SECTION * * *

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SECTION 15052

BUTTERFLY VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Manual operated butterfly valves

1.02 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide bubble-tight at rated pressures with flow in either direction.
2. Satisfactory for applications involving frequent operation and applications involving valve operation after long periods of inactivity.
3. Except as modified or supplemented herein, conform butterfly valves including operators, to requirements of AWWA C504, latest edition.
4. Method for calculating torques for valve operators shall be as outlined in AWWA C504, Appendix A.

1.03 SUBMITTALS

A. Shop Drawings:

1. Submit 3 copies per Section 1300.

B. Operation and Maintenance (O&M) Data:

1. Submit 3 copies.

C. CONTRACTOR/ENGINEER will furnish Shop Drawings of electric actuated valves to SUBCONTRACTOR.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. DeZurik BAW.

B. Tyco Keystone

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C. Bray.

2.02 BUTTERFLY VALVES

A. General:

1. Proportion parts of valve for stresses occurring during continuous operation, and additional stresses occurring during fabrication or erection.
2. Provide tight-closing, rubber seat type with seats fastened to valve body or valve disk.
3. AWWA C504, Class 150B.
4. Epoxy coated interior.

B. Valve Bodies:

1. Valves shall be short bodied pattern. Wafer design valves shall only be acceptable for air piping.
2. Cast Iron: ASTM A126, Class B or ASTM A48, Class 40.
3. Face and Drill Flange Valves: ANSI B16.1, Class 125 standard.
4. Mechanical Joint and Bell Ends: ANSI A21.11 standard.
5. Threaded Ends: ANSI B1.20.1 NPT standard. Integrate 2 trunnions for shaft bearings with each valve body.

C. Valve Shafts: Type 304 stainless steel.

D. Valve Seats:

1. NBR rubber for water service.
2. Replaceable valve seats.
3. No. 18-8 stainless steel mating seat surfaces.
4. Valve Seat in-Place: ASTM D429, Method A or B.
5. Do not use metal to metal.

E. Valve Discs:

1. Valve Sizes Through 48 in.:
 - a. Cast iron: ASTM A48, Class 40.
 - b. Ductile iron: ASTM A536, Grade 65-45-12.
 - c. Alloy cast iron: ASTM A436, Type 1.
2. Valve Sizes 54 in. and Larger:
 - a. Cast iron: ASTM A48, Class 40.
 - b. Fabricated steel: ASTM A36.
 - c. Ductile iron: ASTM A536, Grade 65-45-12.

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3. Attach to valve shaft with No. 18-8 stainless steel taper pins.
4. Valve discs that seat at angle to axis of pipe line other than 90E not accepted.
5. Valve discs shall rotate 90E from full open position to tight shut position.
6. Offset disc design.

F. Valve Bearings:

1. Sleeve type, self-lubricating, corrosion resistant, bronze, woven, oriented teflon or nylon.
2. Bearing load shall not exceed 1/5 of compressive strength of bearing or shaft material.

G. Valve Shaft Seals:

1. 4 in. through 24 in. Line Sizes: O-ring contained in removable corrosion-resistant cartridges.
2. 30 in. and Larger Valves: Self-compensating V-type packing, replaceable (buried service excluded), without removing operator.

2.03 VALVE OPERATORS

A. Manual Valve Operators:

1. Provide lever or worm gear actuators, tee wrenches, extension stems, floor stands, and valve boxes as indicated on Drawings.
2. 2 piece adjustable screw type valve boxes.
3. Actuator:
 - a. Valves 10 in. and larger: Gear actuators and hand wheels.
 - b. Valves less than 10 in.: Lever Actuator
 - c. Enclose gearing in semi-steel housing suitable for running in lubricant with seals provided on shafts to prevent entry of dirt and water into actuator.
 - d. Support actuator shaft and quadrant on permanently lubricated bronze bearings.
 - e. Actuators shall indicate valve position and provide adjustable stop to set closing torque.
 - f. Furnish removable operator lever with each valve specified with lever actuator.

PART 3 EXECUTION

3.01 INSTALLATION

- A. SUBCONTRACTOR shall have a copy of the manufacturer's instructions available at construction site at all times. Valves shall be installed in strict accordance with manufacturer's instructions in order to ensure compliance with guarantee and/or warranty provisions.
- B. Before proceeding with installation, inspect all valves for damage during storage.
- C. Valves shall be oriented parallel with vertical or horizontal axes of reference, unless otherwise indicated on the drawings.

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- D. Valves shall be installed with stems upright or horizontal, not inverted.
- E. Valves shall be firmly supported to avoid undue stresses on piping system.
- F. All valves shall be installed to provide for easy access during operation, removal, and maintenance.
- G. Valves shall be joined to the piping system in accordance with provisions of Section 15010.
- H. Valves shall be cleaned and tested with piping system in accordance with provisions of Section 15010.

* * * END OF SECTION * * *

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SECTION 15054

BALL VALVES & CHECK VALVES

PART 1 GENERAL

1.01 SUBMITTALS

- A. Product Data and Operation and Maintenance (O&M) Data:

PART 2 PRODUCTS

2.01 BALL VALVE

- A. Manufacturers:

1. Nibco
2. Apollo
3. Milwaukee Valve

- B. BALL VALVES for water services having pressures and temperatures less than valve rated pressure and temperature.

1. 2-1/2 in. and smaller.
2. Top or bottom entry type, with full bore ports.
3. Bronze, with Teflon seats.
4. Screwed ends.
5. Hand lever actuator.
6. Rated 250 lb WOG minimum, 125 psi SWP.

2.02 SILENT CHECK VALVE

- A. Manufacturers:

1. APCO Series 600.
2. Val-Matic Series 1800.

- B. Materials:

1. Heavy cast iron body with non-corrosive cushion chamber and non-corrosive shaft.
2. Bronze plug and seat and guide bushing conforming to ASTM B62.
3. Stainless steel spring conforming to ASTM A276.

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C. Operation:

1. Valve shall not open until upstream pressure reaches 1/4 to 1/2 psi.
2. Valve shall completely close with positive head of 1/2 psi on discharge side of valve.

2.03 TWO-DOOR WAFER CHECK VALVE

A. Manufacturers:

1. Cla-Val

B. Valve:

1. Two-Door Wafer

C. Materials:

1. Body: Cast iron, ASTM A126, Class B
2. Doors: Bronze ASTM B584
3. Epoxy coat interior with epoxy approved by National Sanitation Foundation for potable water

PART 3 EXECUTION

3.01 INSTALLATION

- A. SUBCONTRACTOR shall have a copy of the manufacturer's instructions available at construction site at all times. Valves shall be installed in strict accordance with manufacturer's instructions in order to ensure compliance with guarantee and/or warranty provisions.
- B. Before proceeding with installation, inspect all valves for damage during storage.
- C. Valves shall be oriented parallel with vertical or horizontal axes of reference, unless otherwise indicated on the drawings.
- D. Valves shall be installed with stems upright or horizontal, not inverted.
- E. Valves shall be firmly supported to avoid undue stresses on piping system.
- F. All valves shall be installed to provide for easy access during operation, removal, and maintenance.
- G. Valves shall be joined to the piping system in accordance with provisions of Section 15010.
- H. Valves shall be cleaned and tested with piping system in accordance with provisions of Section 15010.

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SECTION 15075

PIPING AND EQUIPMENT IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Plastic pipe markers.
2. Underground line markers
3. Engraved plastic laminate signs.
4. Plastic equipment markers.
5. Piping system color coding schedule.

B. Identification furnished as part of equipment is specified as part of equipment assembly in other sections and shall comply with requirements of this section.

C. Refer to Division 16 sections for identification requirements of electrical and instrumentation work, not work of this section.

1.02 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required. Submit listing of each flow stream identifier with associated color coding.

B. Submit in accordance with Section 01300.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Allen Systems, Inc.
- B. Brady (W.H.) Company, Signmark Division.
- C. Marking Services, Inc.
- D. Industrial Safety Supply Company, Inc.
- E. Seton Name Plate Corporation.

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2.02 MECHANICAL IDENTIFICATION MATERIALS

- A. Provide manufacturer's recommended products as specified for each application.
- B. Where more than single type is specified for application, selection is installer's option, but provide single selection for each product category.

2.03 LETTERING AND GRAPHICS

- A. Coordinate names, abbreviations, and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or if not indicated, as recommended by manufacturers or required for proper identification and operation and maintenance of mechanical systems and equipment. Only painted markers are allowed.

2.04 PLASTIC PIPE MARKERS (**NOT APPLICABLE**)

- A. Snap-On Type: Provide preprinted, semi-rigid snap-on, color coded pipe markers complying with ANSI A13.1.
- B. Pressure Sensitive Type: Provide preprinted, permanent adhesive, color coded, pressure sensitive vinyl pipe markers complying with ANSI A13.1. Dot matrix printing is not acceptable.
- C. Small Pipes: For external diameters less than 6 in. (including insulation, if any), provide full band pipe markers, extending 360° around pipe at each location, fastened by 1 of following methods:
 - 1. Snap-on application of pretensioned, semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Taped to pipe (or insulation) with color coded plastic adhesive tape not less than 4 in. wide, full circle at both ends of pipe marker, tape lapped 1-1/2 in.
- D. Large Pipes: For external dia 6 in. and larger (including insulation, if any), provide either full band or strip type pipe markers not narrower than 3 times letter height (and of required length), fastened by one of following methods:
 - 1. Taped to pipe (or insulation) with color coded plastic adhesive tape, not less than 4 in. wide, full circle at both ends of pipe marker, tape lapped 3 in.
 - 2. Strapped to pipe (or insulation) application of semi-rigid type with manufacturer's standard stainless steel bands.
- E. Lettering: Comply with piping system nomenclature as specified, scheduled or shown and abbreviate only as necessary for each application length, and only with approval of CONTRACTOR/ENGINEER. Lettering height shall be as follows:

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Outside Pipe Dia (in.)	Minimum Letter Height (in.)	Minimum Length of Marker (in.)
3/4 to 1-1/4	1/2	8
1-1/2 to 2	3/4	8
2-1/2 to 6	1-1/4	12
8 to 10	2-1/2	24
over 10	3-1/2	32

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

G. Label and band colors in accordance with ANSI A13.1, Pipe Identification Schedule and following:

2.05 UNDERGROUND TYPE PLASTIC LINE MARKERS

A. Permanent, bright colored, continuous printed plastic tape, intended for direct burial service; not less than 6 in. wide by 4 mils thick. Provide tape with printing most accurately indicating type of service of buried pipe.

2.06 ENGRAVED PLASTIC LAMINATE SIGNS

A. Engraving stock melamine plastic laminate complying with FS L-P-387A(1) in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, white with black core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting necessary because of substrate.

B. Thickness: 1/16 in. for units up to 20 sq in. or 8 in. length, 1/8 in. for larger units.

C. Fasteners: Self-tapping stainless steel screws except contact type permanent adhesive where screws cannot or should not penetrate substrate.

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2.08 PLASTIC EQUIPMENT MARKERS

- A. 2-ply, 1/8 in. thick laminated engraved plastic, engraved.
 - 1. Color: Black letters on white background.
- B. Nomenclature: Include following, matching terminology on schedules as closely as possible:
 - 1. Equipment name (i.e. chilled water pump No. 1).
 - 2. Equipment Tag No. (i.e. 30-P-1).
- C. Size: Provide approximate 3 in. by 6 in. (minimum) for equipment.
 - 1. 1 in. high letters for equipment tag number.
 - 2. 1/2 in. high letters for descriptive equipment name.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification are to be applied to surfaces requiring insulation, painting or other covering or finish mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING SYSTEM IDENTIFICATION

- A. Locate pipe markers with arrows and color bands as follows wherever piping exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exterior non-concealed locations.
 - 1. Near each valve and control device.
 - 2. Near major equipment items and other points of origination and termination.
 - 3. Spaced intermediately at maximum spacing of 30 ft along each piping run, except reduce spacing to 20 ft in congested areas of piping and equipment.
- B. Locate color bands at each marker and at intermediate spacing not to exceed 10 ft between bands, and at lesser spacing as indicated or as required by local codes.
- C. Locate directional arrows at each marker. Provide 2 arrows at each tee or branch fitting.
- D. Where piping is normally visible from more than 1 side, provide 2 or 3 labels and arrows spaced at 120 degree intervals around pipe in accordance with ANSI A13.1.

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E. Painting or Coating:

1. Painting of piping, and equipment is work of Section 09900
2. Colors listed are general. Actual colors will be selected at later date based on approved manufacturer and listed on color coordinating schedule

3.03 UNDERGROUND PIPING IDENTIFICATION

- A. During backfilling/top soil placement of each exterior underground piping systems, install continuous underground type plastic line marker located directly over buried line at 6 to 8 in. below finished grade. Where multiple small lines buried in common trench and do not exceed overall width of 16 in., install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.04 PROCESS VALVE IDENTIFICATION

- A. Install engraved plastic marker or fiberglass tag at each process valve, gate, or flow control device as identified by P&ID tag numbers on Drawings.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION

- A. Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, if not otherwise specified for each item or device. Provide signs for each unit having equipment tag number on Drawings or in Specifications.

3.06 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device visually blocked.
- B. Cleaning: Clean face of identification devices and glass frames of valve schedules.

Piping Identification Schedule - Table 1 to Section 15075				
Flowstream Identifier	Background Label Color	Pipe Label Text	Pipe Color	Pipe Banding
<i>WATER</i>				
Potable	Green	Potable Water	To be determined	---
<i>AIR</i>				
(ALP)	Blue	Air - Low Pressure	Green	Red
(VAC)	Blue	Vacuum	Green	White
(V)	Yellow	(Process) Vent	(Match process color)	Blue
<i>FLAMMABLE GAS</i>				
(G)	Yellow	Natural Gas	Orange	

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SECTION 15140

POTABLE WATER PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Domestic cold water piping for supply for hose bibs and safety shower/eyewash.

1.02 SUBMITTALS

- A. Submit product data in accordance with Section 01300:**

1.03 QUALITY ASSURANCE

- A. Manufacturers:** Firms regularly engaged in manufacture of domestic water piping systems products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 yrs.
- B. Plumbing Code Compliance:** Comply with applicable portions of NAPHCC pertaining to plumbing materials, construction, and installation of products.
- D. ANSI Compliance:** Comply with applicable ANSI standards pertaining to products and installation of domestic water piping systems.

PART 2 PRODUCTS

2.01 DOMESTIC WATER PIPING MATERIALS AND PRODUCTS

- A.** Provide piping materials and factory fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by installer to comply with installation requirements.
- B.** Provide sizes and types matching piping and equipment connections; provide fittings of materials matching pipe materials used in domestic water piping systems.
- C.** Where more than one type of materials or products are indicated, selection is installer's option.

2.02 PIPE, TUBE, AND FITTINGS

- A. Above ground: Galvanized steel pipe**

- 1) Pipe weight: Schedule 40.

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2) Fittings: Cast iron threaded, galvanized, Class 125.

B. Below ground: Polyvinyl chloride pipe (PVC).

1) Pipe weight: Schedule 80.

2) Fittings: PVC Schedule 80 socket type.

2.03 VALVES

A. Complying with Section 15110 and following:

1. Sectional Valves:

a. 2 in. and smaller: Gate valves.

b. 2 in. and smaller: Ball valves.

c. 2-1/2 in. and larger: Gate valves.

d. 2-1/2 in. and larger: Butterfly valves.

2. Shut-Off Valves:

a. 2 in. and smaller: Gate valves.

b. 2 in. and smaller: Ball valves.

c. 2-1/2 in. and larger: Gate valves.

3. Drain Valves:

a. 2 in. and smaller: Gate valves.

b. 2 in. and smaller: Ball valves.

c. 2-1/2 in. and larger: Gate valves.

4. Check Valves:

a. All sizes: Swing check valves.

3.01 INSTALLATION OF EXTERIOR WATER PIPING

A. Install exterior water service piping system in compliance with local governing regulations.

B. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.

* * * END OF SECTION * * *

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SECTION 16000

ELECTRICAL WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for electrical work.

1.02 ELECTRICAL SERVICE CHANGES

- A. These specifications and drawings delineate the remodeling of an existing structure and/or the addition to an existing structure. While the existing structure is occupied, keep the present services intact until the new construction, facilities, or equipment is installed.
- B. Prior to making revisions to the existing service, make certain that every item is thoroughly prepared. Do the actual work at an off-peak time, or overtime, as arranged with the Owner or as hereinafter specified. Once the work is started, vigorously prosecute it to completion to keep downtime to a minimum. Be prepared to temporarily serve the existing service or discontinue the necessary revisions in the event of an emergency or other condition that makes it impossible to finish the scheduled work on time.
- C. Prepare a work procedure for all work-interrupting service to the Owner's equipment. Include a step-by-step procedure that will be followed in the performance of this work and the time involved in each step. Submit this procedure to the Owner's Representative for review two weeks in advance of the performance of the work.

1.03 STANDARDS

- A. Applicable Standards and Codes:
 - 1. Underwriters Laboratories, Inc. (UL).
 - 2. National Electric Code (NEC).
 - 3. National Electrical Contractors "Standards of Installation" (NECA).
- B. Where quantities, sizes, or other requirements shown on the drawings or specified herein exceed the requirements of above standards and codes, Drawings and Specifications shall govern.

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1.04 SUBMITTALS

- A. Submit materials and equipment for review to CONTRACTOR/ENGINEER. Each sheet of descriptive material submitted shall be clearly marked to identify material or equipment, and shall show specification paragraph for which equipment applies.
 - 1. Submit schematics and connection diagrams for all electrical equipment. A manufacturer's standard connection diagram or schematic showing more than one scheme of connections will not be accepted unless it is clearly marked to show intended connections.
 - 2. Submittals showing more than particular item under consideration shall have pertinent description paragraph for which equipment applies circled, or "high-lighted" with a marker intended for that purpose.
- B. Prepare and maintain record drawings current with work completed. Show all changes to underground and other hidden work. Submit to CONTRACTOR/ENGINEER on completion of project.
- C. Provide records of insulation test (megohm check) on all conductors.

1.05 CLEARANCES

- A. Equipment:
 - 1. Maintain clearances from electric panels, and other electrical installations as required by NEC.
 - 2. Maintain working clearances around electrical equipment as required for proper maintenance and operation.

1.06 IDENTIFICATIONS

- A. Provide identification signs on all equipment, switches, breakers, and panels.
- B. Provide a typewritten circuit identification schedule in each distribution or branch circuit load center under glass or plastic.

1.07 CODES AND STANDARDS

- A. These specifications are minimum requirements and shall govern where made stringent by other sections or local, state, or federal laws or regulations. In the event of conflict between these specifications and applicable codes and regulations, the codes and regulations shall govern.

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1.08 DRAWINGS

- A. Drawings and specifications are provided for assistance to SUBCONTRACTOR and are diagrammatic only to indicate general arrangement and location of circuits, outlets, etc. Exact locations will be determined by field conditions. Deviations from arrangement indicated to meet actual conditions shall be made with no expense to CONTRACTOR/ENGINEER.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All electrical equipment and material shall be furnished new and shall be accepted, or certified, or listed, or labeled or otherwise determined to be safe by nationally recognized testing laboratory such as UL or FM.
- B. Substitutions for materials and equipment listed herein must be of equal standards, quality and desired operation, or superior. There will be no approval or consideration of approval of equipment or material submittals for substitution prior to award of Subcontract.
- C. Shop/Factory Finishing
 - 1. Provide baked enamel finishes on exposed surfaces.
 - 2. Provide galvanized finishes for damp or wet locations.
 - 3. Touch up or refinish damaged paint.

2.02 PANELBOARDS

- A. Panelboards shall comply with NEMA PB 1 (panelboards) and UL 67 (electric panelboards) requirements.
- B. Provide dead-front, safety-type panelboards with ratings as scheduled. Panelboards shall be circuit-breaker type and shall be fully rated for short-circuit capacity indicated in the drawings. Panelboards shall be UL listed and labeled and manufactured by General Electric, Cutler-Hammer, Square D, Siemens, or equal.

2.03 TRANSFORMERS

- A. Transformers shall be dry type built in accordance with the latest revision of ANSI C89.2, NEMA ST-20, and UL listed under the requirements of UL 506. Provide voltage taps on the primary winding for transformers 5 kva and larger. Transformers shall be Sorgel Electric Division, Square D Company "Quiet Quality," General Electric Company "QHT," Cutler-Hammer Type Westinghouse "EP or EPT," or equal.

2.04 CONDUIT

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- A. Provide rigid non-metallic conduit, PVC schedule 40, rated for 90 degree C conductors, and conforming to UL standard 651 and Federal Specification WC1094A. PVC conduit shall be used for all underground conduit installations.
- B. Provide rigid galvanized steel, threaded, hot dipped galvanized inside and out conforming to UL standard 6 and ANSI C80.1. Rigid galvanized steel conduit shall be used for all above ground installations.
- C. Provide PVC couplings for PVC conduit and rigid threaded galvanized couplings for galvanized conduit.

2.05 WIRES AND CABLES

- A. Conductors provided on 120/240-volt power systems shall be stranded per ASTM B-8 soft drawn copper.
- B. Insulation system shall be type THWN rated 600 volts as defined and listed in article 310 of the NEC.
- C. Minimum size conductor utilized shall be #14 AWG for control circuits, #12 AWG for power and lighting circuits.
- D. Color code conductor insulation as follows:

Phase	240/120V	240V	480/277V
Phase A	Black	Black	Brown
Phase B	Red	Red	Orange
Phase C	---	Blue	Yellow
Neutral	White	White	Gray
Ground	Green	Green	Green

2.06 TWISTED-SHIELDED CABLE

- A. Single-pair cables shall be two No. 18 AWG and single triads shall be three No. 18 AWG stranded tinned-copper conductors individually insulated with fully color-coded PVC rated at 600 volts; insulated conductors twisted together and shielded with a spiral-wound metal foil tape overlapped for 100% shielding. Outer jacket shall be PVC.

PART 3 - EXECUTION

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3.01 CONDUIT

- A. Install conduit in accordance with the manufacturer's recommendations. All buried conduits shall have locations marked on Drawings.
- B. Install electrical metallic tubing in concealed locations, rigid nonmetallic conduit embedded in concrete or below grade, rigid steel conduit in exposed locations and liquid-tight flexible conduit to motors and vibrating equipment.
- C. Provide 30-inch-minimum cover for direct burial underground conduit.
- D. Bends shall be large radius ells with a maximum equivalent of four corner bends in any run between pulling joints
- E. Fasten all conduits entering boxes with locknut and bushing in the inside and locknut on outside.
- F. Clean all conduit thoroughly inside and outside after installation and just before pulling cables.
- G. Install only undamaged conduit. Plug ends to prevent entry of dirt and moisture.

3.02 WIRES AND CABLES

- A. Install only after completion of work, which might cause damage to wires or conduit.
- B. Clean out or replace conduit in which dirt, water, concrete, or other foreign matter has been allowed to accumulate.
- C. Identify each end of each conductor by wire marking tape or sleeve. Mark on outer cover giving voltage, type, size, and circuit number.
- D. Splices:
 - 1. No splices shall be allowed in conduit or raceway.
 - 2. Make splices in electrical enclosures.
 - 3. Splice insulation shall be equal to original factory insulation.

3.03 PERFORMANCE TESTS

- A. After the electrical installation is complete, test it to demonstrate that the system operates in accordance with the plans and specifications. Tests shall include the following:
 - 1. Wire: Perform insulation resistance test on each complete circuit prior to energizing. Insulation resistance between conductors and between each conductor and ground shall not be less than 25 megohms.

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2. Transformers: Perform insulation resistance test on the windings prior to energizing. The measurements shall be from primary and secondary windings to ground and between primary and secondary windings. The minimum value shall be 10 megohms.

* * * END OF SECTION * *

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SECTION 16060

GROUNDING AND BONDING

PART 1 - GENERAL

1.09 DESCRIPTION

- A. This section includes materials, testing, and installation of electrical grounding.

1.10 SUBMITTALS

- A. Submit material list for all grounding materials and equipment. Indicate size, material, and manufacturer.
- B. Submit test results. Indicate overall resistance to ground and resistance of each electrode.

1.11 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance:
1. Separately Derived Sources (as Defined by NEC 250) Grounding Electrode: 25 ohms.
 2. Grounds Not Covered Above: 25 ohms.

PART 2 - MATERIALS

2.07 GROUND RODS

- A. Ground rods shall be copper-clad steel, 3/4 inch in diameter, minimum 10 feet long, with hardened steel points.

2.08 CONNECTIONS

- A. Ground Clamps: Clamps for connection of ground wire to ground rod shall be bronze.
- B. Exothermic Connections: Provide Cadweld or equal.

2.09 CONDUCTORS

- A. Equipment Ground: Conductors shall be low-voltage building-wire type as specified in Section 16000.
- B. Bare Copper Conductors: Annealed bare copper, conforming to ASTM B3 and B8.

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PART 3 - EXECUTION

3.04 EQUIPMENT GROUNDING

- A. Connect the ground buses of lighting panels, distribution panels, and motor control centers to the ground bus within the main service switchboard with a grounding conductor.
- B. Ground raceways and noncurrent-carrying parts of electrical equipment in accordance with NEC Article 250. Use the metallic conduit system for equipment and enclosure grounding.
- C. Additionally, all circuits shall carry one ground conductor for equipment grounding. Ground conductor shall be in excess of grounding through the metallic conduit system.

3.05 GROUND TEST WELL

- A. Provide a handhole and ground rod as detailed in the drawings to aid in performing ground testing and connecting additional ground rods if required by the test results. Connect ground wire from ground rod to main service switchboard ground bus as detailed in the drawings.

3.06 CONNECTIONS

- A. Exothermic weld all underground connections.

3.07 TESTS

- A. Before making connections to the ground electrode, measure the resistance of the electrode to ground using a ground resistance tester specifically designed for ground resistance testing. Perform testing in accordance with test instrument manufacturer's recommendations using fall-of-potential method. Perform the test not less than two days after the most recent rainfall and in the afternoon after any ground condensation (dew) has evaporated. If a resistance less than the performance requirements is not obtained, provide a ground rod driven 6 inches below grade spaced 10 feet away from the ground well and connect to ground test well with No. 4 AWG bare copper wire and repeat the test. If the performance requirements are still not obtained, inform the Owner for resolution.

* * * END OF SECTION * * *