SECTION 01 12 16 - WORK SEQUENCE

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes general sequencing, project phasing and coordination requirements for the Work.

B. Contract Requirements:

1. The existing Yellowhair, Cottonwood, Nazlini, and Tolani Lake Booster Pump Stations, and Tolani Lake altitude valve shall continuously receive water from the main tanks in the distribution systems they serve. The function of the existing facilities shall not be compromised during the course of the Work, except as may be specified herein. Plan and prosecute the Work such that the operation of the existing pump stations are not interrupted, expect as specified herein.

2. New Yellowhair, Cottonwood, Nazlini, and Tolani Lake Booster Pump Stations

a. The Booster pumps and piping shall be tested, disinfected, and made operational prior to modification of the system and telemetry operation. An approval for disinfection shall be obtained prior to the disinfection process.

b. The new telemetry PLC shall obtain tank level information from the existing Yellowhair Tank and provide start/stop control of the booster pump station.

c. The existing booster pump stations shall remain in operation throughout the remainder of the work and decommissioned after the new booster pump station has been functionally tested and put into operation.

3. New Tolani Lake Altitude Valve

a. The altitude valve and piping shall be tested, disinfected, and made operational prior to modification of the system. An approval for disinfection shall be obtained prior to the disinfection process.

b. The new pressure sensing line shall obtain tank level information from the existing Tolani Lake Tanks and provide open/close control of the altitude valve.

c. The existing altitude valve station shall remain in operation throughout the remainder of the work and decommissioned when the new altitude valve is ready for operation.

1.2 SUBMITTALS

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

B. Work Sequencing Plan: At a minimum, to include the following:

1. Complete sequence of construction for all activities contained herein.

2. Major work activities to occur.

3. Schedule of temporary shutdowns of pump station and estimated duration of shutdowns. Submit a detailed plan for filling storage tanks downstream existing pump stations during temporary shutdowns.

4. Assistance to be required of Owner's operating personnel during shutdowns.

5. Contingency plan identifying what action will be taken if activities during a shutdown cannot be completed within the allotted times, or if there is a failure of pumping equipment to be used during temporary pumping operations.

6. Name and contact information of individual in charge of activity during shutdown.

1.3 PROJECT SPECIFIC WORK CONSTRAINTS

A. Constraints listed below involve limits on activities during construction. These limits relate to the critical nature of the new pump station facility.

1. Coordinate construction schedule and operation with Owner.

2. Schedule the constructing, testing, and commissioning of those components of the facility that are required in order to receive and convey water to storage tanks.

1.4 GENERAL WORK CONSTRAINTS

A. Constraints primarily relate to interfacing with and tying into existing pipelines, power supply, equipment, and other aspects of the operating pump station facility.

B. Make every effort to give proper attention to each of these items so as to minimize interruptions of the existing facilities and avoid delays that may result if the constraints are not observed.

C. Constraints listed below involve limits on activities during construction. These limits relate to the critical nature of the existing pump station facility.

1. Coordinate construction schedule and operation with Owner.

2. Coordinate proposed work with Owner, Engineer, and facility operations personnel before implementing unit shutdowns. Under no circumstances cease Work at the end of a normal working day if such actions may inadvertently cause a cessation of any facility operating process; in which case, remain on site until necessary Work and/or repairs are complete.

3. Owner recognizes portions of the facility and facility operations will have to be interrupted or shut down or interfered with in order to accommodate construction activities. Owner will, through its personnel, attempt to accommodate Work, provided that proper notification is given. Owner reserves the right to deny permission for interruption or shutdown on any day.

4. Do operate any of the existing equipment without written permission from Owner naming the specific piece of equipment, operator(s), and dates equipment may be used. Contractor is liable for any loss or damage caused to property or equipment or any personal injury resulting from or related to this usage.

D. Extended Working Hours: If it is desired to perform any Work outside the specified working hours, obtain written permission from Owner and all necessary permitting agencies, and make all necessary arrangements prior to commencing.

1.5 TEMPORARY SHUTDOWNS

A. Provide seven-day minimum advance notice to request approval of a temporary shutdown of a facility.

B. Each Notice of Request for Approval of a Temporary Shutdown submitted to Owner shall include the following:

1. Dates, times, and duration of proposed shutdown.

2. Work activities to be performed during the shutdown.

3. Assistance required of Owner's personnel before, during, and after shutdown.

4. Personnel to be on Site during shutdown.

5. Contingency plan if work during shutdown is not completed during allotted time or critical equipment fails.

C. Upon receipt of such request, Owner will decide what action(s) is required by Owner and if the requested shutdown is acceptable considering the flows through the pump station at that time. The request from Contractor will be returned to Contractor with the Owner's written decision noted. If Owner deems that the requested shutdown is unacceptable, Owner will state such reasons, and Contractor shall reschedule the shutdown as required.

D. It is hereby agreed between the Contractor and Owner that disapproval by Owner of the Contractor's shutdown request does not entitle Contractor to any time extension unless Contractor can demonstrate to the satisfaction of Owner, through an updated CPM schedule, that the overall project completion date will not be met as a result of this disapproval.

E. Owner may postpone a planned and approved shutdown at any time for pumping capacity, or safety reasons.

1.6 INTERRUPTION OF UTILITY SERVICE

A. Indicate required shutdowns of existing utilities or interruptions of existing operations on Progress Schedule. Interruptions to utility service will be allowed to the extent that customer service will not be adversely compromised.

B. Submit requests for interruptions to utility service not less than five business days in advance of the date scheduled for the interruption.

C. Following receipt of the request, Engineer will notify Contractor if the requested date will be permitted. Evaluation of the request will be based upon the availability of the utility owner's personnel to assist and monitor utilities during the shutdown period and impact to customer service.

D. Minimize the period of interruption by thorough advance planning. Procure and provide all required materials, equipment, and labor on site during the shutdown.

E. Do not begin interruption until written authorization is received from Engineer.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01 10 00 – SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Work covered by Contract Documents.
2. Site access
3. Work by Owner or other Work at the Site.
4. Owner-furnished products. – NOT USED.
5. Contractor's use of Site.
6. Work sequence – NOT USED.
7. Owner occupancy – NOT USED.
8. Permits.
9. Specification conventions – NOT USED.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Work of the Project includes furnishing all permits, labor, materials, and equipment necessary for construction of the following:

1. Installation of precast concrete pump houses with electrical rooms and telemetry control systems. The pumps will be Grundfos CRE vertical multistage, centrifugal in-line pump, mounted on a skid with suction and discharge manifolds. The new booster pump stations will replace the existing booster pump stations.

B. Installation of ductile iron yard piping and related appurtenances connecting distribution system upstream and downstream of pump stations.

C. Installation of a new altitude valve, piping, and fitting assemblies with valve vault.

1. The abandonment of existing booster pump stations, and underground meter or valve vaults.

2. Limit water outages to water users to a minimum possible outage time. Contractor is required to notify all existing water users when and how long outages will occur.

D. The defined Work elements are a general outline of principal features of the Work and does not in any way limit the responsibility of the Contractor(s) to perform all Work and furnish all equipment, labor and materials required by the Contract Documents.

1.3 SITE ACCESS

A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings and as indicated by requirements of this Section.

B. Use of Site: Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.

b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.4 WORK BY OWNER OR OTHERS

A. Coordinate Work with utilities of Owner and public or private agencies.

B. Navajo Tribal Utility Authority will provide electrical services to the new pump houses and to be completed in accordance with the installation and procurement requirements as outlined in the electrical drawings and specifications.Unless otherwise indicated in the Contract Documents, all castings, pipe, equipment, demolition debris, spoil or any other discarded material or equipment shall become the property of the Contractor and shall be disposed of in a manner compliant with applicable Federal, State, and local laws and regulations governing disposal of such waste products. No burning of debris or any other discarded material will be permitted.

1.5 OWNER-FURNISHED PRODUCTS – NOT USED

1.6 CONTRACTOR'S USE OF SITE

A. The Work included in the Contract Documents is to construct new booster pump stations where work performed will be on the existing water distribution systems and near the existing booster pump stations that must continue in operation during construction. The Contractor shall always cooperate fully with the Owner and the Engineer to ensure that the operation of the existing systems will continue and that any interruption to operations are minimized.

1. The specific major requirements for maintaining the existing water distribution systems and booster pump stations operations are listed below. These requirements are not necessarily complete in every detail:

2. Seven day's-notice shall be given to the Owner by the Contractor when any interruption of or modification to the operation of the existing systems and/or piping is desired.

3. Follow the sequence of construction requirements as described in Section 01 12 16, Work Sequence.

B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.

C. Provide not less than 7-day notice to Owner of activities that will affect Owner's operations.

D. Construction Operations: Limited to areas indicated on Drawings.

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

F. Utility Outages and Shutdown:

1. Coordinate and schedule electrical and other utility outages with Owner.

2. Outages: Allowed only at previously agreed upon times.

3. At least one week before scheduled outage, submit Outage Request Plan to Owner itemizing the dates, times, and duration of each requested outage.

G. Construction Plan: Before start of construction, post electronic file to Project website of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner. After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.

1.7 WORK SEQUENCE – NOT USED

1.8 OWNER OCCUPANCY – NOT USED

1.9 PERMITS

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

B. Furnish necessary permits for construction of Work including, but not limited to, the following:

1. Navajo Environmental Protection Agency Construction Permit for review of construction drawing sets and approval of improvements.

1.10 SPECIFICATION CONVENTIONS

A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Temporary construction facilities and control requirements for the Work include the following. Contractor responsible for providing all other temporary facilities and controls necessary to complete the Work as described in the Contract Documents.

1. Utilities including lighting and electricity, heat, telephone service, internet access and water.
2. Sanitary facilities.
3. Fire protection.
4. Roads.
5. Security fencing.
6. Enclosures.
7. Parking.
8. Traffic Control.
9. Owner's access to facilities.

B. Maintain temporary facilities in proper and safe condition throughout progress of Work.

C. Comply with federal, state, and local codes and regulations, and utility company requirements.

1.2 LAYOUT OF TEMPORARY FACILITIES

A. Before starting Work, submit to Owner, for approval, proposed layout of temporary facilities.

B. Should Contractor require space in addition to that shown on Drawings, Contractor shall make arrangements for storage of materials and equipment in locations off Site.

1.3 UTILITY PROPERTIES AND SERVICE

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

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

C. Contractor to contact one-number locator service (811) at least 48 hours in advance in advance of all excavations or other activities that may disturb and/or damage existing utilities. Existing utilities which may be impacted include the following.:

Potable Water, Storm Drain	NTUA
Sanitary Sewer (on-site)	NTUA
Non-potable water	NTUA
Natural Gas	NTUA
Telephone/Data	Navajo Nation Telecommunication & Utilities
Power	NTUA

1.4 TEMPORARY LIGHTING AND ELECTRICITY

A. General:

1. Temporary lighting shall be sufficient to enable Contractor and Subcontractors to complete Work and enable Owner to observe Work. Illumination shall meet or exceed state code requirements.

B. Temporary electric power may be obtained from Owner's electrical system as follows:

1. Power is available at the site but may be limited. Power is available within existing structures but maybe significantly limited due to existing equipment and loads.

2. Make arrangements with Owner to review potential sources of temporary electricity and limitations of existing power supplies.

3. Based on review and potential sources, Contractor shall develop a layout of temporary electrical power for review by Owner.

4. Contractor is responsible to implement temporary power and provide electrical protection to prevent disruption of plant power from over-current, ground faults, and short circuits.

C. Temporary Electric Power:

1. Provide, maintain, and remove temporary electric service facilities.

2. Provide temporary electric systems and components in conformance with requirements of National Electric Code and local authorities.

3. Facilities exposed to weather shall be weatherproof type.

4. Enclosures shall be locked to prevent unauthorized access.

5. Provide lamps, wiring, switches, sockets, and similar equipment required for temporary lighting and power tools.

6. Provide electric service to temporary offices.

1.5 TEMPORARY HEAT

A. General:

1. Provide heating required for cold weather protection for all facilities.

2. Provide heating required after enclosure of structure.

3. Except as otherwise called for, temperature shall be kept above 50°F.

4. Heat shall be warm air from oil, electric or gas-fired portable heaters suitably vented to outside.

5. Open salamander type heaters are not permitted.

B. Temporary Heating:

1. Provide temporary heat, pay fuel costs, and maintain heating units.

2. Provide adequate heat to all parts of structure.

3. Repair or replace materials damaged because of lack of heat.

4. Provide throwaway filters if permanent system used for temporary heat.

5. If permanent system is used for temporary heat during construction, all system components shall be cleaned at completion of work, including ductwork.

1.6 TEMPORARY COMMUNICATIONS

A. Provide temporary telephone service for Contractor's use. Cell phones are acceptable but a source for local sending/receiving of fax transmission is required.

B. Provide temporary internet access service for Contractor's use. Internet access shall be capable of sending and receiving emails with large file attachments, drawings, spreadsheets, and other documents.

1.7 PROJECT IDENTIFICATION

A. Project Identification Signs:

1. See Section 01 58 00 Project Sign.

1.8 WATER FOR CONSTRUCTION AND TESTING

A. Contractor is responsible for making all arrangements necessary for temporary water for construction.

1. Non-potable water for construction purposes will be furnished by the Owner at no cost.

2. The Contractor shall furnish all valves, hoses, connections, and other devices as necessary to obtain sufficient water for construction and for filling and testing of water lines as required. Fire hydrant use is allowed only by permission of the utility owner.

3. Backflow protection is required on all connections to potable water systems.

1.9 SANITARY FACILITIES

A. Provide temporary sanitary facilities conforming to state and local regulations, in sufficient numbers for use of Contractor's and Subcontractor's employees.

B. Maintain in sanitary condition and properly supply with toilet paper.

C. Use of the City's existing sanitary facilities is not allowed.

1.10 TEMPORARY FIRE PROTECTION

A. Provide and maintain fire extinguishers and other fire protection equipment and devices as would be reasonably effective in extinguishing fires during early stages by personnel at Site.

1.11 TEMPORARY SITE AND OTHER ROADS

A. Maintain existing roads used during construction free from accumulation of dirt, mud, and construction debris.

B. Contractor shall repair or replace existing roads that remain to original or better condition prior to Final Completion. Survey and record condition of existing roads prior to construction.

1.12 CONTRACTOR'S WORK AREA

A. Work Area:

1. Limit construction operations and storage of equipment and materials to areas shown on Drawings and as determined by Owner.

2. Except as provided herein, no private property, or other area adjacent to Site shall be used for storage of Contractor's equipment and materials unless prior written approval is obtained from legal owner of the respective locations.

3. Contractor shall maintain staging areas during construction in a manner that will not obstruct operations of existing facilities. Work shall proceed in an orderly manner, maintaining construction Site and staging area free of debris and unnecessary equipment or materials.

B. Storage and Protection of Equipment and Materials:

1. The Contractor shall be solely responsible for the protection and security of all equipment and materials stored on the site. Equipment and materials stored at the site shall be placed neatly on the job site in an area and environment that will provide protection and security. Materials that are not adequately protected or stored in conformance with the Manufacturer's recommendations will be rejected. Unusable materials (i.e., rejected, or damaged liner material, old concrete chunks, metal scraps, etc.) shall be expeditiously removed from the job site.

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

3. No equipment and/or materials shall be stored outside the immediate work area, in the following locations, or in the following manner:

a. In any maintained landscaped or lawn area.

b. In a manner that would totally eliminate an individual residents' street parking, or parking for the City's existing buildings.

c. In front of any business.

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

1.13 SECURITY

A. The wastewater treatment plant site is fenced. No other security will be provided by Owner.

B. Outside of the treatment plant is not fenced.

C. Contractor shall be responsible for loss or injury to persons or property where Work is involved and shall provide security and take precautionary measures to protect Contractor’s and Owner’s interests.

D. Provide and maintain temporary fencing of design and type needed to prevent entry into active construction areas.

1.14 ENCLOSURES

A. Provide and maintain all enclosures, scaffolds, tarpaulins, canopies, warning signs, steps, platforms, bridges, and other temporary construction necessary for proper completion of Work.

1.15 PARKING

A. Staging area and designated areas within construction limits may be used for parking of construction personnel’s private vehicles and Contractor’s lightweight vehicles. Parking shall not impede access or chemical deliveries to the wastewater treatment plant facilities.

B. Make arrangements for additional parking off site as required.

C. No overnight parking, camping, or storage of personal vehicles, trailers or other items will be authorized.

1.16 TRAFFIC CONTROL AND PROTECTION

A. The Contractor shall maintain traffic control and protection in the work areas 24 hours per day. Traffic control shall conform to the requirements set forth by the Oregon Department of Transportation as well as the standards set forth in the Manual on Uniform Traffic Control Devices (MUTCD) and local jurisdiction.

B. The Contractor shall conduct its operations so as to keep one lane of traffic open for public and private access at all times on City, County and Public streets, roads and highways. Permits obtained for the Project may have more stringent requirements than noted in this section.

C. Prior to beginning construction and as necessary or required by local or state agencies, the Contractor shall submit a detailed street closure and traffic control plan to the Owner for approval, which meets the requirements of the Oregon State Department of Transportation. As construction proceeds, the Contractor shall notify the Owner as to the status of street closures and detours, if required.

D. All work shall be carried on with due regard for safety to the public. Open trenches shall be backfilled or covered with steel plates at the end of each day.

1.17 CONTRACTOR'S FIELD OFFICES AND BUILDINGS - NOT USED

1.18 ENGINEER'S FIELD OFFICE AND EQUIPMENT - NOT USED

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Maintain and operate systems to ensure continuous service for duration of construction.
B. Modify and extend systems, as Work progress requires.

3.2 REMOVAL

A. Completely remove temporary materials, equipment, signs, and structures when no longer required.

B. In unfinished areas, clean and repair damaged caused by temporary installations or use of temporary facilities, restore drainage, and evenly grade, seed, or plant as necessary to provide appearance equal to or better than original.

C. In finished areas, restore existing or permanent facilities used for temporary services to specified, or original condition.

3.3 DAMAGE TO EXISTING PROPERTY

A. Contractor is responsible for replacing or repairing damage to existing buildings, structures, sidewalks, roads, parking areas, and other existing assets.

B. Contractor shall have option of having Owner contract for such Work and have cost deducted from Contract Price.

3.4 OWNER'S USE

A. Upon acceptance of Work, or portion of work defined and certified as Substantially Complete by Owner, and Owner commences full-time successful operation of facility or portion thereof, Owner will pay cost for utilities used for Owner's operation. Contractor shall continue to pay for utilities used until final acceptance of Work, except as provided herein. However, heat for building as required for construction purposes shall still be paid by Contractor unless, due to occupancy by Owner, more heat shall be required due to increased temperature or lengthened duration, in which case Owner will bear difference in cost.

END OF SECTION

SECTION 01 45 00 - QUALITY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

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

1.2 PROVISIONS

A. Contractor's Responsibility for Testing

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

B. Owner's Right to Perform Additional Tests

The Owner or Engineer reserves the right to complete additional testing. In such cases, the Contractor shall provide safe access for the Owner or Engineer and their inspectors to adequately inspect the quality of work and the conformance with Project specifications.

1.3 QUALITY ASSURANCE

A. Testing Requirements

An independently owned and operated laboratory approved by the Engineer shall perform all testing as specified herein.

B. Testing

1. General

a. All required testing of work and/or materials shall be conducted in the presence of the Engineer. The Contractor shall provide 48-hour notification to the Owner and Owner's representative prior to conducting any and all quality assurance testing. Where applicable, work and materials shall only be buried with the consent of the Engineer.

b. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample, or samples of material to be tested shall be selected by such laboratory or agency or by the Engineer. The Contractor shall furnish such samples of all materials without charge to Owner.

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

2. Costs of Testing

    a. The Contractor shall be responsible for and shall pay for all tests as specified in Part 3 of this Section. Additional information has been provided regarding the payment responsibility for the Owner with regards to the Project.

    b. With regards to all materials to be tested, where test results demonstrate that the material or workmanship does not meet the minimum requirements of the Contract Documents, additional testing shall be completed and shall be paid for by the Contractor with no reimbursement by the Owner.

1.4 SPECIAL INSPECTIONS

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

A. Special Inspectors and Testing Agencies Responsibilities

1. Verify that manufacturers maintain detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.

2. Promptly notify Owner and Contractor of irregularities and deficiencies observed in the Work during performance of their services.

3. Submit certified written report of each test, inspection and similar quality control service to Owner, Contractor, and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

4. Submit final report of special inspections at Substantial Completion, including a list of unresolved deficiencies.

5. Re-test and re-inspect corrected work.

B. Contractor's Responsibilities

1. Provide quality requirements to all subcontractors and enforce all requirements.

2. Notify Owner, Engineer, Special Inspectors and Testing Agencies at least 48 hours in advance of time when Work that requires testing or special inspecting will be performed, unless otherwise indicated in the Contract Documents.

3. Pay for any Contractor requested testing and inspecting not required by the Contract Documents.

4. Pay for any re-testing or re-inspections by Special Inspectors and Testing Agencies for replacement work resulting from work that failed to comply with the Contract Documents. Owner will deduct such costs from the Contract Price.

5. Submit copies of licenses, certifications, correspondence, records, and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the Owner, Engineer, and Special Inspectors.

6. Where Special Inspection requires pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:

    a. Provide test specimens representative of proposed products and construction in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

    b. Provide information on configurations of test assemblies, testing procedures and laboratory test records to adequately demonstrate capability of products to comply with performance requirements.

7. Cooperate with Agencies performing required tests, special inspections, and similar quality control services. Notify Agencies in advance of operations to permit assignment of personnel. Provide the following:

    a. Access to the Work.

    b. Incidental labor, equipment, and materials necessary to facilitate tests and special inspections.

    c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.

    d. Provide facilities for storage and field curing of test samples.

    e. Deliver samples to Testing Agencies.

8. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.

9. Schedule times for tests, special inspections, obtaining samples, and similar activities. Distribute schedule to Owner, Engineer, Special Inspectors, Testing Agencies, and each party involved in portions of the work where tests and special inspections are required.

1.5 SUBMITTALS

A. Laboratory Test or Inspection Reports

Each report shall be signed and certified by the independently owned and operated testing laboratory. Unless otherwise specified, submit three copies of each report to the Owner or Owner's Representative.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 FIELD TESTING SCHEDULE

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

Material to be Tested	Payment Responsibility for Initial Testing	Minimum Testing Frequency
Structural Backfill	Owner	In-place compaction testing (w/ nuclear compaction gauge) performed at 2-foot elevation increments, one test per 2,500 sf of material placed. See [Article 3.5, Field Quality Control of Section 31 23 23,] Fill for further details on testing requirements.
Trench Backfill	<Owner> <Contractor>	In-place compaction testing (w/ nuclear compaction gauge) performed at 2-foot elevation increments, one test per 200 lineal feet of pipeline trench as measured along pipe centerline. Engineer may reduce frequency to one test per lift for every 1,500 lineal feet of pipeline trench when satisfied with Contractor's method of compaction. See [Article 3.16, Field Quality Control of Section 31 23 17,] Trenching for further details.
Asphalt Concrete	<Owner> <Contractor>	As required when placed. See detailed requirements in [Article 3.3, Field Quality Control of Section 32 12 16, Asphalt Paving.]
Material to be Tested	**Payment Responsibility**	**Minimum Testing Frequency**
Concrete	Owner	As required when placed. See detailed requirements in [Article 3.12, Concrete Tests of Section 03 30 00, Cast-In-Place Concrete.]
Waterline – Hydrostatic testing and disinfection	Contractor	As required. See Section 33 13 00, Testing & Disinfection of Water Utility Piping.

END OF SECTION

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

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

B. Section includes:

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

1.2 DEFINITIONS

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

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

1.3 SCHEDULE OF SUBMITTALS

A. Within 10 days after the Effective Date of the Contract, Contractor shall submit to Engineer a preliminary Schedule of Submittals, including proposed list of major products proposed for use, with specification section reference, name of Manufacturer, supplier, trade name, subcontractor, and model number of each product. Provide a schedule of specific target dates for the submission and return of submittals and shop drawings required by the Contract Documents.

B. For products specified only by reference standards, indicate Manufacturer, trade name, model or catalog designation, and reference standards.

C. The list and schedule shall be updated and resubmitted when requested by the Engineer.

D. Contractor's Schedule of Submittals will be acceptable to the Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

1.4 SHOP DRAWING AND SAMPLE SUBMITTAL REQUIREMENTS

A. Before submitting a Shop Drawing or Sample, Contractor shall have:

1. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

3. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

B. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.

C. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review of each such variation.

1.5 SUBMITTAL PROCEDURES

A. Contractor shall submit Shop Drawings and Samples to Engineer for review in accordance with the accepted Schedule of Submittals.

B. Transmit each submittal with Engineer-accepted transmittal form certifying compliance with requirements of Contract Documents.

C. Sequentially number transmittal forms. Mark transmittal forms for resubmittals with original number and sequential alphabetic suffix.

D. Show each Submittal with the following numbering and tracking system:

1. Submittals shall be numbered according to specification section. For example, the first product submittal for Section 05 50 00 would be "05 50 00-1". Resubmittals of that submittal would be "05 50 00-1.1", followed by "05 50 00-1.2", and so on. The second product submittal for that Section would be "05 50 00-2".

2. Submittals containing product information from multiple sections of the specifications will not be reviewed. Contractor and/or their supplier shall divide submittals in a manner that meets the numbering and tracking system requirements stated herein.

3. Alternative method of numbering may be used if acceptable to Engineer.

E. Identify: Project, Contractor, subcontractor and supplier, pertinent drawing and detail number, and specification Section number appropriate to submittal.

F. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.

G. Coordinate submission of related items.

1. All shop drawings for interrelated items shall be scheduled for submission at the same time.

2. The Engineer may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the Engineer will advise the Contractor in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.

H. When hard copies of submittals are provided by the Contractor, six copies of all materials shall be provided to the Engineer. Two copies of reviewed submittals will be kept by the Engineer, two copies of reviewed submittals will be transmitted to the Owner, and two copies of reviewed submittals will be returned to the Contractor. If the Contractor requests that more than two copies of the reviewed submittal be returned, then the Contractor shall submit the appropriate quantity of submittals.

I. When electronic transmittals of submittals are provided by the Contractor under established protocols described elsewhere in the Contract Documents or as jointly developed by the Owner, Engineer and Contractor, provide electronic submittals in portable document format (PDF) in addition to the source document format (Word, Excel, AutoCAD, etc.). Reviewed submittals will be returned to the Contractor as PDF electronic files.

J. For each submittal for review, allow not less than 14 days for Engineer review, excluding delivery time to and from Contractor.

K. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.

L. Allow space on submittals for Contractor and Engineer review stamps or comments.

M. When revised for resubmission, the Contractor shall identify changes made since previous submission. A narrative of changes shall be provided, and shop drawings or calculations shall indicate that a revision was made.

N. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with review comments.

O. Submittals not requested will not be recognized nor processed.

P. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.6 ENGINEER REVIEW

A. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.

B. The Engineer’s review of submittals and shop drawings is not a check of any dimension or quantity and will not relieve the Contractor from responsibility for errors of any sort in the submittals and shop drawings.

C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.

D. The Engineer will review the submitted data and shop drawings and return to the Contractor with notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", "Revise and Resubmit", or "Submit Specified Item".

E. If more than two submissions of an item are required to meet the Project specifications, Contractor shall be responsible for Engineer’s charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

F. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer’s review will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

G. Engineer’s review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

H. Engineer’s review of a separate item as such will not indicate approval of the assembly in which the item functions.

I. Engineer’s review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 1.4.C and Engineer has given written acceptance of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such accepted variation from the requirements of the Contract Documents in a Field Order.

J. Engineer’s review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 1.4 A. and B.

K. Engineer's review of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

L. Neither Engineer's receipt, review, return of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

M. Contractor shall perform the Work in compliance with the requirements and commitments set forth in returned Shop Drawings and Samples, subject to the provisions of Paragraph 1.6.I.

1.7 RESUBMITTAL PROCEDURES

A. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

B. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required review of an item with no more than two submittals. Engineer will record Engineer's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring review, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

C. If Contractor requests a change of a previously reviewed submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

PART 2 PRODUCTS

2.1 CONSTRUCTION PROGRESS SCHEDULES

A. Within 10 days after the Effective Date of the Contract, prepare and submit to the Engineer a practicable schedule showing the order in which the Contractor proposes to carry out the Work, the dates on which the important features of the work will start, and the contemplated dates for completing same. A time-scaled bar chart schedule shall include the following:

- Construction activities
- Submittal and review of critical material samples and shop drawings
- Procurement and delivery of critical materials
- Duration of work, including completion times of all stages and their sub-phases

B. Attention is drawn to typical local climatic weather patterns and Work shall be coordinated accordingly.

C. Complete Project schedule shall be revised and resubmitted to the Engineer at a minimum occurrence of every 4 weeks for review.

D. Three Week Lookahead Schedules: Provide each week at the weekly construction meeting. The previous week's completed work shall be shown on the schedule for a total of 4 weeks shown.

2.2 BREAKDOWN OF CONTRACT PRICE

A. Within 10 days after the Effective Date of the Contract, submit a complete breakdown of all lump sum bid items showing the value assigned to each part of the work, including an allowance for profit and overhead adding up to the total lump sum contract price.

B. Breakdown of lump sum bids shall be coordinated with the items in the schedule and shall be in sufficient detail to serve as the basis for progress payments during construction.

C. Engineer will review the contract price breakdown and may request items to be further broken down or for more items be added in order to facilitate tracking of work progress for payment.

D. Preparatory work, bonds, and insurance required in setting up the job will be allowed as a separate entry on the cost breakdown but shall not exceed 5 percent of the total base bid.

E. Upon acceptance of the breakdown of the contract price by the Engineer, it shall be used as the basis for all requests for payment.

2.3 PRODUCT DATA

A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents. Submitted data shall be sufficient in detail for determination of compliance with the Contract Documents.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement Manufacturers' standard data to provide information specific to this Project.

1. Note submittal will be returned to Contractor without review of submittal if products, models, options, and other data are not clearly marked or identified.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.4 SHOP DRAWINGS

A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer licensed in the state of Project, responsible for designing components shown on Shop Drawings.

1. Include signed and sealed calculations to support design.

2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.

3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. All dimensioned shop drawings shall be scalable and provided as full-sized (22-inch x 34-inch) sheets. PDF electronic files shall print as scalable full-sized sheets.

E. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.5 SAMPLES

A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

B. Samples for Selection as Specified in Product Sections:

1. Submit to Engineer for aesthetic, color, and finish selection.
2. Submit Samples of finishes, textures, and patterns for Owner selection.

C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.

D. Include identification on each Sample, with full Project information.

E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.

F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.

G. Samples will not be used for testing purposes unless specifically stated in Specification Section.

H. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.6 DESIGN DATA

A. Informational Submittal: Submit data for Engineer's knowledge as Contract administrator or for Owner.

B. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

2.7 TEST REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.

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

2.8 CERTIFICATES

A. Informational Submittal: Submit certification by Manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

2.9 MANUFACTURER'S INSTRUCTIONS

A. Informational Submittal: Submit Manufacturer's installation instructions for Engineer's knowledge as Contract administrator or for Owner.

B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Engineer in quantities specified for Product Data.

C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

2.10 MANUFACTURER'S FIELD REPORTS

A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.

B. Submit report within 48 hours of observation to Engineer for information.

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

2.11 ERECTION DRAWINGS

A. Informational Submittal: Submit Drawings for Engineer's knowledge and records as Contract administrator or for Owner.

B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

1.1 PROJECT HEALTH AND SAFETY PROGRAM

D. Develop, publish, and implement an overall Project Health and Safety Program for the Project. This Program shall conform to all applicable codes. The written Safety Program shall be provided within 30 days after the receipt of the written Notice to Proceed. The Plan shall be assembled to address project specific health and safety issues to both the public and on-site personnel. The plan shall include at a minimum the following items when they apply:

1. Employee orientation

2. Safety inspections
3. Instruction and training
4. Accident reporting
5. Signs and barricades
6. Fire prevention and protection
7. Welding, cutting, and burning
8. Painting and surface treatment
9. Electricity
10. Machinery and mechanized equipment
11. Excavations
12. Sanitation
13. Job hazard analysis
14. First aid/medical facilities
15. Personal protective equipment
16. Confined space entry plan
17. Shoring plan
18. Fall protection plan
19. Emergency Action Plan
20. Housekeeping
21. Safety training requirements and certification

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

2.12 CONSTRUCTION PHOTOGRAPHS

1. Not used.

2.13 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

A. Submit preliminary O&M materials for review by Engineer. The Equipment Manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your equipment has this accessory..." or listings of equipment not furnished are eliminated. O&M materials will be returned to the Contractor for resubmittal if the O&M materials do not clearly indicate what specific equipment was furnished and all items not provided being clearly crossed out. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:

1. Reviewed shop drawings and submittal data;
2. Model, type, size, and serial numbers of equipment furnished;
3. Equipment and driver nameplate data;
4. List of parts showing replacement numbers;

5. Recommended list of spare parts;
6. Complete operating instructions including start-up, shutdown, adjustments, cleaning, etc.;
7. Maintenance and repair requirements including frequency and detailed instructions; and
8. Name, address and phone numbers of local representative and authorized repair service.

B. Following review of the preliminary O&M materials by the Engineer and before acceptance of the Work, submit four copies of complete final operation and maintenance instructions for all equipment supplied. Submit items in 8-1/2 x 11-inch heavy-duty three-ring binders when appropriate, or in 8-1/2 x 11-inch file folders. All binders and folders shall have clear plastic pockets on the front of the cover and the spine to allow for insertion of identifying information.

2.14 OTHER REQUIRED SUBMITTALS

A. Other required submittals include the items listed below. This list is provided for Contractor's convenience only and may not be complete in all respects. Contractor shall provide all submittals specified or required, whether or not listed here.

1. Contractor Emergency Contact List.
2. Erosion and Sediment Control Plan.
3. Traffic Control and Protection Plan.

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 DESCRIPTION

A. This section includes procedural requirements for providing, compiling, and submitting operation and maintenance data required for this Project.

1.2 SUMMARY

A. This section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. General contents of data.
2. Specific data for each equipment and system.
3. Manual for materials and finishes.
4. Assembly.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. O&M Manual Content: Operations and maintenance manual submittal requirements are specified in individual Specification Sections for the Products for which they must be supplied. Submit reviewed manual content formatted and organized by this Section and as defined in Section 01 33 00.

1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Manual Submittal: Submit an electronic copy of each manual in final form prior to requesting inspection for Substantial Completion and as defined in Section 01 33 00. Engineer will return an electronic copy with comments.

1. The Contractor to correct or revise each manual to comply with Engineer’s comments.

C. Submit one electronic and 3 hard copies of each corrected manual as a final manual within 15 days of receipt of Engineer's comments and prior to commencing startup, commissioning, and/or training.

D. After acceptance, deliver one electronic copy to the Engineer.

1.5 FORMAT (HARDCOPY)

A. Prepare data in the form of an O&M instructional manual.

B. Binders: Commercial quality, 8-1/2 x 11-inch three-hole post type binders with hardback, 3-inch maximum binder size. When multiple binders are used, correlate data into related consistent groupings. Three ring binders are not acceptable.

C. Arrange contents by Specification Section numbers and sequence of Table of Contents of this Project Manual.

D. Provide tabbed fly leaf for each separate product and system, with printed description of product and major component parts of equipment. Insert type tab labels must be secured or bonded to prevent the labels from falling out.

E. Text: Manufacturer's printed data, or typewritten data on 20-pound paper.

F. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages and insert into clear plastic envelopes that can be secured into the three-hole post binders.

1.6 FORMAT (ELECTRONIC DOCUMENTATION)

A. The Contractor must provide Operation and Maintenance Manual information specific to the configuration of the Project in electronic form that is substantively the same as that hard copy materials. Documents should be formatted like a web site complete with index page and Table of Contents. The electronic format must be such that the Owner is able to load the files onto a server to provide online access via any standard web browser. The Contractor shall make use of HTML (for text-based documents) and PDF (for CAD type drawings) file formats. The complete document shall be provided on a flash drive.

B. The electronic O&M data must be organized in a logical manner to aid operation in troubleshooting and information retrieval.

1.7 QUALITY ASSURANCE

A. Preparation of data shall be performed by personnel:

1. Trained and experienced in O&M of described equipment.

2. Familiar with requirements of this section.

3. Skilled as technical writers to the extent required to communicate the essential data to the Reader.

4. Skilled as drafters competent to prepare any required drawings.

1.8 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION" are part of this Specification.

1. 01 78 23A, Contractor Submittal Form

2. 01 78 23B, Equipment Data Form

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL CONTENTS OF DATA

A. Each individual manual shall contain equipment data pertaining to not more than one Specification section number as indicated in the Contract Documents.

1. Completed Contractor Submittal Form (01 78 23A). An electronic copy of the form can be provided to the Contractor upon request

B. Title Sheet: First page in data listing following:

1. Title: “OPERATION AND MAINTENANCE INSTRUCTIONS”.

2. Title of Project: As shown on Contract Documents.

3. Name(s) of applicable building(s) or structure(s) in which equipment is located.

4. Name of equipment as described in Contract Documents.

5. Contractor’s name, address, and telephone number.

6. Subcontractor’s name, address, and telephone number if equipment is provided by Subcontractor.

7. Contractor’s or Subcontractor’s purchase order number, Manufacturer’s shop order number or other such numbers required for parts and service ordering.

8. Manufacturer’s name, address, and telephone number.

9. Name, address, and telephone number for local source of supply for parts and service.

C. Equipment List: Immediately following title sheet containing the following:

1. Table of Contents: Immediately following equipment list. Arrange in logical, systematic order and shall include as minimum each tabbed divider. Each page shall be numbered.

2. Tabbed Dividers: Insert tabbed section dividers between each major section

a. Provide title of section on each tab.
b. Provide table of contents for each tabbed section, arranged in systematic order.

3. Equipment Data Sheets: Provide catalog sheets showing configuration, Manufacturer’s specifications, models, options, and styles of equipment and major components being provided. Product data sheets will show project specific information with inapplicable information deleted by crossing out or removal. Include in tabbed section(s).

4. Text:

    a. Include only those sheets applicable to Project.

    b. Each sheet shall:

        1) Identify specific equipment or part installed.
        2) Identify text applicable to equipment or part installed.
        3) Do not include inapplicable information or neatly strike it out.

5. Drawings:

    a. Supplement text with drawings to clearly illustrate following:

        1) Equipment and components.
        2) Relations of component parts of equipment and systems.
        3) Control and flow diagrams.

    b. Actual drawings of equipment from Manufacturer. "Typical" drawings are not acceptable unless they accurately illustrate actual installation for this contract.

6. Specially written information, as required to supplement text for particular installation.

    a. Provide explanation of interrelationships of equipment and components, and effects one component has on another or entire system.

    b. Provide overall instructions and procedures for equipment tying in instructions and procedures for separate components into unified instructional package.

    c. Provide glossary of any special terms used by the Manufacturer if applicable.

    d. Organize in consistent format under separate headings for different O&M procedures.

    e. Provide logical sequence of instructions in order of O&M action required for each procedure.

3.2 SPECIFIC DATA FOR EACH ITEM AND/OR SYSTEM

A. For each item of equipment and system include:

1. Completed Equipment Data Form (01 78 23B). An electronic copy of the form can be provided to the Contractor upon request.

2. Description of equipment and component parts:

    a. Function

    b. Normal operating characteristics

    c. Limiting conditions.

    d. Performance curves

e. Engineering data

f. Test as applicable.

g. Complete nomenclature and model number of replaceable parts including keyed labeled exploded diagram.

h. Complete nameplate data.

i. Owner's tag (or asset) numbers for equipment as indicated on the Contract Drawings.

3. Operating Procedures:

a. Startup and break-in.
b. Normal operating instructions.
c. Regulation and control
d. Stopping and shutdown,
e. Emergency instructions.
f. Summer and winter operating instructions, as applicable.
g. Special operating instructions.

4. Maintenance Procedures:

a. Routine maintenance operations.
b. Guide to troubleshooting.
c. Disassembly, repair, and reassembly instructions.
d. Alignment, adjusting, and checking instructions.

5. Servicing and Lubrication Schedule:

a. List of lubricants required and quantity to be applied.
b. Schedule of lubrication.
c. Schedule for other routine maintenance.

6. Manufacturer's printed instructions regarding safety precautions for both (a) protection of personnel operating equipment and systems and (b) prevention of damage to equipment and systems.

7. Description of sequence of operation of controls.

8. Assembly drawings and diagrams required for maintenance.

9. Manufacturer's parts list and illustrations

a. Predicted life of parts subject to wear.

b. Items recommended to be stocked by the Owner as spare parts and quantities of same.

10. Accepted control diagrams such as ladder diagrams, instrumentation loop diagrams, and electrical schematics.

11. Bill of material.

12. Other data as required under applicable Specification sections.

B. Each electric and electronic system, as applicable to equipment such as switchgear, motor control centers, panel boards, switchboards, starters, breakers, and relays shall include:

1. Description of System and Component Parts:

    a. Function
    b. Normal operating characteristics
    c. Limiting conditions.
    d. Performance curves
    e. Engineering data
    f. Rating tables
    g. Tests, as applicable.
    h. Complete nomenclature and model number of replaceable parts.
    i. Complete nameplate data.
    j. Owner's Tag (asset) numbers for equipment as indicated on the Contract Drawings.

2. Circuit Directories of Panel Boards:

    a. Electrical service.
    b. Controls.
    c. Communications.

3. Complete instrumentation

    a. Loop diagrams
    b. Tabulated listing of components in each control circuit or loop.

4. Operating Procedures:

    a. Routine and normal operating instructions.
    b. Sequences required.
    c. Special operating instructions.

5. Maintenance Procedures:

    a. Routine maintenance operations.
    b. Guide to troubleshooting.
    c. Disassembly, repair, and reassembly instructions.
    d. Adjustment and checking instructions.

6. Manufacturer's printed instructions regarding safety precautions for both:

    a. Protection of personnel operating equipment and systems.
    b. Prevention of damage to equipment and systems.

7. List of original all of the Manufacturer's components, spare parts with diagram, and recommended quantities to be maintained in storage by the Owner.

8. Other data as required under pertinent sections of Specifications.

C. Prepare and include additional data when need for such data becomes apparent during instruction of Owner's personnel. Differences between the equipment O&M manual and the Manufacturer's training session shall result in the training and/or O&M Manual being corrected.

3.3 MANUAL FOR MATERIAL AND FINISHES

A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Include Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

C. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional Requirements: As specified in individual product specification sections.

E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.4 ASSEMBLY

A. Assemble in 3 sets.

B. Remove bindings of individual manuals.

C. Insert index tabs labeled with the respective piece of equipment to separate individual manuals.

D. Provide a Table of Contents at the front of each volume showing the equipment items in the order in which they appear in the volume. Each equipment items shall include the functional name, applicable specifications section, and the plan listing, if any.

E. The preventive maintenance schedule shall be bound in the front of each section immediately following the index tab sheet. The schedule shall be identified with respect to the piece of equipment it is referring to.

F. Sheet Size: 8-1/2 x 11 sheets.

G. Drawings may be on 11 x 17-inch sheets folded to 8-1/2 x 11 inches.

H. Engrave on covers and end of binder, title OPERATIONS AND MAINTENANCE INSTRUCTIONS, name of Project, Owner's project number, date of Contract, and volume number with subject matter of contents, and Engineer's name.

END OF SECTION

01 78 23A	CONTRACTOR SUBMITTAL FORM		
TO: (Engineer) (Address) (City, State, Zip) (Attn:)		DATE:	
		SPECIFICATION SECTION TITLE:	
		SECTION NO.:	
		MANUFACTURER/ VENDOR:	
FROM: (Contractor) (Address) (City, State, Zip)		NO. OF COPIES SUBMITTED TO ENGINEEER:	
		SIGNATURE OF CONTRACTOR:	

GENTLEMEN:
We have checked the O&M manual submittal dated _____, 20__, and have found it to be in accordance with the requirements of Specification Section 01 78 23 as noted below.

FORMAT
Size: 8-1/2 x 11 or 11 x 17
Paper: 20-lb minimum
Text: Printed data/neatly typed
Drawings: Standard size bound in text; in text-size labeled envelopes
Tabbed Section Dividers
Cover Label: Title
Project name
Building/structure ID
Equipment name
Specification section
Binders: 3-ring

CONTRACTOR SUBMITTAL FORM			Page 2 of 5
Provided	Not Applicable	Page No.	
3.01 GENERAL CONTENTS			
			A. Section number - one specification only
			B. Title Page
			1. Title
			2. Project title
			3. Building/structure ID
			4. Equipment name
			5. Contractor ID
			6. Subcontractor ID
			7. Purchase order data
			8. Manufacturer ID
			9. Service/parts supplier ID
			C. Product List
			D. Table of Contents
			E. Tabbed Sections
			F. Pertinent data sheets
			1. Annotated as needed
			G. Text
			1. Pertinent to project
			2. Annotated
			H. Drawings
			1. Supplement text
			a. Illustrate product and components
			b. Relations of equipment systems
			c. Control and flow diagrams
			2. Actual drawing of project equipment

CONTRACTOR SUBMITTAL FORM			Page 3 of 5
Provided	Not Applicable	Page No.	
3.01 GENERAL CONTENTS			
			I. Special Information
			1. Interrelationships of equipment and components
			2. Instructions and procedures provided
			3. Instructions organized in consistent format
			4. Instructions in logical sequence
			5. Glossary
			J. Warranty, Bond, Service Contract
3.02 SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			A. For each item of equipment
			1. Complete Form 2 to Section 01 78 23
			2. Description of Unit and Components
			a. Equipment functions
			b. Normal operating characteristics
			c. Limiting conditions
			d. Performance curves
			e. Engineering data
			f. Test data
			g. Replaceable parts list (with numbers)
			h. Nameplate data
			i. P&ID numbers
			3. Operating Procedures
			a. Startup, break-in
			b. Routine/normal operation
			c. Regulation and control
			d. Stopping and shutdown
			e. Emergency

CONTRACTOR SUBMITTAL FORM			Page 4 of 5
Provided	Not Applicable	Page No.	
3.02 SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			3. Operating Procedures (continued)
			f. Seasonal operation
			g. Special instructions
			4. Maintenance Procedures
			a. Routine/normal instructions
			b. Troubleshooting guide
			c. Disassembly/repair/assembly
			d. Alignment, adjusting and checking instructions
			5. Servicing and Lubrication
			a. List of lubricants
			b. Lubrication schedule
			c. Maintenance schedule
			6. Safety Precautions/Features
			7. Sequence of Operation of Controls
			8. Assembly Drawings
			9. Parts List and Illustrations
			a. Predicted life
			b. Spare parts list
			10. Control Diagrams/Schematics
			11. Bill of Materials
			12. Other Data as Required

CONTRACTOR SUBMITTAL FORM			Page 5 of 5
Provided	Not Applicable	Page No.	
3.02 SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			B. Each electrical and electronic system
			1. Description
			a. Equipment functions
			b. Normal operating characteristics
			c. Performance curves
			d. Engineering data
			e. Test data
			f. Replaceable parts list (with numbers)
			g. Nameplate data
			h. P&ID numbers
			2.Circuit and Panel Board Directories
			a. Electrical
			b. Controls
			c. Communications
			3. Instrumentation
			a. Loop Diagrams
			b. Components list each circuit/loop
			4. Operation Procedures
			a. Routine/normal operating instructions
			b. Sequences required
			c. Special operating instruction
			5. Maintenance Procedures
			a. Routine/normal instructions
			b. Troubleshooting guide
			c. Disassembly/reassembly
			d. Adjusting and checking
			6. Safety Precautions/Features
			7. Spare Parts List
			8. Additional Data

01 78 23B	EQUIPMENT DATA FORM			
PROJECT NAME				
CONTRACT NO.				
CONTRACTOR				
EQUIPMENT NO.			ASSET NO.*	
DESCRIPTION			MAINT. NO.*	
LOCATION				
MANUFACTURER				
PURCHASED FROM				
VENDOR ORDER NO.			PURCHASE $	
DATE OF PURCHASE				
LOCAL SUPPLIER				
ADDRESS				
PHONE NO.				
MODEL NO.				
NO. OF UNITS		SERIAL NOS.		
*By Owner				

EQUIPMENT DATA FORM			Page 2 of 4
NAMEPLATE DATA			
ELECTRIC MOTOR		PUMP/HVAC UNIT	
MANUFACTURER		MANUFACTURER	
TYPE	[ ] AC [ ] DC	TYPE	
HORSEPOWER		SIZE	
RPM		CAPACITY	
VOLTAGE		PRESSURE	
AMPERAGE		ROTATION	
PHASE		IMPELLER SIZE	
FRAME		IMPELLER MATERIAL	
DRIVE/REDUCER		OTHER (I&C)	
MANUFACTURER		MANUFACTURER	
TYPE	[ ] GEAR [ ] V-BELT [ ] CHAIN [ ] VARIDRIVE	TYPE	
		SIZE	
SERVICE FACTOR		CAPACITY	
RATIO		RANGE	

EQUIPMENT DATA FORM			Page 3 of 4
MAINTENANCE SUMMARY			
EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	
MAINTENANCE OPERATION:		FREQUENCY:	
List briefly each Maintenance Operation required and refer to specific information in Manufacturer's Manual, if applicable. Refer by symbol to "Lubricant List" for Lubrication Operation.		List required frequency of each maintenance operation.	
*By Owner			

EQUIPMENT DATA FORM			Page 4 of 4	
LUBRICANT/RECOMMENDED SPARE PARTS LIST				
EQUIPMENT NO.		ASSET NO.*		
DESCRIPTION		MAINT. NO.*		
LUBRICANT LIST				
REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED LUBRICANT AND MANUFACTURER		
List symbols in "Maintenance Operation" (Page 3).	List general lubricant type.	List specific lubricant name, viscosity, and Manufacturer.		
RECOMMENDED SPARE PARTS LIST				
PART NO. **	DESCRIPTION	UNIT	QUANTITY	UNIT COST
ADDITIONAL DATA AND REMARKS				

* By Owner
** Identify parts provided by this contract with two asterisks.
Note: Attach additional sheets if necessary; identify each sheet at top with equipment number and description.

SECTION 02 41 00 - DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

Demolition of the existing pump stations is not included in this contract and are to remain functional throughout construction. Some demolition of site systems and appurtenances may be required and are shown on the drawings but shall not interfere with normal operations of the water system.

A. Section Includes:

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

B. Related Sections:

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

1.2 SUBMITTALS

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

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

1.3 QUALITY ASSURANCE

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

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

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

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

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

E. If the existing material to be demolished and removed contains any hazardous materials which will require special handling upon removal, such as asbestos or lead, it is the responsibility of

the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring, or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or Specifications.

B. Crushed Rock: As specified in Section 31 05 16-2.1, Aggregates for Earthwork. Of the size shown in the Drawings or specified herein.

C. Sand: As specified in Section 31 05 16-2.2, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

A. The Owner assumes no responsibility for the actual condition of the facilities to be demolished. The Contractor shall visit the site, inspect all facilities and be familiar with all existing conditions and utilities.

B. Demolition drawings identify major equipment and structures to be demolished only. Auxiliary utilities such as water, air, chemicals, drainage, lubrication oil, hydraulic power fluid, electrical wiring, controls, and instrumentation are not necessarily shown shall be considered incidental to all demolition work.

C. Identify waste and salvage areas for placing removed materials.

3.2 PREPARATION

A. Carefully coordinate the work of this Section with all other work and construction.

B. Coordinate utility locates with NTUA not less than three working days before performing Work.

C. Request underground utilities to be located and marked within and surrounding construction areas.

D. Disconnect or arrange for disconnection of utilities (if any) affected by required work.

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

3.3 PROTECTION

A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.

B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.

C. Preservation and Trimming of Trees, Shrubs and Other Vegetation: As specified in Section 31 10 00-3.4.C, Site Clearing.

D. Landscaped Areas: Protect existing landscaped areas as specified in Section 31 10 00-3.4.D, Site Clearing.

E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, guy wires, utility poles, and curbs.

F. Repair and Replacement:

1. Damaged items, including but not restricted to those noted above, shall be repaired, or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of Work of this contract.

2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.4 DEMOLITIONS

A. Areas which are to be excavated for the purpose of demolition shall be cleared and stripped in accordance with Section 31 10 00-3.6, Site Clearing.

B. Carefully consider all bearing loads and capacities for placement of equipment and material on site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, consult with Engineer prior to the placement of such equipment or material.

C. Demolition of Existing Structures:

1. Excavate around existing structures as required to perform demolition operations and to plug associated existing pipelines where shown in the Drawing.

2. Provide shoring, bracing, and supports, as required, to ensure adjacent structures are not damaged and structural elements of existing structure are not overloaded during demolition activities.

a. Increase structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract.

b. Remove all temporary protection when the Work is complete or when so authorized by the Engineer.

3. Any floors that are to remain in place shall be completely cracked through to allow for drainage. Cracking shall be accomplished by dropping a demolition ball or by other methods approved by the Engineer.

4. Remove and dispose of all exposed and/or protruding metalwork, piping, plumbing, and conduits resulting from demolition activities, and all woodwork, roofing, and electrical and mechanical equipment removed from demolished structures.

    a. Reinforcing bars shall be cut flush with final wall elevations as shown in the Drawings.

    b. No detached metalwork, excluding concrete reinforcing bars, shall be buried with the concrete and masonry rubble.

D. Backfill at Demolished Structures:

1. For structures designated to be abandoned and/or demolished in place, concrete and/or masonry rubble and excavated soils resulting from demolition activities shall be used for backfill or placed in the bottoms of said structures only as directed by the Engineer.

2. Concrete and masonry rubble used for backfilling shall be broken into pieces no larger than 12 inches on any one side.

3. Materials resulting from abandonment/demolition activities approved for backfill shall be combined with imported filler sand to create a dense, compacted backfill.

4. Backfilling or placement of the excavated material in the structures shall meet the following requirements.

    a. Furnish, place and compact filler sand along with the concrete and masonry rubble so that all voids are filled and a dense, compacted backfill is obtained.

    b. Filler sand shall be placed in horizontal layers completely filling all voids between pieces of rubble and not exceeding 12 inches in thickness.

    c. Each layer of filler sand shall be compacted to obtain at least 90 percent of maximum density as determined by ASTM Method D-698-78 (AASHTO T-99).

    d. Water shall be furnished by the Contractor and added to each layer as required to maintain optimum moisture content.

    e. The amount of filler sand used shall only be the amount needed to fill all voids created by placement of the concrete and asphalt rubble, as directed by the Engineer.

    f. At locations where concrete and masonry rubble are used for backfill, they shall be placed such that a minimum of 3 feet of compacted non-rubble backfill material (crushed rock) exists between any rubble and finished grade. Protruding reinforcing bars shall be cut to lengths that allow granular backfill to be placed and compacted to required levels in and above the rubble.

5. Disposal of all materials not used for backfill shall be performed off-site and in compliance with applicable local, state, and federal codes and requirements.

6. In areas where new construction will take place, no trace of these structures shall remain prior to placing of backfill.

E. Backfilling within the footprint of new structures with rubble material resulting from demolition activities will not be allowed.

F. All existing improvements designated in the Drawings or specified to be removed, including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the demolition work.

G. Unless otherwise specified, any resulting voids shall be backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.

3.5 EXISTING WATER UTILITY PIPING ABANDONMENT

A. As specified in Section 33 05 50, Existing Pipe Abandonment.

3.6 ELECTRICAL AND CONTROL SYSTEM DEMOLITION

A. All electrical and control system demolition work shall at all times be conducted in a safe and proper manner to avoid injury from electrical shock to all personnel.

1. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable.

2. At no time shall live electrical wiring or connections or those which can become energized be accessible to any persons without suitable protection or warning signs.

3.7 EXISTING FENCING

A. Existing fencing shall be removed as shown on the plans.

B. Coordinate new fencing connections to existing as required.

3.8 ASPHALTIC CONCRETE DEMOLITION

A. Asphalt pavement shall be removed to the limits shown in the Drawings.

B. The limits of the removal shall be saw cut.

C. Asphalt pavement may not be used as rubble fill.

3.9 REMOVAL

A. Remove debris, rock, excavated materials, rubble, abandoned piping, and extracted plant life resulting from abandonment and/or demolition activities from site.

B. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.

C. Removal: All material resulting from demolition, clearing, and grubbing, and trimming operations shall be removed from the Project Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.

3.10 GRADING

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

3.11 CLEANUP

A. During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, debris, and dust and shall leave all areas affected by the work in a clean, condition, as may be subject to Engineer approval.

B. Adjacent structures shall be cleaned of dust, dirt, and debris resulting from demolition.

C. Adjacent areas shall be returned to their existing condition prior to the start of work.

3.12 SCHEDULE

A. Not used.

END OF SECTION

SECTION 03 41 20 - PRECAST CONCRETE ALTITUDE VAULT

PART 1 GENERAL

1.1 DESCRIPTION

Contractor shall furnish a precast concrete transportable vault to be delivered and placed and buried on a contractor-prepared crushed stone foundation in accordance with manufacturer's recommendations. The vault shall be provided by the manufacturer with all necessary openings as specified on the drawings in conformance with manufacturer's structural requirements. Vault interior dimensions shall be as shown in the drawings.

1.2 SUBMITTAL PROCEEDURES

A. As required by Section 01 33 00.

1.3 REFERENCES (LATEST EDITIONS WHERE NOT INDICATED)

A. American Association of State Highway and Transportation Officials (AASHTO).

1. LRFD Bridge Design Specifications.

B. American Concrete Institute:

1. ACI 301 Specifications for Structural Concrete.
2. ACI 318-19 Building Code Requirements for Structural Concrete.

C. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. A185/A185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM C857 – Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
6. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
7. ASTM C33 - Standard Specification for Concrete Aggregates.
8. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
9. ASTM C150 - Standard Specification for Portland Cement.

10. ASTM C890 – Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.

11. ASTM C1577 - Standard Specification for Precast Concrete Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD.

D. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

E. Precast/Prestressed Concrete Institute:

1. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.

2. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.

3. PCI MNL-122 - Architectural Precast Concrete.

4. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete.

F. Other:

1. ASCE/SEI 7-16 with Supplement 1
2. IBC 2021

1.4 DESIGN REQUIREMENTS

A. Design units to withstand design loads as calculated per the AASHTO, ASCE and IBC codes, including erection forces. Calculate structural properties of units in accordance with ACI 318. The following shall be per the General Structural Notes (G.S.N.) in the plan set:

1. Risk Category
2. Live Load
3. Snow Load
4. Floor Live Load
5. Soil Lateral and Bearing Design Values
6. Adjacent Traffic Load
7. Buoyancy

B. Design requirements: Structural analysis, design, and detailing:

1. Analyze and design structures including the effects of 2-way action (“plate action”) and of load transfer around current and future openings.

2. Where structures include sections designed for future removal (“knockout sections”), design structures for loads and stresses with any combination of any or all such sections in place or removed.

3. Design structures in accordance with the requirements of ACI 318 and this Section.

4. Provide reinforcement at all areas subject to tensile stress when loaded with the specified loads and combinations thereof.

5. Provide temperature and shrinkage reinforcement to equal or exceed ACI 318 requirements in all concrete sections.

6. Provide minimum clear concrete cover over reinforcement at both interior and exterior faces of all members in accordance with the following:

    a. Diversion structures: 2 inches.

7. Reinforcement details:

    a. Walls: For structures with wall thickness of 8 inches or less, locate a single mat of reinforcement at the center of the wall.

    b. Slabs: For structures with slab thickness of 7 inches or less, locate a single mat of reinforcement at the center of the slab.

    c. Structures with wall or slab thicknesses exceeding these limits shall have reinforcement at each face of the member.

8. Joints:

    a. Seal joints watertight per the General Structural Notes (GSN) in the plan set.

    b. Joints shall be interlocking to secure proper alignment between sections and prevent migration of soil through the joint.

C. Design requirements: Materials:

1. Portland cement concrete diversion structures:

    a. In accordance with ASTM C858, except as modified in this Section.

    b. Proportion concrete mixes to resist damage from freezing and thawing in a moist environment, and for exposure to deicing chemicals. In accordance with ACI 318 requirements for minimum specified compressive strength and air entrainment.

D. Diversion structure shall be solid walled construction.

1. Where penetrations of the pre-cast concrete diversion structure are required, such penetrations shall be accommodated through pre-cast openings or core-drilled sections.

2. Openings for penetrations shall be smooth and free of surface irregularities and without exposed steel reinforcing.

3. Diversion structures need not be designed to resist thrust from piping passing through the diversion structure.

4. Coordinate pipe penetration locations with piping arrangement as indicated on the Drawings.

5. Minimum wall, floor, and lid thickness shall be 8-inches.

1.5 SUBMITTALS

A. Shop Drawings:

1. Submit for approval complete drawings sealed by a professional engineer in the State of Arizona. Indicate layout, unit locations, configuration, connection details, support items, location of lifting devices, dimensions, openings, and other appurtenances.

B. Design Data:

1. Submit for approval engineering calculations sealed by a professional engineer in the State of Arizona.

1.6 CLOSEOUT SUBMITTALS

A. As required by Section 01 33 00.

1.7 QUALITY ASSURANCE

A. The precast concrete building producer shall be a plant-certified member of either the National Precast Concrete Association (NPCA), The Precast/Prestressed Concrete Institute (PCI), or equal.

B. The precast concrete building producer shall be a plant-certified member of either the National Precast Concrete Association (NPCA), The Precast/Prestressed Concrete Institute (PCI), or equal.

C. Perform Work in accordance with governing agency requirements.

D. Structural design shall be under the direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State of Arizona.

E. Welder: Qualified within the previous 12 months in accordance with AWS D1.1 and AWS D1.4.

1.8 PRE-INSTALLATION MEETINGS

A. Convene a minimum of two weeks prior to commencing installation of work in this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handle precast units to position, consistent with their shape and design. Lift and support only from support points.

B. Blocking and Lateral Support During Transport and Storage: Clean, non-staining, without causing harm to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

C. Protect units to prevent staining, chipping, or spalling of concrete.

D. Mark units with date of production in location not visible to view when in final position in structure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Four Corners Pre-Cast, Inc., 1790 Bisti Hwy, Farmington, NM 87401 or approved equal.

2.2 MATERIALS

A. Cement: ASTM C150, Type 1 - Normal Portland.

B. Concrete Materials: ASTM C33; water and sand.

C. Reinforcement: ASTM A615, Grade 60 deformed steel size and spacing commensurate with precast unit design.

D. Sealant: Per the General Structural Notes (G.S.N.) in the plan set.

2.3 ACCESORIES

A. Aluminum hatch with safety fall protection grate. Manufacturer Halliday Model No. S2S 4848 or approved equal. Install per the manufacturer's recommendations.

B. Aluminum ladder. Manufacturer Halliday Model No. L1B or approved equal. Install per the manufacturer's recommendations.

C. Aluminum ladder extension. Manufacturer Halliday Model No. L1E or approved equal. Install per the manufacturer's recommendations.

2.4 MIX

A. Concrete: Minimum 4,000 psi, 28-day strength, in accordance with ACI 318.

2.5 FABRICATION

A. Fabricate in conformance with PCI MNL-117 and ACI 318.

B. Maintain plant records and quality control program during production of precast units. Make records available upon request.

C. Maintain consistent quality during manufacture.

D. Fabricate connecting devices, plates, angles, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

E. Weld steel fabrications in accordance with AWS D1.1. Weld reinforcing steel in accordance with AWS D1.4. Do not tack weld reinforcing.

F. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items for door frames.

G. Locate hoisting devices to permit removal after erection.

H. Cure units to develop concrete quality, and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.

I. Minor patching in plant is acceptable if approved by the engineer, and providing structural adequacy and appearance of units is not impaired.

1. Section Connections: All sections shall be securely fastened together with 3/8” thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A36 and hot dipped galvanized after fabrication. All fasteners to be ½” diameter bolts complying with ASTM A325 for carbon steel bolts. Cast-in anchors used for section connections to be Dayton-Superior F-63 coil inserts, or equal. All inserts for corner connections must be secured directly to form before casting sections. No floating-in of connection inserts shall be allowed.

2. Where penetrations of the pre-cast concrete diversion structure are required, such penetrations shall be accommodated through pre-cast openings or core-drilled sections.

3. Diversion structures need not be designed to resist thrust from piping passing through the diversion structure.

4. Coordinate pipe penetration locations with piping arrangement as indicated on the Drawings.

2.6 FABRICATION TOLERANCES

A. Maximum Out of Square: 1/8 inch in 10 feet, non-cumulative.

B. Variation From Dimensions Indicated on Drawings: Plus or minus 1/8 inch.

C. Maximum Misalignment of Anchors, Inserts, Openings: 1/8 inch.

2.7 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 45 00 - Quality Control: Testing, inspection, and analysis requirements.

B. Test and analyze concrete in accordance with ACI 318.

C. The precast contractor to submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

PART 3 EXECUTION

3.1 PREPARATION

A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

3.2 ERECTION

A. Pre-cast concrete sections shall be transported and handled with care in accordance with the manufacturer's written recommendations.

1. Where lifting devices are provided in pre-cast sections, such lifting devices shall be used as intended.

2. Where no lifting devices are provided, the Contractor shall follow the manufacturer's recommendations for lifting procedures to provide proper support during lifting.

B. Buried pre-cast concrete structures shall be assembled and placed in excavations on properly compacted soil foundations as indicated. Pre-cast concrete diversion structures shall be set to grade and oriented to provide the required dimensions and clearances from pipes and other structures.

C. Erect units without damage to shape or finish. Replace or repair damaged sections.

D. Erect units level and plumb within allowable tolerances.

E. Align and maintain uniform horizontal and vertical joints as erection progresses.

F. When units require adjustment beyond design or tolerance criteria, discontinue affected work; advise Engineer.

G. Weld units in place. Perform welding in accordance with AWS D1.1.

H. Touch-up field welds scratched or damaged surfaces.

I. Weld reinforcing steel in accordance with AWS D1.4. Do not tack weld reinforcing.

J. Exposed Joint Dimension: 1/2 inch.

K. Where joints are designed in pre-cast concrete diversion structures, such joints shall be interlocking to secure proper alignment between members and prevent migration of soil through the joint. Structural sections at joints shall be sized sufficiently to reinforce the section against localized distress during transportation and handling and against excess contact bearing pressures through the joint.

3.3 ERECTION TOLERANCES

A. Maximum Variation from Plane of Location: ¼ inch in 10 feet, non-cumulative.

B. Maximum Offset from Indicated Alignment Between Two Connecting Units: 1/4 inch.

C. Joint Tolerance: Plus or minus 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1.

3.5 ADJUSTING

A. Adjust units so joint dimensions are within tolerances.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Use non-combustible shields during welding operations to protect adjacent Work.

END OF SECTION

SECTION 03 41 10 - PRECAST CONCRETE BOOSTER PUMP STATION (BPS) BUILDING

PART 1 GENERAL

1.1 DESCRIPTION

Contractor shall furnish a precast concrete transportable building to be delivered and placed on a contractor-prepared crushed stone foundation in accordance with manufacturer's recommendations. The building shall be provided by the manufacturer with all necessary openings as specified on the drawings in conformance with manufacturer's structural requirements. Building interior dimensions shall be as shown in the drawings.

1.2 SUBMITTAL PROCEEDURES

A. As required by Section 01 33 00.

1.3 REFERENCES (LATEST EDITIONS WHERE NOT INDICATED)

A. American Concrete Institute:

1. ACI 301 Specifications for Structural Concrete.
2. ACI 318-19 Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. A185/A185M-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
6. ASTM C33 - Standard Specification for Concrete Aggregates.
7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C150 - Standard Specification for Portland Cement.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Precast/Prestressed Concrete Institute:

1. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.

2. PCI MNL-120 - PCI Design Handbook - Precast and Prestressed Concrete.

3. PCI MNL-122 - Architectural Precast Concrete.

4. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete.

E. Other:

1. ASCE/SEI 7-16 with Supplement 1
2. IBC 2021

1.4 DESIGN REQUIREMENTS

A. Design units to withstand design gravity and lateral (wind and seismic) loads as calculated per the ASCE and IBC codes, including erection forces. Calculate structural properties of units in accordance with ACI 318. The following shall be per the General Structural Notes (G.S.N.) in the plan set:

1. Risk Category
2. Roof Live Load
3. Roof Snow Load
4. Floor Live Load
5. Wind Load
6. Seismic Design Criteria
7. Soil Bearing Design Values

B. Joints shall be watertight per the General Structural Notes (GSN) in the plans set and shall be interlocking to secure proper alignment between sections.

1.5 SUBMITTALS

A. Shop Drawings:

1. Submit for approval complete drawings sealed by a professional engineer in the State of Arizona. Indicate layout, unit locations, configuration, connection details, support items, location of lifting devices, dimensions, openings, and other appurtenances.

B. Design Data:

1. Submit for approval engineering calculations sealed by a professional engineer in the State of Arizona.

1.6 CLOSEOUT SUBMITTALS

A. As required by Section 01 33 00

1.7 QUALITY ASSURANCE

A. The precast concrete building producer shall be a plant-certified member of either the National Precast Concrete Association (NPCA), The Precast/Prestressed Concrete Institute (PCI), or equal.

B. The precast concrete building producer shall be a plant-certified member of either the National Precast Concrete Association (NPCA), The Precast/Prestressed Concrete Institute (PCI), or equal.

C. Perform Work in accordance with governing agency requirements.

D. Structural design shall be under the direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State of Arizona.

E. Welder: Qualified within the previous 12 months in accordance with AWS D1.1 and AWS D1.4.

1.8 PRE-INSTALLATION MEETINGS

A. Convene a minimum of two weeks prior to commencing installation of work in this section.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Handle precast units to position, consistent with their shape and design. Lift and support only from support points.

B. Blocking and Lateral Support During Transport and Storage: Clean, non-staining, without causing harm to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

C. Protect units to prevent staining, chipping, or spalling of concrete.

D. Mark units with date of production in location not visible to view when in final position in structure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Four Corners Pre-Cast, Inc., 1790 Bisti Hwy, Farmington, NM 87401 or approved equal.

2.2 MATERIALS

A. Cement: ASTM C150, Type 1 - Normal Portland.

B. Concrete Materials: ASTM C33; water and sand.

C. Reinforcement: ASTM A615, Grade 60 deformed steel size and spacing commensurate with precast unit design.

D. Sealant: Per the General Structural Notes (G.S.N.) in the plan set.

2.3 ACCESORIES

A. Steel door and frame cast into wall shall comply with Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI-100) and as herein specified. All door and frame galvanizing shall be in accordance with ASTM A924 and A653, A60 minimum coating thickness.

1. The buildings shall be equipped with double or single (as shown on the plans) 3'-0" x 6'-8" x 1-3/4" thick insulated, 18 gauge, metal doors with 16-gauge frames (to meet wall thickness). Doors to have flush top cap. 12 gauge flat astragals shall be applied to the active leaf to protect against the elements or forced opening. Doors and frames shall be factory bonderized and painted with one coat of rust inhibitive primer and one finish coat of enamel paint; color to be selected by the engineer.

2. Doors and frames shall meet SDI standard Level 2, 1¾" heavy duty. Manufacturers: Republic, Steelcraft, Ceco, Black Mountain, Pioneer, Curries, Mesker, MPI, Door components or approved equal.

B. Door hardware to include the following:

1. Pull Handle: Shall meet requirements of ANSI A156.2. Shall be thru bolt attached and constructed of a minimum ¾" diameter stainless pull handle sized 8" center to center with a stainless backer plate, minimum 0.053" on both sides. Manufacturers: Design Hardware, Don-Jo, or approved equal.

2. Hinges: Shall comply with ANSI A156.1 and be of the ball bearing, non-removable pin type (3 per door minimum). Hinges shall be 4 ½" x 4 ½" US26D (652) brushed chrome finish. The manufacturer shall provide a lifetime limited warranty. Manufacturers: Design Hardware or approved equal.

3. Deadbolt: Commercial Grade Deadbolt conforming to ANSI 156.5 furnished with a 2 ¼" face plate and a 1" projecting deadbolt with hardened steel pins. Dead bolts shall be UL and ADA approved. Finish shall be US26D (626) brushed chrome finish. The manufacturer shall provide a lifetime limited warranty. Manufacturers: Design Hardware, Dorma, or approved equal

4. Surface Bolt: 8" Surface bolt UL listed. Finish US26D (626) brushed chrome finish. (2 per inactive leaf).

5. Bumper Seal type threshold with a maximum 1" rise to prevent water intrusion. Thresholds shall be approved for UL 10B suitable for use with fire doors rated up to three hours. Manufacturer: National Guard Products or approved equal.

6. **T**hreshold: Bumper Seal type threshold with a maximum 1" rise to prevent water intrusion. Thresholds shall be approved for UL 10B suitable for use with fire doors rated up to three hours. Manufacturers: National Guard Products or approved equal.

7. Drip Cap: Aluminum drip cap with minimum projection of 2 ½" shall be furnished. Manufacturers: Design Hardware, National Guard Products, or approved equal.

8. Door Stop: ANSI 156.16 approved wall mounted door stop with keeper constructed of a corrosion resistant cast brass material. Finish US26D (626) brushed chrome finish. Manufacturers: Don-Jo, Rockwood, or approved equal.

C. Interior of building to be insulated and finished with FRP wall panels.

2.4 MIX

A. Concrete: Minimum 4,000 psi, 28-day strength, in accordance with ACI 318.

2.5 FABRICATION

A. Fabricate in conformance with PCI MNL-117 and ACI 318.

B. Maintain plant records and quality control program during production of precast units. Make records available upon request.

C. Maintain consistent quality during manufacture.

D. Fabricate connecting devices, plates, angles, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.

E. Weld steel fabrications in accordance with AWS D1.1. Weld reinforcing steel in accordance with AWS D1.4. Do not tack weld reinforcing.

F. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items for door frames.

G. Locate hoisting devices to permit removal after erection.

H. Cure units to develop concrete quality, and to minimize appearance blemishes including non-uniformity, staining, or surface cracking.

I. Minor patching in plant is acceptable if approved by the engineer, and providing structural adequacy and appearance of units is not impaired.

J. Roof: Single component monolithic section (except where shown on the plans) and shall slope ½" from front to back as shown on the plans. The roof shall extend a minimum of 2 ½" beyond the wall section on each side and have a turndown design which extends ½" below the top edge of the wall sections to prevent water migration into the building along top of wall sections.

K. Section Connections: All sections shall be securely fastened together with 3/8" thick steel brackets. Steel is to be of structural quality, hot-rolled carbon complying with ASTM A36 and hot dipped galvanized after fabrication. All fasteners to be ½" diameter bolts complying with ASTM A325 for carbon steel bolts. Cast-in anchors used for section connections to be Dayton-Superior F-63 coil inserts, or equal. All inserts for corner connections must be secured directly to form before casting sections. No floating-in of connection inserts shall be allowed.

2.6 FINISH – PRECAST UNITS

A. Integrally cast slump block or brick finish.

B. Prime and finish paint exterior concrete surfaces. Color as selected by the engineer.

2.7 FINISH – EXPOSED METAL

A. Clean surfaces of rust, scale, grease, and foreign matter.

B. Prime paint in one coat and finish paint in two coats metal doors and frames and all exposed metal surfaces, except surfaces in direct contact with concrete or requiring field welding. Color to be selected by the engineer.

C. Galvanizing for Structural Steel Members: ASTM A123/A123M; galvanize after fabrication.

D. Galvanizing for Fasteners, Connectors, and Anchors:

1. Hot-Dipped Galvanizing: ASTM A153/A153M.
2. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

2.8 FABRICATION TOLERANCES

A. Maximum Out of Square: 1/8 inch in 10 feet, non-cumulative.

B. Variation From Dimensions Indicated on Drawings: Plus or minus 1/8 inch.

C. Maximum Misalignment of Anchors, Inserts, Openings: 1/8 inch.

2.9 SOURCE QUALITY CONTROL AND TESTS

A. Section 01 45 00 - Quality Control: Testing, inspection, and analysis requirements.

B. Test and analyze concrete in accordance with ACI 318.

C. The precast contractor to submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

PART 3 EXECUTION

3.1 PREPARATION

A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

3.2 ERECTION

A. Erect units without damage to shape or finish. Replace or repair damaged sections.

B. Erect units level and plumb within allowable tolerances.

C. Align and maintain uniform horizontal and vertical joints as erection progresses.

D. When units require adjustment beyond design or tolerance criteria, discontinue affected work; advise Engineer.

E. Weld units in place. Perform welding in accordance with AWS D1.1.

F. Touch-up field welds scratched or damaged surfaces.

G. Weld reinforcing steel in accordance with AWS D1.4. Do not tack weld reinforcing.

H. Exposed Joint Dimension: 1/2 inch.

I. Seal perimeter and intermediate joints in accordance with this Section.

3.3 ERECTION TOLERANCES

A. Maximum Variation from Plane of Location: ¼ inch in 10 feet, non-cumulative.

B. Maximum Offset from Indicated Alignment Between Two Connecting Units: 1/4 inch.

C. Joint Tolerance: Plus or minus 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1.

3.5 ADJUSTING

A. Adjust units so joint dimensions are within tolerances.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Use non-combustible shields during welding operations to protect adjacent Work.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 62 00 – SHEET METAL FLASHING AND TRIM

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.

B. Sealants for joints within sheet metal fabrications.

C. Related Sections:

1. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.

2. Section 07 92 00 – Sealants and Caulking: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.2 REFERENCE STANDARDS

A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

H. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

I. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).

J. CDA A4050 - Copper in Architecture - Handbook current edition.

K. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.3 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, (0.0239) inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.

1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.

2. Color: As selected by Architect from Manufacturer's standard colors.

B. Aluminum: ASTM B209 (ASTM B209M); 20-gauge, (0.032 inch) (0.81 mm) thick; anodized finish of color as selected.

C. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20-gauge, (0.032 inch) (0.81 mm) thick; plain finish shop pre-coated with modified silicone coating.

1. Modified Silicone Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.

2. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.

D. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gauge, (0.0156 inch) (0.40 mm) thick; smooth No. 4 - Brushed finish.

E. Copper: ASTM B370, cold rolled 16 oz/sq ft (24 gauge) (0.0216 inch) (0.55 mm) thick; natural finish.

2.2 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.3 GUTTER AND DOWNSPOUT FABRICATION

A. Downspout Boots: Steel.

B. Seal metal joints.

2.4 EXTERIOR PENETRATION FLASHING PANELS

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.5 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by Manufacturer for substrates to be sealed; color to match adjacent material.

E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 INSTALLATION

A. Comply with drawing details and SMACNA standard installation practices.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Secure gutters and downspouts in place with concealed fasteners.

F. Connect downspouts to downspout boots, and grout connection watertight.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 07 92 00 - SEALANTS AND CAULKING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the work necessary to furnish and install sealing or caulking joints between dissimilar materials for watertight seal.

B. Section includes:

1. Sealants
2. Filler gaskets
3. Primers and bond breakers

1.2 DEFINITIONS

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

1.3 SUBMITTALS

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

PART 2 PRODUCTS

2.1 MATERIALS

A. Type A Sealant

1. Application: General building sealant.

2. Material: One component polyurethane sealant.

a. Vulkem 116, as manufactured by Tremco.
b. MasterSeal NP1, as manufactured by BASF.

B. Type B Sealant

1. Application - General building sealant for wide joints.

2. Materials - Self leveling one component polyurethane.

a. Vulkem 45SSL, as manufactured by Tremco

C. Filler Gasket (Backer Rod) Cord Strip

1. Ethafoam, as manufactured by Dow Chemical
2. Sonolastic Closed-cell Backer Rod, as manufactured by Sonneborn

3. Equal, as approved by Engineer

PART 3 EXECUTION

3.1 PREPARATION

A. Surfaces to receive caulking materials shall be thoroughly clean and free of any non-compatible primers or protective coatings, including lacquers, form coatings, clear sealers, etc.

B. Brush out all foreign matter and loose particles.

C. Clean metal surfaces with solvents and wipe dry while the surface is still wet with solvent.

3.2 INSTALLATION

A. Primers and Bond Breakers

1. Apply to surfaces as required; verify with Manufacturer.

2. In general, prime all concrete and Portland cement-based plaster or grout surfaces.

3. Prime wood surfaces where specifically required.

4. Use proper type primers and bond breakers, apply per Sealant Manufacturer's printed instructions.

B. Sealants

1. Provide watertight caulked joints at all building exterior locations where possible water penetration through joint may occur.

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

C. Gaskets or Fillers

1. Compress all gaskets to tight fit. Where required as backing for caulking system, roll or stretch in gasket sections to depth from sealant face or as shown (in general, to 3/8-inch).

2. Install gun grade material with gun nozzle of similar size as joint width as shown. Tool all beads, after application to assume full firm contact. Strike off excess material.

3. Maintain edge surfaces adjacent to joints clean and free of caulking stain and excess material. Trim joints as required per Manufacturer's printed instructions.

4. Do not apply caulking materials to a "bleeding" type of surface, such as asphaltic or other oil-emitting types. Where such material occurs at caulking joint (roofing, etc.), isolate from caulking with gasket filler.

5. Avoid mixing any water in caulking mixture before and during application. Do not thin material.

3.3 CORRECTIONS AND CLEANUP

A. Remove all damaged, defective, or improperly installed sealant and/or caulking and replace.

B. Clean and remove all sealant and caulking from adjacent surfaces.

C. Upon completion of the work, remove all disused implements, rubbish, and debris, and leave premises neat and clean.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Applications of insulation specified in this Section include rigid foam board and loose-fill type systems.

B. The extent of insulation work is shown on Drawings and indicated by provisions in this Section.

C. Section includes:

1. Building insulation.
2. Installation.

D. Related Sections:

1. Section 06 10 00 - Rough Carpentry.

1.2 SUBMITTALS

A. Submit a complete list of products, product information, types, and grades for approval by the Engineer prior to beginning building construction.

1.3 PRODUCT HANDLING

A. General Protection:

1. Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow.

2. Comply with Manufacturer’s recommendations for handling, storage, and protection during installation.

PART 2 PRODUCTS

2.1 MATERIALS

A. R Value: Minimum R value and thickness shall be as shown in Drawings.

B. Concrete Walls and Ceilings

1. Rigid foam board insulation panels manufactured by Owens/Corning, Foamular XPS or equal.

2. Install wall system as shown in the drawings and per manufacturer's instructions.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Installer must examine substrates and conditions under which insulation work is to be performed and must notify Contractor in writing of unsatisfactory conditions.

B. Do not proceed with insulation work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

C. Install insulation system in accordance with Manufacturer's recommendations or requirements.

D. Set vapor barrier faced units with vapor barrier to warm side (winter) of construction.

E. Do not obstruct ventilation spaces, except for firestopping.

END OF SECTION

SECTION 07 92 25 - SEALANTS AND CAULKING FOR STEEL RESERVOIRS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the work necessary to furnish and install sealing or caulking joints between dissimilar materials for watertight seal. In particular, work includes sealing the joint between the exterior floor the tank and the top of the existing reinforced concrete foundation.

B. Section includes:

1. Sealants
2. Filler gaskets
3. Primers and bond breakers

C. Related Sections:

1. Section 33 16 23 – Ground-Level Welded Steel Water Storage Tanks

1.2 DEFINITIONS

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

1.3 SUBMITTALS

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

PART 2 PRODUCTS

2.1 MATERIALS

A. Type A Sealant

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

2. Material: One component polyurethane sealant.

a. Dymonic 100, as manufactured by Tremco Commercial Sealants & Waterproofing.
b. Approved equal.

B. Filler Gasket (Backer Rod) Cord Strip

1. Sonolastic Closed-cell Backer Rod, as manufactured by Sonneborn.
2. Equal, as approved by Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Surfaces to receive caulking materials shall be thoroughly clean and free of any non-compatible primers or protective coatings, including lacquers, form coatings, clear sealers, etc.

B. Brush out all foreign matter and loose particles.

C. Clean metal surfaces with solvents and wipe dry while the surface is still wet with solvent.

3.2 INSTALLATION

A. Primers and Bond Breakers

1. Apply to surfaces as required; verify with Manufacturer.
2. In general, prime all concrete and Portland cement-based plaster or grout surfaces.
3. Use proper type primers and bond breakers, apply per Sealant Manufacturer's printed instructions.

B. Sealants

1. Provide watertight caulked joints at all building exterior locations where possible water penetration through joint may occur.

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

C. Gaskets or Fillers

1. Compress all gaskets to tight fit. Where required as backing for caulking system, roll or stretch in gasket sections to depth from sealant face or as shown (in general, to 3/8-inch).

2. Install gun grade material with gun nozzle of similar size as joint width as shown. Tool all beads, after application to assume full firm contact. Strike off excess material.

3. Maintain edge surfaces adjacent to joints clean and free of caulking stain and excess material. Trim joints as required per Manufacturer's printed instructions.

4. Do not apply caulking materials to a "bleeding" type of surface, such as asphaltic or other oil-emitting types. Where such material occurs at caulking joint (roofing, etc.), isolate from caulking with gasket filler.

5. Avoid mixing any water in caulking mixture before and during application. Do not thin material.

3.3 CORRECTIONS AND CLEANUP

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

END OF SECTION

SECTION 08 91 19 - FIXED LOUVERS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes intake and exhaust stationary air louvers and accessories.

B. Section Includes:

1. Louvers
2. Screens

C. Related Sections:

1. Section 05 50 00 - Metal Fabrications
2. Section 09 90 00 - Painting and Coatings

1.2 SUBMITTALS

A. Manufacturer's catalog and/or other data confirming conformance to specified design, material, and equipment requirements.

B. Certified results of pressure drop test data and water penetration data. The equipment list should identify each louver with an equipment number and indicate the room or structure in which it is located.

C. Louvers shall bear the AMCA certified ratings seal for both air performance and water penetration.

1.3 REFERENCE STANDARDS

A. Aluminum Association (AA):

1. AA 45 - Designation System for Aluminum Finishes.

B. Air Movement and Control Association (AMCA) International:

1. AMCA Standard 500 - Test Methods for Louvers, Dampers, and Shutters.

C. ASTM International (ASTM):

1. ASTM B221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

PART 2 PRODUCTS

2.1 MANUFACTURERS

Manufacturers include Airolite, Construction Specialties, Greenheck, and Ruskin, or equal.

2.2 MATERIALS

A. Frame: ASTM B221, 6063-T52 extruded aluminum alloy

B. Fasteners: Aluminum

C. Bird Screen

2.3 EQUIPMENT

A. Blades:

1. Material: ASTM B221, 6063-T52 extruded aluminum alloy

2. Blades shall be of the combination of fixed and adjustable, drainable type with interlocking blade braces to provide an uninterrupted horizontal line.

3. Blades for all louvers shall be minimum 0.081-inch thick.

4. Slideable interlocked mullions shall have provisions for expansion and contraction.

B. Frame:

1. Material: ASTM B221, 6063-T52 extruded aluminum alloy

2. The frame shall be minimum 0.081-inch thick by 4 inches deep.

3. The louver frame shall be assembled by welding.

4. The head, sill, and jamb shall be one-piece structural members and shall have an integral calking slot and retaining bead.

C. Screen:

1. Material: Aluminum wire mesh

2. The louver shall be furnished with a removable bird screen constructed of 1/2-inch mesh, 16-gauge wire and secured within a 10-gauge extruded aluminum frame.

3. The screen shall be mounted on the interior louver face but independent of the louver.

D. Fasteners: Aluminum.

E. Finish:

1. Unless otherwise specified, all louvers shall receive an AAMA 2605, 70 percent fluoropolymer paint finish after assembly.

2. Minimum coating thickness shall be 0.7-mil.

3. Color to match door.

2.4 FABRICATION

A. General: Fabricate louvers to comply with requirements indicated for design, dimensions, materials, joinery, and performance.

B. Assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Maintain equal louver blade spacing to produce uniform appearance.

E. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances of louvers, adjoining construction and perimeter sealant joints.

F. Include supports, anchorages and accessories required for complete assembly.

G. Provide vertical mullions of type and at spacing's indicated but not more than recommended by Manufacturer, or 72 inches on center, whichever is less. At horizontal joints between louver units, provide horizontal mullions except where continuous vertical assemblies are indicated.

H. Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.

I. Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary:

1. With fillet welds, concealed from view.

2. With fillet welds, concealed from view; or mechanical fasteners; or a combination of these methods; as standard with Louver Manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Locate and place louver units plumb, level, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items

that cannot be refinished in the field to the shop, make required alterations and refinish entire unit, or provide new units.

F. Protect nonferrous metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that are in contact with concrete, masonry, or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where required to make louver joints weathertight. Comply with Section 07 90 00 for sealants applied during installation of louver.

3.2 FINISHING

A. Adjusting and Protection

1. Protect louvers from damage of any kind during construction period including use of temporary protective coverings where needed and approved by Louver Manufacturer. Remove protective covering at time of Substantial Completion.

2. Restore louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by the Owner's Representative, remove damaged units, and replace with new units.

a. Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

B. Cleaning

1. Periodically clean exposed surfaces of louvers that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

2. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Rinse surfaces thoroughly and dry.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 GENERAL

1.1 THE REQUIREMENT

A. Work under this Section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.

B. This specification is applicable to coated pipe, steel, concrete, and other surfaces listed in the coating schedule at the end of this section. The Coating System Schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

C. Related Work Specified in Other Sections -- Shop coatings and/or factory finishes on fabricated or manufactured equipment may be specified in other divisions. Some items with factory finishes, or corrosion resistant finishes may be scheduled or directed to be painted by the Engineer to unify a wall finish or color scheme, at the Engineer's discretion.

D. Exclusions -- Do not coat the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze, and other corrosion-resistant material (except for valve bodies and piping); Electrical switch-gear and motor control centers having factory finish; Fencing; Multiple coated factory finished baked enamel or porcelain products; Concealed areas such as ducts, piping, conduits, and items specified elsewhere for special linings and coatings.

E. Damaged Factory Finish -- If directed by the Engineer, refinish the entire exposed surfaces of equipment chipped, scratched, or otherwise damaged in shipment or installation.

F. All coating coming in contact with potable water shall be NSF approved.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

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

1. "Architectural Specification Manual" by the Painting and Decorating Contractors of America (PDCA), 333 Taylor Avenue North, Seattle, Washington 98109.

2. "Systems and Specifications" - Volume 2 of Steel Structures Painting Council (SSPC).

3. NSF International (NSF) Standard No. 61.

4. NSF International (NSF) Standard No. 600 – Health Effects Evaluation and Criteria for Chemicals in Drinking Water (Effective beginning January 1, 2023)

B. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers, P.O. Box 986, Katy, TX 77450.

C. Pipe Coating Commercial Standards

ANSI/AWWA C105	Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
ANSI/AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inch and Larger - Shop Applied
ANSI/AWWA C209	Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Pipelines.
ANSI/AWWA C210	Liquid Epoxy Coating for Exterior and Interior of Steel Pipe.
ANSI/AWWA C213	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
ANSI/AWWA C214	Tape Coating systems for the Exterior of Steel Water Pipelines.

D. Federal Specifications

DOD-P-23236A(SH)	Military Specification, Paint Coating Systems, Steel Ship Tank, Fuel and Saltwater Ballast.

1.3 CONTRACTOR SUBMITTALS

A. Coating Materials List -- The Contractor shall provide a coating materials list which indicates the Manufacturer and the coating number, keyed to the coating systems herein. The amount of copies to submit shall be as specified within Section 01 10 00, Summary of Work.

B. Coating Manufacturer's and Applicator Information -- For each coating system to be used the Contractor shall submit, the following listed data.

1. Manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.

2. Manufacturer's instructions and recommendations on surface preparation and application.

3. Colors available for each product and each coat.

4. Compatibility of shop and field applied coatings (where applicable).

5. Material safety data sheet (MSDS) for each product used.

6. The Manufacturer’s recommended products and procedures for field coating repairs and field preparation of field cut pipe ends.

7. The name of the proposed coating applicator shop along with certification that the applicator shop is qualified and equipped to apply the coatings systems as specified.

8. Certificate -- Submit Manufacturer's certificate of compliance with the specifications and standards signed by a representative in the Manufacturer's employ.

9. Samples -- Provide painted surface areas at the job for approval of main color selections or submit sample on 12-inch sample of substrate using required finish system at Engineer's discretion.

1.4 QUALITY ASSURANCE

A. Painter Qualifications -- The Painting/Coating Contractor must be capable of performing the various items of work as specified. The Painting/Coating Contractor shall furnish a statement covering experience on similar work, a list of machinery, plant, and other equipment available for the proposed work, and a financial statement, including a complete statement of the Painter/Coating Contractor's financial ability and experience in performing similar painting and coating work. The Painting/Coating Contractor shall have a minimum of 5 years practical experience and a successful history in the application of the specified products to concrete/steel surfaces. Upon request, the Painting/Coating Contractor shall substantiate this requirement by furnishing a list of references, which shall include jobs of similar nature.

B. The Contractor shall give the Engineer a minimum of 3 days advance notice of the start of any field surface preparation work of coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

C. All such work shall be performed only in the presence of the Engineer unless the Engineer has granted prior approval to perform such work in its absence.

D. Inspection by the Engineer, or the waiver of inspection of any particular portion of the work, shall not relieve the Contractor of its responsibility to perform the work in accordance with these Specifications.

E. Surface Preparation -- Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.

F. Scaffolding shall be erected and moved to locations where requested by the Engineer to facilitate inspection. Additional illumination shall be provided by the Contractor to cover all areas to be inspected.

G. Paint Products -- No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified. Painting shall be done at such times as the Contractor and Engineer may agree upon in order that dust-free and neat work be obtained. All painting shall be in strict accordance with the Manufacturer's instructions and shall be performed in a manner satisfactory to the Engineer.

H. Manufacturer's Representative -- Require Coating Manufacturer's representative to be at job site when the first day's coating application is in progress and periodically during progress of the work.

I. Labels -- Deliver to the job site in the original sealed containers with Manufacturer's name, product name, type of product, Manufacturer's specification or catalog number or federal specification number, and instructions for reducing where applicable.

J. Colors -- Colors will be selected from Manufacturer's standard colors as reviewed by Engineer and approved by the Owner. Colors for special coatings that are limited in their availability and color selection will be chosen on the basis of Manufacturer's standard colors, provided that the Manufacturer's product line represents a color range comparable to similar products of other manufacturers.

K. Flame Spread -- Provide paint materials which will result in a Class II finish for all coated surfaces in exit corridors, and a Class III finish for all other interior rooms or areas.

L. Film Thickness Testing -- On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest model FM, Elcometer model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using wet film gauge readings and destructive film thickness tests.

M. Inspection Device -- The Contractor shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the Engineer’s use at all times while coating is being done, until final acceptance of such coatings.

1.5 DELIVERY, HANDLING, AND STORAGE

A. Deliver in labeled containers as specified above and store in a locked room accessible for inspection. Comply with fire and health regulations.

B. Provide adequate heat and forced mechanical ventilation for health, safety, and drying requirements. Use explosion proof equipment. Provide face masks.

C. Protect adjacent surfaces with suitable masking and drop cloths as required. Remove cloths or waste from the Project daily.

D. Apply to surfaces under recommended environmental conditions and within the limitations established by the Material Manufacturer. Do not apply coating in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces, unless otherwise permitted by the Coating Manufacturer's printed instructions. Coating application may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the Paint Manufacturer during application and drying periods.

1.6 PROTECTION

A. Follow all safety recommendations of Manufacturer regarding ventilation and danger from explosion or breathing paint fumes or skin exposure, and all applicable O.S.H.A. and other regulations.

B. Protect surface adjacent to work being coated from overspray, drips, or other damage.

1.7 EXTRA STOCK

Provide one gallon of each type and color, fully labeled, at completion of job.

PART 2 PRODUCTS

2.1 GENERAL

A. Definitions -- The terms "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.

B. General -- Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, Manufacturer's directions, and name of Manufacturer, all of which shall be plainly legible at the time of use.

C. The Contractor shall use coating materials suitable for the intended use and recommended by their Manufacturer for the intended service.

D. Compatibility -- In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the approval of the Engineer, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

E. Colors -- All colors and shades of colors of all coatings shall be as selected or specified by the Engineer. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the Manufacturer's standard color samples by the Engineer. Color pigments shall be lead free.

F. Protective Coating Materials -- Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the Contractor shall provide the Engineer with the names of not less than 10 successful applications of the proposed Manufacturer's products demonstrating compliance with this specification requirement.

G. Substitute or "Or-Equal" Submittals -- Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The Contractor shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that said material meets the specified requirements and is equivalent or better than the listed materials.

H. The cost of all testing and analyzing of the proposed substitute materials that may be required by the Engineer shall be paid by the Contractor. If the proposed substitution requires changes in the contract work, the Contractor shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 INDUSTRIAL COATING SYSTEMS

A. General

Provide and apply the industrial coatings systems which follow as listed in the coating schedule, as required by these specifications, and as directed by the Engineer. Coat all existing and new exposed interior or exterior surfaces and submerged and intermittently submerged surfaces as indicated, except as specifically excluded in Part 1 of this section or on the drawings or finish schedules. Coating System Numbers listed below shall be used as the Coating System code letter, and shall be used on any coating submittals or correspondence.

B. Industrial coating systems shall be as follows

1. Coating System 100

   a. Location -- Exposed, unprimed, non-galvanized, nonsubmerged metal surfaces, both interior and exterior including piping, and structural steel.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Apply prime coat and topcoat, 4.0-6.0 mils each coat of Tnemec Series 66-2 Hi-Build Epoxoline, or equal. Color as selected by Owner.

2. Coating System 101

   a. Location -- Exposed metal surfaces, shop primed, both interior and exterior including piping, railings, ladders, steel doors, and any other metal items not otherwise specified.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Apply shop prime coat 3.0 mils DFT Tnemec Series 90-97 Tneme-Zinc, one coat 4.0 - 6.0 mils DFT Tnemec Series 66 Hi-Build Epoxoline, and 3.0 - 4.0 mils DFT of Tnemec Series 175 Endura Shield, or equal. Color as selected by Owner.

3. Coating System 102

   a. Location -- Unprimed or non-galvanized, continuously or intermittently submerged metal items, both interior and exterior including piping, structural steel, and all other metal items not otherwise specified.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Prime, intermediate and topcoat, 4.0-6.0 mils each coat of Tnemec Series 22, or equal. Color as selected by Owner.

4. Coating System 103

   a. Location -- Vertical concrete walls, exterior, below finish grade, not exposed to view.

   b. Surface Preparation -- As specified herein.

   c. Paint System -- Apply two coats 9.0-10.0 mils each, Carboline Bitumastic 50, or equal.

5. Coating System 104

    a. Location – Non-submerged, exposed to view, PVC piping.

    b. Surface Preparation -- As specified herein.

    c. Coating System -- Apply one coat, 4.0-6.0 mils Tnemec Series 66-2 Hi-Build Epoxoline, or equal. Color as selected by Owner.

2.3 SPECIAL PIPE AND SEVERE SERVICE COATING SYSTEMS

A. General

The following coatings are for buried pipe and surfaces used in severe service conditions. The Manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated within the paragraph entitled " 'Or-Equal' Clause" in Section 01 10 00, Summary of Work.

B. Special pipe and severe service coating systems shall be as follows

1. Coating System 200 -- Cement Mortar Coating

    a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

    b. Surface Preparation - As specified herein.

    c. Coating System -- A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than 1-part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C 309-81, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped by at least 6 inches. At the Engineer's discretion, the hot applied coal tar epoxy coating may be used as the curing membrane for the mortar coating.

2. Coating System 201 -- Hot Applied Coal Tar Epoxy Coating

    a. Location -- Exterior surface of concrete pipe and cement-mortar coated pipe and fittings.

    b. Surface Preparation -- As specified herein.

    c. Coating System -- The hot applied coal tar epoxy shall be a solvent free 100 percent solids coal tar epoxy chemically compatible with hydrating cement and suitable for application on moist surfaces of freshly placed cement mortar or concrete and properly prepared cured surfaces. The coal tar epoxy coating material shall be Amercoat 1972B or equal. The finish coal tar epoxy coating shall have a minimum DFT of 26 mils.

3. Coating System 202 -- Coal-Tar Epoxy Coating System

    a. Location -- Exterior surface of buried steel pipe, fittings, and other ferrous surfaces.

    b. Surface Preparation -- As specified herein.

    c. Coating System -- High build, two-component amine or polyamide cured coal-tar epoxy shall have a solids content of at least 68 percent by volume, suitable as a long-term coating of buried surfaces, and conforming to AWWA C210. Prime coats are for use as a shop primer only. Prime coat shall be omitted when both surface preparation and coating are to be performed in the field. The coal-tar epoxy coating system shall include:

        1) Prime coat (DFT = 1-1/2 mils), Amercoat 83HS, Tnemec P66, or equal.

        2) Finish coats (Two or more, DFT = 18 mils), Amercoat 78 HB, Tnemec 46 H-413, or equal.

        3) Total system DFT = 19-1/2 mils.

4. Coating System 203 -- Fusion Bonded Epoxy

    a. Location -- Ferrous surfaces of sleeve couplings, steel pipe, and fittings.

    b. Surface Preparation -- As specified herein.

    c. Coating System -- The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines". The coating shall be applied using the fluidized bed process.

        1) Liquid Epoxy -- For field repairs, the use of a liquid epoxy will be permitted, applied in not less than three coats to provide a DFT 16 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the Powder Epoxy Manufacturer.

        2) Coating (DFT = 16 mils), Scotchkote 203, or equal.

        3) Total system DFT = 16 mils.

5. Coating System 204 -- Hot, Coal-Tar Enamel

    a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

    b. Surface Preparation - As specified herein

    c. Coating System -- Coal-Tar Enamel materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a primer layer, coal-tar enamel layer, coal-tar saturated non-asbestos felt outer wrap, and a finish coat. Total system DFT = 188 mils.

6. Coating System 205 -- Hot Applied Tape

    a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

b. Surface Preparation -- As specified herein.

c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a cold-applied liquid primer and heated coal-tar base tape. Total system DFT = 50 mils.

7. Coating System 206 -- Cold Applied Tape

a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

b. Surface Preparation -- As specified herein.

c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. Prefabricated tape shall be Type II. The system shall consist of a primer layer, inner layer tape of 35 mils, and an outer layer tape of 35 mils. Total system DFT = 70 mils.

8. Coating System 207 -- PVC Tape

a. Location -- Small galvanized steel pipe and fittings.

b. Surface Preparation -- As specified herein.

c. Coating System -- Prior to wrapping pipe with PVC tape, the pipe and fittings shall be primed using a primer recommended by the PVC Tape Manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half lapped for a total thickness of 40 mils.

9. Coating System 208 -- Mastic

a. Location -- Pipe and fitting joints, and general buried surface coating repair and touch up.

b. Surface Preparation - As specified herein.

c. Coating System -- Mastic shall be a one-part solvent drying heavy bodied thixotropic synthetic elastomeric coating with chemically inert resins and fillers and an average viscosity of 650,000 CPS at 77 degrees Fahrenheit (F), thereby requiring generous applications by hand or trowel. Total coat thickness shall be 30 mils, minimum. Mastic shall be Protecto Wrap 160 H or equal and be fully compatible with pipeline coating systems.

10. Coating System 209 -- Polyethylene Encasement

a. Location -- Ductile iron, steel and concrete cylinder pipe and fittings

b. Surface Preparation -- None required.

c. Coating System -- Except as otherwise specified, application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

11. Coating System 210 – Wax Tape

    a. Location – Buried ductile iron and steel pipe fittings and couplings where specified.

    b. Surface Preparation – As specified herein

    c. Coating System -- Except as otherwise specified, application of wax tape installation shall be in accordance with ANSI/AWWA C217.

12. Coating System 211 – Zinc coating and polyethylene encasement

    a. Location – Buried ductile iron pipe and fittings

    b. Surface Preparation – As specified herein.

    c. Coating System – The exterior of the pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc applied shall be 200 grams per square meter (0.6554 ounces per square foot) of pipe surface. A finishing layer topcoat shall be applied to the zinc. Zinc coated pipe shall be use in conjunction with V-Bio polywrap installed per ANSI/AWWA C105 method C.

2.4 ARCHITECTURAL COATING SYSTEMS

A. General

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or topcoat.

Fungus Control: Submit evidence for all paints attesting the passing of Federal Test Method Standard No. 141, Method 6271.1 showing no fungus growth or other approved test results.

Apply to surfaces under recommended environmental conditions and within the limitations established by the Material Manufacturer. Acrylics require 60 degrees F and above temperature and below 50 percent relative humidity. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F and 90 degrees F unless otherwise permitted by the Paint Manufacturer's printed instructions.

B. Architectural coating systems shall be as follows

1. Coating System 300

    a. Location -- Vertical, exterior concrete masonry unit walls exposed to view.

    b. Surface Preparation -- As specified herein.

    c. Coating System -- Apply prime, intermediate and topcoat, 75 square foot per gallon (ft^2/gal), 100 ft^2/gal and 100 ft^2/gal respectively for each coat of Tnemec Series 156 Envirocrete or equal. Color as selected by Owner.

2. Paint System 301

    a. Location -- Vertical concrete exterior walls and flat concrete exterior roofs and slabs exposed to view.

    b. Surface Preparation -- As specified herein.

    c. Coating System -- Apply two coats 6.0-9.0 mils (100 ft^2/gal) each coat, Tnemec Series 156 Envirocrete, or equal. Color as selected by Owner.

3. Paint System 302

    a. Location -- Interior concrete masonry unit walls and interior and exterior wood walls, ceilings, and other wood surfaces not otherwise specified, exposed to view.

    b. Surface Preparation -- As specified herein.

    c. Coating System -- Prime as specified by Coating Manufacturer. Apply two coats 6.0 - 9.0 mils (100 ft^2/gal) each coat, Tnemec Series 156 Envirocrete, or equal. Color as selected by Owner.

4. Paint System 303

    a. Location -- Wood surfaces not otherwise specified, exposed to view.

    b. Surface Preparation -- As specified herein.

    c. Coating System -- Apply an alkyd primer as recommended by the Manufacturer, 2 mils. Apply finish coats (two or more coats 6 mils total) of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Total DFT = 8 mils. Color as selected by Owner.

5. Paint System 304

    a. Location -- Interior drywall surfaces not otherwise specified, exposed to view.

    b. Surface Preparation - As specified herein.

    c. Coating System -- Apply two coats 2.0 - 3.0 mils each coat of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Color as selected by Owner.

6. Paint System 305

    a. Location -- Exterior brick surfaces not otherwise specified, exposed to view.

    b. Surface Preparation -- Surfaces shall be cleaned with a Manufacturer's approved chemical cleaner and power washed. Surfaces shall be completely dry, free from efflorescence, oils, paint, and other contaminants before the coating system is applied. Coating system shall be applied according to the Manufacturer's published recommendations. A Manufacturer's representative shall be present during application of the coating system, if required by the Manufacturer's warranty.

c. Coating System -- Apply two coats of masonry water retardant material. The system shall be clear, non-staining, silane-modified-siloxane, Fabrishield 161, Rainstopper 1500, or equal. The selected coating system shall provide a minimum of a 5-year Manufacturer's warranty.

PART 3 EXECUTION

3.1 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Manufacturer's Recommendations -- Unless otherwise specified herein, the Coating Manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for all other procedures relative to coating shall be strictly observed.

B. All protective coating materials shall be used within the Manufacturer's recommended shelf life.

C. Storage and Mixing -- Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification.

1. Solvent Cleaning (SSPC-SP1) -- Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC-SP2) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC-SP3) -- Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC-SP5) -- Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products, and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC-SP6) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC-SP7) -- Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC-SP10) -- Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

8. High- and Ultra High- Pressure Water Jetting (SSPC-SP12): Water jetting at high- or ultra-high-pressure to prepare a surface for recoating using pressure above 10,000 pounds per square inch (psi).

9. Surface Preparation of Concrete (SSPC-SP-13) - Surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.

10. Industrial Blast Cleaning (SSPC-SP14): Blast cleaning to remove all visible oil, grease, dust, and dirt, when viewed without magnification

3.3 CORRECTIONS AND CLEANUP

At completion any damaged, de-laminated or defaced coated surfaces shall be touched up, restored, and left in first class condition. Any coated or finished surfaces damaged in fitting or erection shall be restored. If necessary, an entire wall shall be refinished rather than spot finished. Upon completion and prior to final acceptance, all equipment and unused materials accumulated in the coating process shall be removed from the site and any spillage, spatter spots or other misplaced coating material shall be removed in a manner which will not damage surfaces. Perform required patching, repair, and cleaning to the satisfaction of the Engineer. Cooperate and coordinate work with the work of other trades in the removal and replacement of hardware, fixtures, covers, switch plates, etc., as required for coating.

3.4 SURFACE PREPARATION

A. General

Prepare all surfaces scheduled to receive new coating systems, as required to provide for adequate bonding of the specified coating system to the substrate material. Request review of prepared surfaces by the Engineer prior to proceeding. For existing coated surfaces, hand wash with cleaner or product recommended by Coating Manufacturer to properly prepare existing surface and provide for bonding of coating specified to follow. Remove any loose, peeling or flaking coating, or mildewed areas. Surface preparation minimums shall be as follows:

1. Exposed metal items, non-submerged, unprimed, non-galvanized both interior and exterior, including piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP6, "Commercial Blast Cleaning".

2. Exposed metal items, shop primed, both interior and exterior including piping, steel doors, steel ladders to be painted, and railings, and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning"; SSPC-SP2, "Hand Tool Cleaning"; and SSPC-SP3, "Power Tool Cleaning" as may be required to remove grease, loose, or peeling or chipped paint.

3. Metal items, unprimed or non-galvanized, continuously or intermittently submerged, both interior and exterior including piping, structural steel, and all other metal items not otherwise specified, shall undergo surface preparation in conformance with SSPC-SP10, "Near-White Blast Cleaning".

4. Stainless Steel – Non-submerged and submerged, exposed piping and fittings, both interior and exterior shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning".

5. Polyvinyl Chloride (PVC) – Non-submerged, both interior and exterior, process piping and plumbing, shall be lightly sanded prior to application of the specified coating system to follow.

6. Non-submerged Concrete - Clean all concrete surfaces of dust, form oil, curing compounds, or other incompatible matter. Etch and prime if required by Manufacturer for specified coating products to follow. Allow minimum 28-day cure of concrete prior to application of coating systems.

7. Concrete Masonry Units -- Repair all breaks, cracks, and holes with concrete grout. The surface must be free of dirt, dust, loose sand, and other foreign matter. Brush clean. Allow minimum 28-day cure of concrete joint mortar and repair grout prior to application of coatings system.

8. Wood -- Wood surfaces shall be thoroughly cleaned and free of all foreign matter with cracks, nail holes, and other defects properly filled, smoothed, and sandpapered to fine finish. Wipe clean of dust.

9. Preparation of All Existing Coated Surfaces -- Removed rough and defective coating film from material surfaces to be painted. Touch up with approved primer. Clean all greasy or oily surfaces, to be painted, with benzine or mineral spirits or Rodda's Gresof before coating, or as recommended by Manufacturer. For walls, patch existing nicks and gouges, sand to match wall finish.

3.5 PRIME COATING

A. Exposed Steel -- Prime coat all exposed steel in accordance with SSPC PS 13.01 for epoxy-polyamide coating systems. Prime coats shall be applied following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above.

B. Galvanized Metal -- After surface preparation specified above, prime galvanized metal items receiving paints as specified with Tnemec Series 66 Hi-Build Epoxaline or equal, verifying with Manufacturer before application the compatibility with coatings specified to follow.

C. Shop Primed Metal -- Where indicated on the plans or coating schedule and following the surface preparation procedures specified in paragraph 3.4.A.2 above, the Contractor shall apply intermediate and topcoats of the specified paint system to shop primed metal. The Contractor shall verify with the Manufacturer(s) representative of the item(s) to be painted, before application, the compatibility of shop primers with the specified intermediate and topcoat coating systems.

D. Non-Shop Primed Metal and Piping -- Prime coat all exposed metal and piping, except stainless steel, received at job site following completion of surface preparation requirements as specified in Paragraph 3.4.A.1 above. Prime paint in accordance with SSPC PS No. 13.01 for epoxy-polyamide primers. Epoxy-polyamide primers shall conform to the standards set forth in SSPC Paint Specification No. 22.

E. Cast-In-Place Reinforced Concrete -- After surface preparation specified above, prime coat concrete as specified in the coating schedule found elsewhere in the specifications.

F. Concrete Masonry Units -- After surface preparation specified above, prime coat as specified in the coating schedule found elsewhere in the specifications.

G. Wood Surfaces -- Following surface preparation specified above, prime coat exterior exposed wood surfaces with appropriate coating system as specified in the painting schedule.

3.6 FIELD PRIME

Wherever shop priming has been damaged in transit or during construction, the damaged area shall be cleaned and touched up with field primer specified herein or returned to the shop for resurfacing and re-priming, at the Engineer’s discretion. Metal items delivered to the job site unprimed shall be cleaned and primed as specified herein.

3.7 APPLICATION

A. Thickness -- Apply coatings in strict conformance with the Manufacturer's application instructions. Apply each coat at the rate specified by the Manufacturer to achieve the dry mil thickness specified. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material. Correct apparent deficiency of film thickness by the application of an additional coat.

B. Porous Surfaces -- Apply paint to porous surfaces as required by increasing the number of coats or decreasing the coverage as may be necessary to achieve a durable protective and decorative finish.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same working day.

D. Coatings shall be applied in accordance with the Manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe coating for these areas.

F. Special attention shall be given to materials which will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

G. Ventilation -- Adequately ventilate enclosed rooms and spaces during painting and drying periods.

H. Drying Time -- Do not apply next coat of coat until each coat is dry. Test non-metallic surfaces with moisture meter. The Manufacturer's recommended drying time shall mean an interval under normal condition to be increased to allow for adverse weather or drying conditions. Coating Manufacturer's representative shall verify by cure testing, complete cure of coatings systems used for immersion service.

3.8 COATING SCHEDULE

Coating Schedule

Item	Location	Material	Coating System
Piping Coatings (exterior surface of pipe)	Inside Pump Stations	Steel	Coating System 101
Piping Coatings (exterior surface of pipe)	Inside Pump Stations	Ductile Iron	Coating System 101
Piping Linings	Inside Pump Stations	Steel	Coating System 102
Piping Coatings (exterior surface of pipe)	buried	Ductile Iron	See Specification Section 33 11 10
Piping Coatings (exterior surface of pipe)	Vaults	Ductile Iron	Coating System 101
Doors	Pump Stations	Steel	Coating System 101
Louvers	Pump Stations	Aluminum	Coating System 101
Precast Structures (exterior surfaces)	Valve Vaults	Concrete	Coating System 103
Precast Structures (exterior surfaces)	Pump Stations	Concrete	Coating System 301

Notes:

1. If a location and material are not specifically identified in the table, the coating systems specified in Section 2, Products, shall apply to the entire project as noted in the specifications for each coating system.

END OF SECTION

SECTION 10 14 10 - IDENTIFYING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers the work necessary to furnish and install, complete, identifying devices for the Project.

B. Section includes:

1. Process pipe color coding and labeling
2. Process equipment nameplates
3. Door and warning signs

C. Related Sections:

1. Section 40 05 13 - Common Work Results for Process Piping

1.2 STANDARDS, SPECIFICATIONS, AND CODES

A. All safety related signs, markers, labeling, and symbols shall conform to the applicable provisions or codes of the Occupational Safety and Health Administration (OSHA), unless specifically modified hereinafter.

B. All signage providing emergency information or general circulation directions, or identifies rooms for the physically handicapped, shall comply with the requirements of the latest edition of American National Standards Institute (ANSI A117.1).

1.3 SUBMITTALS

A. In accordance with Section 01 33 00, Submittal Procedures.

B. Manufacturer's Data - Specifications and installation instructions for each type of sign required.

C. Samples - Submit three full size samples of each color and finish of pipe labeling, process equipment nameplates, and warning signs with sample letters.

1. Engineer's review of samples will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

2. Submit samples of any other special identifying or signing provided for elsewhere in this specification.

PART 2 PRODUCTS

2.1 PIPE LABELING AND COLORS

A. Unless noted otherwise on the Drawings or specified differently hereinafter, pipe labeling and colors shall conform to the following schedule:

Service	Symbol (label)	Symbol Color (label)	Pipe Color
Plant Water/Potable Water/Well Water	PW	White	Blue
Domestic Water (Cold/Hot)	--	White	Blue
Drains	D	White	Gray
Misc. Piping	As directed by the Engineer	As directed by the Engineer	As directed by the Engineer

B. Pipe identification labels and flow direction arrows shall consist of lettering and symbols applied over the pipe base color.

C. Coating systems and surface preparation requirements used in color coding piping and lettering and flow arrows shall be as specified in Section 09 90 00, Painting and Coating.

2.2 PROCESS EQUIPMENT NAMEPLATES

A. Nameplates shall be used to identify all process equipment including but not limited to pumps, chlorinators, control panels, and any other equipment requiring identification as directed by the Engineer.

B. Fabricated from 1/16-inch-thick satin-surfaced Setonply, all edges beveled neatly.

C. Furnish with drilled holes for mounting to the appropriate equipment or nearest adjacent surface. As an alternative, acceptable adhesive attachment methods may be used if approved by the Engineer.

D. Nameplate background color, lettering color, and wording shall be as directed by the Engineer and approved by the Owner.

E. Minimum Size: 4-inch x 1-1/2-inch.

F. Manufacturer: Seton Nameplate Company, New Haven, CT, Style 2060-40 or equal.

2.3 CONFINED SPACE WARNING SIGNS (TOLANI LAKE BPS ONLY)

A. Painted aluminum with a yellow background and black lettering.

B. Each sign shall contain the following wording:

"DANGER
PERMIT-REQUIRED CONFINED SPACE
DO NOT ENTER"

2.4 EXTERIOR STATION SIGNS

A. A bronze metal plaque shall be fabricated and mounted on the pump station exterior wall as shown with approximate dimensions of 16 inches high by 20 inches wide with back sides for epoxy mounting.

B. Bronze plaque shall be free of pits, scale, sand holes, and other defects.

C. Bronze used shall be 85-5-5-5 alloy.

D. Hand tool and buff to provide clean, sharp figures with a bright finish.

E. Provide border, background, texture, and finish as selected by the Engineer from Manufacturer's standards.

F. Protect the exposed surfaces with two coats clear non-yellowing lacquer.

G. Provide hardware for concealed mounting on brick or CMU and mount at location as directed.

H. Plaques shall be lettered as directed below. Obtain Engineer's written approval of proof before fabricating.

I. Plaque face shall have a 4-inch diameter rendition of the NTUA logo and the following lettering for each pumps station site:

NAVAJO TRIBAL UTILITY AUTHORITY	
YELLOWHAIR BOOSTER PUMP STATION	
GABBERT SERVICE LEVEL	
ENGINEER:	CONSOR NORTH AMERICA, INC.
CONTRACTOR:	Navajo Engineering & Construction Authority
CONSTRUCTED:	<to follow>

NAVAJO TRIBAL UTILITY AUTHORITY	
COTTONWOOD BOOSTER PUMP STATION	
COTTONWOOD SERVICE LEVEL	
ENGINEER:	CONSOR NORTH AMERICA, INC.
CONTRACTOR:	Navajo Engineering & Construction Authority
CONSTRUCTED:	<to follow>

NAVAJO TRIBAL UTILITY AUTHORITY	
NAZLINI BOOSTER PUMP STATION	
NAZLINI SERVICE LEVEL	
ENGINEER:	CONSOR NORTH AMERICA, INC.
CONTRACTOR:	Navajo Engineering & Construction Authority
CONSTRUCTED:	<to follow>

NAVAJO TRIBAL UTILITY AUTHORITY	
TOLANI LAKE BOOSTER PUMP STATION	
TOLANI LAKE SERVICE LEVEL	
ENGINEER:	CONSOR NORTH AMERICA, INC.
CONTRACTOR:	Navajo Engineering & Construction Authority
CONSTRUCTED:	<to follow>

PART 3 EXECUTION

3.1 PIPE LABELS AND FLOW DIRECTION ARROWS

A. Location: At all connections to equipment, valves, branching fittings, at wall boundaries, and at intervals along the piping not greater than 5 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe. Exposed piping not normally in view, such as behind ceilings and in closets and cabinets, shall also be labeled.

B. Labels shall not be applied to the pipe until all pipe painting is complete or as approved by the Engineer.

C. Application: By stencil over pipe base color. Base coat shall be cured, clean, and dry, prior to application of lettering.

D. Lettering sizes for pipe labels shall be in accordance with ANSI A13.1, Table 3, and based upon the outside diameter of the pipe to which they are applied.

E. Stripes on solution pipe shall be applied at intervals along the piping not greater than 5 feet on center with at least one stripe applied to each exposed horizontal and vertical run of pipe.

3.2 PROCESS EQUIPMENT NAMEPLATES

A. Location: As directed by the Engineer.

B. Mounting of process equipment nameplates shall be in accordance with the Manufacturer's instructions, and as directed by the Engineer.

3.3 PAINTED SIGNS

A. Prepare and mask base material as required to provide clean surface for application of letters by stencil.

B. Unless otherwise noted, color of letters shall be black.

C. Paint Type: Semi-gloss alkyd enamel.

3.4 CONFINED SPACE WARNING SIGNS

A. Securely fasten signs to the underside of all hatches entering vaults such that the sign can be read when the hatch is opened.

3.5 EXTERIOR STATION SIGNS

A. Mount signs in the locations as directed by the Engineer.

B. Secure signs to fences using stainless steel fasteners.

END OF SECTION

SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 SUMMARY

A. Work under this Section includes requirements to furnish and install, complete, portable fire extinguishers.

B. Section includes:

1. Fire extinguishers

1.2 SUBMITTALS

A. Manufacturer, catalog data for each item including certifications and mounting information.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in Manufacturer's original, unopened protective packaging.

B. Store and handle products in accordance with Manufacturer's instructions to protect them from damage.

PART 2 PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

A. General

1. All Extinguishers:

a. UL listing
b. Charged and ready for service

2. Provide heavy-duty brackets with clip-together strap for wall mounting.

3. Manufacturers: Products of the following, or equal, meeting these Specifications, may be used on this Project:

a. Amerex Corp.
b. Ansul Co.
c. General Fire Extinguishing Corp.
d. J.L. Manufacturing Co.
e. Kiddle Belleville
f. Larsen's Manufacturing Co.
g. Modern Metal Products
h. Potter-Roemer, Inc.
i. W.D. Allen Manufacturing Co.

B. Multi-Purpose Hand Extinguisher (F. Ext-1)

1. Tri-class dry chemical extinguishing agent.
2. Pressurized, red enameled steel shell cylinder.
3. Activated by top squeeze handle.
4. Agent propelled through hose or opening at top of unit.
5. For use on A, B, and C class fires.
6. Minimum UL Rating: 4A-60B:C, 10-pound (4.5-kilogram) capacity.

PART 3 EXECUTION

3.1 INSTALLATION

A. Portable Fire Extinguishers

1. Provide at locations shown on Drawings.
2. Mount hangers securely in position, in accordance with Manufacturer's recommendations.
3. Top of Extinguisher: No more than 5 feet (1.5 meters) above the floor.

END OF SECTION

SECTION 22 10 00 - PLUMBING PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Work Included:

1. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Buried Within 5 feet ofBuilding
2. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Above Grade
3. Water Piping, Buried Within 5-feet of Building
4. Cleanouts

B. Related Sections:

1. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.2 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

B. In addition, meet the following:

1. NSF 61, Annex G.

2. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.

3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).

4. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.

5. Manufacturer's Standards Society (MSS) for valving and support referencestandard.

6. American Water Works Association (AWWA) for Valving Assembly Standards.

7. American Society of Sanitation Engineers (ASSE) for Valving Standards.

8. American National Standards Institute (ANSI) for Piping Standards.

9. NFPA Standard 51B - “Fire Prevention in Use of Cutting and Welding Processes”.

10. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSAB1375, or DIN 16892 and 16893.

1.3 SUBMITTALS

A. Provide shop drawings and technical literature covering details of equipment, fixtures, and accessories furnished under this section.

B. Provide list of recommended spare parts.

1.4 QUALITY ASSURANCE

A. Codes:

1. Comply with the rules and regulations of Authorities having jurisdiction over the work specified herein, including the 1991 Uniform Plumbing Code with local amendments.

2. Where specifically indicated, fixtures shall be provided and installed in accordance with ANSI A117.1: “Specifications for Making Buildings and Facilities Accessible to, and usable by, the Physically Handicapped.”

B. Obtain Permits and inspections as required by the various codes.

C. The Drawings shall be taken in a sense as diagrammatic. Size of pipes and general method of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that may be encountered.

1.5 WARRANTY

A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. See component manufacturers listed in individual articles below.

B. Uponor

C. Cerro

D. Tyler

E. ADS

F. Charlotte

G. Elkhart

H. Enfield

I. Fuseseal

J. Gruvlok

K. Spears

L. Nibco

M. Orion

N. American-USA

O. Sioux Chief

P. Viega

Q. Mueller

R. Or equal.

S. Cleanouts:

1. J.R. Smith
2. Zurn
3. Wade
4. Watts
5. Sioux Chief
6. Or equal.

T. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:

1. Hilti
2. Proset
3. Or equal.

2.2 GENERAL

A. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.

B. Manufactured materials delivered, new to the Project Site and stored in their original containers.

C. Product Marking: Furnish each item with legible markings indicating name brand and Manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

2.3 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.

1. Fittings: Cast iron.

2. Coupling Assembly:

a. Heavy Duty: ASTM C1540, Clamp-All Hi-Torq 125, Husky SD 4000, MissionHeavyWeight couplings.

B. PVC Pipe: ASTM D 2665 IPS Schedule 40, SOLID WALL piping for drainage/waste andvent (DWV).

1. Fittings: PVC DWV ASTM D2665.

2. Joints: Solvent welded, with ASTM D2564 solvent cement, 2-step glue (primer andglue) is required.

2.4 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE

1. Not used.

2.5 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B88, hard drawn, Type K (A).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper andbronze.
2. Joints: Brazed - BCuP2.

B. Ductile Iron Pipe: AWWA C151/A21.51.

1. Fittings: Ductile or gray iron, standard thickness.
2. Joints: AWWA C111/A21.11, rubber gasket with 3/4-inch diameter rods, mega lugtype.

2.6 HOT AND COLD DOMESTIC WATER ABOVE GRADE

A. Copper Tube: 3-inches and above. ASTM B88 (ASTM BA88m), Type L (B), Drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper andbronze.
2. Joints: Brazed BCuP2.

B. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.

1. Fittings: ASME B16.18 copper.
2. Joints: ASTM B32, alloy Sn95 solder.

C. Copper Tube: Water pressures up to 250 PSI gauge. ASTM B 88 (ASTM BA 88m), TypeK (A), Drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper andbronze.
2. Joints: Brazed BCuP2.

D. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn.

1. Fittings: ASME B16.22, wrought copper.
2. Joints: Roll grooved mechanical coupling. ASTM A536.

2.7 CONDENSATE PIPING

A. Not used.

2.8 PRIMER PIPING

A. Not used.

2.9 CHEMICAL RESISTANT DWV PIPING

A. High Silicon Alloy Cast Iron Pipe: At all locations and rated assemblies. 14.5 percentsilicon content ASTM A518 and A861.

1. Fittings: Matching high silicon alloy. Cast iron.

2. Joints: Acid resistant jute and poured lead or mechanical stainless steel fitting with PTFE/PFA liners.

B. Stainless Steel Pipe: Locations above grade. Austenitic 316 stainless steel.

1. Fittings: 316 stainless steel push fit (hub/spigot)

C. PVDF Pipe: At all locations and rated assemblies F1673.

1. Fittings: PVDF.
2. Joints: Socket thermal fusion ASTM 2657.

D. Polypropylene - Fire Retardant Pipe: All locations except plenums and rated assemblies. Polypropylene, flame retardant. ASTM F1412.

1. Fittings: Polypropylene.
2. Joints: Electrical resistance fusion. ASTM 1290.

2.10 CLEANOUTS

A. Locate cleanouts as shown on Drawings and as required by local code. Cleanoutssame size as pipe except that greater than 4-inches will not be required. Plastic components not allowed, except unless specifically noted.

B. Types:

1. Tile Floor Cleanouts: J. R. Smith 4020 with round heavy-duty nickel bronze top,taper thread, ABS plug and standard screws.

2. Carpeted Floor Cleanout: J. R. Smith 4020-X with carpet clamping frame, round heavy-duty nickel bronze top, taper thread, ABS plug, carpet clamping device andstandard screws.

3. Concrete Floor Cleanout (General): J. R. Smith 4020 with round heavy-duty nickelbronze top, taper thread and ABS plug with standard screws.

4. Parking, Drives and Concrete Floor Cleanouts (Heavy Load): J. R. Smith 4100 withround heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.

5. Wall Cleanout: J. R. Smith 4472-U, countersunk bronze taper thread plug,stainless steel shallow cover and vandal proof screws.

6. Outside Area Walks: J. R. Smith 4020-U with round heavy-duty nickel bronze top,taper thread, ABS plug and top secured with vandal proof screws. Install in 18- by18- by 6-inch-deep concrete pad flush with grade.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Underground Piping Systems:

1. Examination: Verify that excavations are to required grade, dry, and not over-excavated.

2. Perform necessary excavation and backfill required for installation of plumbing work. Repair piping or other work at no expense to Owner.

3. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand,crushed rock, or other approved material at no expense to Owner.

4. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of testing laboratory.

5. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (muck, peat), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose of site native excavation material. Adequate width of trench for properinstallation of piping or conduit.

6. Support Foundations:

a. Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction, and disposal of excavated materials to conform to requirements contained in other Specification Sections or Drawings.

b. Over-Excavations: Where trench excavation exceeds required depths, provide,place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.

c. Foundation Material: Where native material has been removed, place andcompact necessary foundation material to form base for replacement of required thickness of bedding material.

	Class A		Class B	
MaterialPassing	Min.	Max.	Min.	Max.
3/4-inchSquare Opening	27	47	0	1

d. Bedding Material: Full bed piping on sand, pea gravel, or 3/4-inch minus crushed rock. Place minimum 4-inch-deep layer of sand, pea gravel, or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe onbedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide firm foundation.

7. Backfilling:

a. Following installation and successful completion of required tests, backfillpiping in lifts.

1) In "Pipe Zone" place backfill material and compact in lifts not to exceed 6-inches in depth to height of 12-inches above top of pipe. Place backfillmaterial to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.

2) Place and compact backfill above "Pipe Zone" in layers not to exceed 12 inches in depth.

b. Backfill Material:

1) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand, or peagravel.

2) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."

8. Compaction of Trench Backfill:

a. Where compaction of trench backfill material is required, use one of followingmethods or combination thereof:

1) Mechanical tamper,
2) Vibratory compactor, or
3) Other approved methods appropriate to conditions encountered.

b. Architect to have right to change methods and limits to better accommodatefield conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.

B. General Installation:

1. Work performed by experienced journeyman plumbers. No exceptions.

2. Provide access panels for concealed valves, shock arrestors, trap primers and thelike.

3. Install pipes and pipe fittings in accordance with recognized industry practices and Manufacturer's recommendations.

4. Align piping accurately at connections, within 3/32-inch misalignment tolerance.Comply with ANSI B31 Code for Pressure Piping.

5. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.

    a. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.

    b. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24-inches horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.

    c. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.

    d. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.

    e. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.

    f. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by Contractor at completion; such items to remain Contractor property.

    g. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Install mating flange faces true and parallel to each other and not requiring springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.

    h. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.

    i. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to, or greater than, the maximum working pressure of the system.

    j. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit

venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.

k. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors, or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.

C. Testing:

1. General:

a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) isinstalled and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and time.

b. Notify Architect and local Plumbing Inspector 2 days before tests.

c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbingcode or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

e. Send test results to Architect for review and approval and include inOperation and Maintenance Manual.

2. Testing of Pressurized Systems:

a. Test each pressurized piping system at 150 percent of operating pressureindicated, but not less than 125 PSIG test pressure.

b. Observe each test section for leakage at end of test period. Test fails if leakageis observed or if pressure drop exceeds 2 percent of test pressure.

3. Test hot and cold domestic water piping systems upon completion of rough-inand before connection to fixtures at hydrostatic pressure of 125 PSIG.

D. Corrosive Soil Conditions:

1. Wrap steel, iron, copper, or other metal piping materials/fittings with ProtectoWrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per Manufacturer's recommendations.

2. Provide epoxy coated cast iron pipe and fittings for drainage systems.

3. Obtain and review Project soils report for verification of requirements concerningcorrosive soils.

E. Protection:

1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment, and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.

F. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled holeand pipe passing through to meet requirements of ASTM E814.

G. Cut piping squarely, free of rough edges and reamed to full bore. Insert piping fully into fittings.

H. Provide joints of type indicated in each piping system.

I. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by Pipe/Fitting Manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.

J. Sleeves:

1. Pipe Sleeves:

a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.

b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with non-shrinking grout or approved caulking compound (Except DWV Piping penetrating a concrete slab set on finish grade), provide "Link-Seal" sleeve sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements

c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing

through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.

d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.

2. Installation of metallic or plastic piping penetrations through non-fire-rated walls and partitions and through smoke-rated walls and partitions:

a. Install fabricated pipe sleeve.

b. After installation of sleeve and piping, tightly pack entire annular voidbetween piping or piping insulation and sleeve identification.

c. Seal each end airtight with a resilient nonhardening seal per code.

3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:

a. Select and install pre-engineered pipe penetration system in accordance withUL listing and Manufacturer's recommendation.

b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.

3.2 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Excavation and Backfill:

1. See 3.1.A. above.

B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, topermit system to be filled with water and subjected to water pressure of minimum of5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections ifminimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

C. Corrosive Soil Conditions:

1. Wrap steel, iron, copper, or other metal piping materials/fittings with ProtectoWrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per Manufacturer's requirements.

2. Provide epoxy coated cast iron pipe and fittings for drainage systems.

D. Cast-Iron Joints: Comply with Coupling Manufacturer's Cast Iron Soil Pipe InstituteStandards and installation instructions.

E. Sanitary and Storm Drainage:

1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.

2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings.Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60-inches.

3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures arespecified in Section 22 40 00, Plumbing Fixtures.

4. Drains:

a. Install drains to suit finished floor. Install drains and components per Manufacturer's instructions. Slope flooring to floor drain or sink a minimum of1/2-inch below finished floor elevation.

b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of thesame materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.

5. Wall Access Panel: Secure to wall framing and install so that flange forms a close-fitting joint with the finished wall surface.

6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.

7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

F. Epoxy Coated Cast Iron Pipe and Fittings: Coat the piping terminus of any cut pipingwith an applied epoxy per Manufacturer's instructions. Denso Protal 7200 fast-cure epoxy repair coating.

3.3 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE

A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, topermit system to be filled with water and subjected to water pressure of minimum of5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections ifminimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

B. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled holeand pipe passing through to meet requirements of ASTM E814.

C. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and CopperDevelopment Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.

D. Cast-Iron Joints: Comply with Coupling Manufacturer's Cast Iron Soil Pipe InstituteStandards and installation instructions.

E. Sanitary and Storm Drainage:

1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.

2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings.Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60 inches.

3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures arespecified in Section 22 40 00, Plumbing Fixtures.

4. Drains:

a. Install drains to suit finished floor or roof surface. Install drains and components per Manufacturer's instructions. Slope flooring to floor drain orsink a minimum of 1/2-inch below finished floor elevation.

b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of thesame materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.

5. Wall Access Panel: Secure to wall framing and install so that flange forms a close-fitting joint with the finished wall surface.

6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.

7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

3.4 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Excavation and Backfill:

1. See 3.1.A. above.

B. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

C. Domestic Water:

1. "Piping" to include pipes, fittings, nipples, valves, and accessories connectedthereto.

2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits, and work of other trades, and as close to ceilingor other construction as practical, free of unnecessary traps or bends.

3. Grade water supply piping for complete drainage of the system. Install hose bibbsat low points.

4. Use unions for piping connections to equipment.

5. Provide sufficient elbows, swings, and offsets to permit free expansion andcontraction.

6. Use reducers or increasers. Use no bushings.

7. Ream or file each pipe to remove burrs. Inspect each length of pipe and eachfitting for workmanship and clear passageways.

8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report onfinal water quality results.

9. Install exposed connections to equipment with special care, showing no toolmarks or threads at fittings and piping. No bowed or bent piping permitted.

10. Make ferrous to non-ferrous connections with dielectric fittings.

11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2inches. Use no close nipples. Use only shoulder-type nipples.

12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wroughtcopper elbow which securely anchors ears in wall at through-wall pipes.

13. Provide drain valves at base of risers and at low points on the system.

14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.

D. Sterilization of Domestic Water System:

1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.

2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. Afterretention, drain, reflush and return system to service.

3. Certification: Provide copy of domestic water chlorination certificate in eachoperation and maintenance manual.

4. Provide water line disinfections performed by a licensed contractor with trainingin potable water line disinfections.

E. Buried Pre-Insulated Pipe Installation:

1. Installation and Testing: Install and test products in accordance with Manufacturer's installation instructions.

2. Manufacturer's installation instructions are to describe the following:

a. Storage and handling of pipes.
b. Trench preparation.
c. Installing pipe.
d. Installing accessories.
e. Installing fittings.
f. Building penetrations.
g. Field insulation kits.
h. Testing.

3.5 HOT AND COLD DOMESTIC WATER ABOVE GRADE

A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

B. Testing of Pressurized Systems:

1. Test each pressurized piping system at 150 percent of operating pressureindicated, but not less than 125 PSIG test pressure.

2. Observe each test section for leakage at end of test period. Test fails if leakage isobserved or if pressure drop exceeds 2 percent of test pressure.

C. Test hot and cold domestic water piping systems upon completion of rough-in andbefore connection to fixtures at hydrostatic pressure of 125 PSIG.

D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled holeand pipe passing through to meet requirements of ASTM E814.

E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and CopperDevelopment Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.

F. Braze copper tube and fitting socket with BCuP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWSFB3A or FB3C.

"Shock" cooling is prohibited. A continuous fillet is to be visible aroundthe completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCuP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.

G. Domestic Water:

1. "Piping" to include pipes, fittings, nipples, valves, and accessories connected thereto.

2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits, and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.

3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.

4. Use unions for piping connections to equipment.

5. Provide sufficient elbows, swings, and offsets to permit free expansion and contraction.

6. Use reducers or increasers. Use no bushings.

7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.

8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.

9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.

10. Make ferrous to non-ferrous connections with dielectric fittings.

11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2 inches. Use no close nipples. Use only shoulder-type nipples.

12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.

13. Provide drain valves at base of risers and at low points on the system.

14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.

H. Sterilization of Domestic Water System:

1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.

2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.

3. Certification: Provide copy of domestic water chlorination certificate in each operation and maintenance manual.

4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

3.6 CONDENSATE PIPING

A. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled holeand pipe passing through to meet requirements of ASTM E814.

3.7 PRIMER PIPING

A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, topermit system to be filled with water and subjected to water pressure of minimum of5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections ifminimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

3.8 CHEMICAL RESISTANT DWV PIPING

A. Installation Guidelines for Polypropylene Pipe:

1. Install hangers and supports at intervals specified in the applicable Plumbing Codeand as recommended by Pipe Manufacturer.

2. Support vertical piping at each floor and as specified in the applicable PlumbingCode.

3. Fusion Welding of Joints:

a. Install fittings and joints using socket-fusion, electrofusion, or butt-fusion as applicable for the fitting type. Make fusion-well joints in accordance with thePipe and Fitting Manufacturer's specifications and product standards.

b. Fusion-weld tooling, welding machines, and electrofusion devices as specifiedby the Pipe and Fittings Manufacturer.

c. Prior to joining, prepare the pipe and fittings in accordance with F 2389 andthe Manufacturer's specifications.

d. Joint preparation, setting and alignment, fusion process, cooling times andworking pressure to be in accordance with Manufacturer's installation guidelines.

B. Testing of Pressurized Systems:

1. Test each pressurized piping system at 150 percent of operating pressureindicated, but not less than 125 PSIG test pressure.

2. Observe each test section for leakage at end of test period. Test fails if leakage isobserved or if pressure drop exceeds 2 percent of test pressure.

C. Test hot and cold domestic water piping systems upon completion of rough-in andbefore connection to fixtures at hydrostatic pressure of 125 PSIG.

D. Corrosive Soil Conditions:

1. Wrap steel, iron, copper, or other metal piping materials/fittings with ProtectoWrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per Manufacturer's requirements.

2. Provide epoxy coated cast iron pipe and fittings for drainage systems.

E. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

3.9 CLEANOUTS

A. Install in aboveground piping and building drain piping as indicated, as required by code; at each change in direction of piping greater than 135 degrees; at minimum intervals of 100-feet; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping. Select type to match adjacent building finish. Provide shop drawings to Architect to coordinate locations and types of cleanouts with Architect prior to installation.

B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

C. Corrosive Soil Conditions:

1. Wrap steel, iron, copper, or other metal piping materials/fittings with ProtectoWrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per Manufacturer's requirements.

2. Provide epoxy coated cast iron pipe and fittings for drainage systems.

D. Cast-Iron Joints: Comply with Coupling Manufacturer's Cast Iron Soil Pipe InstituteStandards and installation instructions.

END OF SECTION

SECTION 22 14 29 - SUMP PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sump pumps.

B. Related Sections:

1. Section 22 10 00 – Plumbing Piping.

1.2 DESING REQUIREMENTS

A. Design Criteria:

1. Refer to schedule at end of this section.

1.3 SUBMITTALS

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

B. Shop Drawings:

1. Submit installation details for pumps, piping, controls, and accessories including wiring schematics.

C. Product Data: Submit data for specified Products.

D. Manufacturer’s Certificates: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NTUA standards.

1.6 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing work of this section approved by Manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Prepare pumps and accessories for shipment to prevent entry of foreign matter into product body.

C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.9 COORDINATION

A. Coordinate work with NTUA.

PART 2 PRODUCTS

2.1 SUMP PUMPS

A. Materials:

1. Impeller: Cast iron, semi-open, non-clog.
2. Casing: Cast iron.
3. Mechanical Seal: Silicon carbide.
4. Shaft: Stainless steel.
5. Designed for continuous operation.
6. Bearings: Upper and lower heavy duty ball bearings.

2.2 PUMP MOTORS

A. Fully submerged in high-grade turbine oil for lubrication and efficient heat transfer.

B. Power Cable: Severe duty rated, oil and water resistant, epoxy seal on motor end.

C. Built-in overload with automatic reset.

D. Class B insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Verify connections, size, and location are as indicated on Drawings.

3.2 INSTALLATION

A. Install sump pumps in accordance with Drawings and Manufacturer’s instructions.

B. Provide necessary piping, fittings, and valves as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation, examine, adjust, and test each pump for proper operation.

B. Test each pump with clean water through minimum of four complete cycles.

3.4 MANUFACTURER'S FIELD SERVICES

A. Not used.

3.5 SCHEDULES

A. Not used.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Moving and Conditioning Association, Inc. (AMCA): 203, Field Performance Measurement of Fan Systems.

2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): HVAC Applications Handbook.

3. Associated Air Balance Council (AABC): National Standards for Field Management and Instrumentation Total System Balance.

4. National Environmental Balancing Bureau (NEBB):

   a. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.

   b. Procedural Standards for Measuring Sound and Vibration.

5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): HVAC Testing, Adjusting, and Balancing Manual.

1.2 SUBMITTALS

A. Informational Submittals:

1. Documentation of experience record of testing authority.

2. Documentation of current AABC or NEBB certifications for those technicians in responsible charge of the work under this Contract.

3. Submit detailed test and balance procedures, including test conditions for systems to be tested, prior to beginning the Work.

4. Written verification of calibration of testing and balancing equipment.

5. Balancing Log Report following completion of system adjustments including test results, adjustments, and rebalancing procedures.

1.3 QUALITY ASSURANCE

A. Air Balancing and Vibration Test Agency Qualifications: Have a proven record of at least five similar projects.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide materials, tools, test equipment, computers, and instrumentation required to complete the work included.

B. Test Hole Plugs: Plug test holes in ducts with plugs made for that purpose and replace any insulation removed to specified conditions.

PART 3 EXECUTION

3.1 GENERAL

A. Adjust and balance exhaust and supply air systems in accordance with standard procedures and recognized practices of the AABC or SMACNA.

3.2 AIR SYSTEM ADJUSTING AND BALANCING

A. Preparation: Prior to beginning the Work, perform the following activities:

1. Review Shop Drawings and installed system for adequate and accessible balancing devices and test points.

2. Recommend to Engineer dampers that need to be added or replaced in order to obtain proper air control.

3. Verify proper startup procedures have been completed on the system

4. Verify controls installation is complete and system is in stable operation under automatic control.

5. Verify test instruments have been calibrated to a recognized standard and are within Manufacturer's recommended calibration interval before beginning the Work.

B. General:

1. When adjustments are made to a portion of a fan system, reread other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.

2. Lock and mark final positions of balancing dampers with permanent felt pen.

3. Adjust or correct fan and airflow measurements as required for actual cubic feet per minute measured at Site elevation.

C. Equipment Data: Collect the following data and included in final report:

1. Type of unit

2. Equipment identification number

3. Equipment nameplate data (including Manufacturer, model, size, type, and serial number)

4. Motor data (frame, horsepower (hp), volts, full load amps rate per minute (FLA rpm), and service factor)

5. Sheave Manufacturer, size, and bore

6. Sheave centerline distance and adjustment limits

7. Starter and motor overload protection data

8. Include changes made during course of system balancing.

D. Fan Systems:

1. Measure fan system performance in accordance with AMCA 203.

2. In each system at least one airpath from fan to final branch duct termination shall have dampers fully open. Achieve final air quantities by adjusting fan speed.

3. Adjust Fan Air Volumes:

a. Adjust fan speeds and motor drives for required equipment air volumes, with allowable variation of plus 10 percent minus 0 percent.

b. After final adjustments, do not operate motor above nameplate amperage on any phase.

c. After final adjustments, do not operate fan above maximum rated speed.

d. Perform airflow test readings under simulated or actual conditions.

4. Adjust outside air dampers, supply air dampers, exhaust air dampers, and motorized louvers for maximum and minimum air requirements.

5. Read and record static pressures at unit inlet and discharge, each filter set, coils, dampers, plenums, and mixing dual-duct or adjustable-volume boxes, on every supply, return, and exhaust fan for each test condition.

6. Read and record motor amperage on all phases for each test condition.

E. Air Outlets and Inlets:

1. In each system at least one air path from fan to final branch duct termination shall have dampers fully open.

2. Adjust air volumes on exhaust and supply diffusers and grilles, with allowable variation of plus or minus 10 percent.

3. Adjust diffusers and grilles for proper deflection, throw, and coverage. Eliminate drafts and noise where possible.

4. After final adjustments are made secure dampers to prevent movement and mark final positions with permanent felt pen.

F. Building Static Pressure: Measure building static pressure relative to outside in perimeter entrances during normal system conditions that would yield widest range in internal building pressure. Adjust accordingly to maintain minimum of 0.05-inch water column (WC) negative pressure in the room with entrance doors closed to outside.

3.3 FIELD QUALITY CONTROL

A. Vibration Performance Testing:

1. Upon completion of air system balance, perform vibration testing for all fans except restroom fan.

2. Take measurements at each bearing housing using calibrated electronic analyzer.

3. Measure velocity in direction parallel to rotating shaft, and in two directions perpendicular to shaft and to each other. Align measurement directions where possible to the horizontal and vertical planes.

4. Record log shall include equipment symbol or tag, location, identification, specified vibration velocity limits, and maximum measured velocity in each direction.

5. Notify Engineer if amplitude exceeds upper limit specified.

END OF SECTION

SECTION 23 83 00 – HEATING UNITS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Provisions of Division 23 Heating, Ventilation and Air Conditioning apply to this section.

1.2 DESCRIPTION

A. Work in this section includes self-contained heating units such as unit heaters, convectors, finned pipe units, cabinet heaters, and radiant heaters.

1.3 REGULATORY AGENCIES

A. All work shall be in conformance with the requirements of the applicable codes.

1.4 REFERENCE STANDARDS

A. The publications of the organizations listed below form a part of this specification to the extent referenced.

1. National Electrical Manufacturers Association (NEMA)
2. Underwriters Laboratories (UL)

1.5 SUBMITTALS

A. Product Data

1. Electric Unit Heaters

PART 2 PRODUCTS

2.1 ELECTRIC UNIT HEATERS

A. Manufacturers:

1. Resznor, EUH
2. Qmark, MUH
3. Chromalox, LUH
4. Or Equal

B. Unit heaters shall be electric coil, horizontal blow type with propeller fan, size and capacity as scheduled

C. Heaters shall be completely factory wired and assembled, with all required electrical power devices and accessories, including automatic re-setting overheat control, wall bracket, contactors, fuses, transformer, and terminal blocks. Unit shall be UL approved.

D. Heater shall provide the airflow and heating capacity as shown on the Drawings.

E. Heater shall be protected from air flow failure, so heater is inoperative unless fan is running.

F. Heater shall be wall mounted using the supplier's wall mounting bracket.

G. Controls: Heater shall be controlled from the SCADA PLC. Provide transformer as needed.

PART 3 EXECUTION

3.1 INSTALLATION

A. All equipment and accessories shall be installed with required clearances from combustible surfaces. Provide a minimum of 36" clearance in front of the electrical access panel.

B. Install heater suspended by four, 3/8" steel threaded rod supports from roof structure.

C. When using a non-integral thermostat, install thermostat outside the heater's direct fan exhaust path to avoid on/off cycling.

END OF SECTION

SECTION 23 34 00 - HVAC FANS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Acoustical Society of America (ASA)
2. Air Movement and Control Association International (AMCA)
3. American Bearing Manufacturers Association (ABMA)
4. ASTM International (ASTM)
5. National Electrical Manufacturers Association (NEMA)
6. Occupational Safety and Health Act (OSHA)
7. Underwriters Laboratories Inc. (UL)

1.2 SUBMITTALS

A. Action Submittals: Provide for all products specified, as follows:

1. Unit tag number or equipment identification as referenced in Contract Documents.
2. Manufacturer's name and model number.
3. Descriptive specifications, literature, and drawings.
4. Dimensions and weights.
5. Fan sound power level data (reference 10 to power minus 12 Watts) at design operating point.
6. Fan Curves:
    a. Performance Curves Indicating:
        1) Relationship of flow rate to static pressure for various fan speeds.
        2) Brake horsepower curves.
        3) Acceptable selection range (surge curves, maximum revolutions per minute, etc.).
        4) Static pressure, capacity, horsepower demand, and overall efficiency required at the duty point, including drive losses.
7. Capacities and ratings.
8. Construction materials.
9. Fan type, size, class, drive arrangement, discharge, rotation, and bearings.
10. Wheel type, diameter, revolutions per minute, and tip speed.
11. Motor and Power Data: Refer to Section 26 20 00, Low Voltage AC Induction Motors.

12. Manufacturer's standard vibration isolation accessories.

13. Factory finish system.

B. Informational Submittals:

1. Recommended procedures for protection and handling of products prior to installation.

2. Manufacturer’s installation instructions, including seismic anchorage and bracing requirements.

3. Factory test reports.

4. Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 FAN DRIVES

A. Drive assembly shall be sized for a minimum 140 percent of fan motor horsepower rating.

B. Shaft Guard:

1. Provide shaft guard for each fan and drive not housed in its own fan enclosure.

2. Shaft guards shall be easily removable and enclose entire drive assembly, meeting federal and OSHA requirements.

3. Guard faces shall be constructed of expanded metal having minimum 60 percent free area for ventilation.

2.2 FINISHES

A. Carbon Steel Parts: Factory finish as follows, unless indicated otherwise.

1. Parts cleaned and chemically pretreated with a phosphatizing process.
2. Alkyd enamel primer.
3. Air-dry enamel topcoat.

B. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.

C. Stainless Steel Parts: Finished smooth and left unpainted.

2.3 DIRECT DRIVE SIDWALL MOUNTED FANS

A. General Description:

1. Fan arrangement shall be exhaust, see Fan Schedule

2. Sidewall mounted applications

3. Maximum continuous operating temperature 130 Fahrenheit (F)

4. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

B. Wheel:

1. Propeller shall be aluminum blade riveted to steel hub

2. A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft

3. Statically and dynamically balanced in accordance with AMCA Standard 204-05

4. The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency

C. Motors:

1. Motor enclosures: Totally enclosed fan cooled

2. Motors are permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at 120 voltage and single phase

3. Accessible for maintenance

D. Drive Frame:

1. Drive frame assemblies and fan panels shall be galvanized steel.

2. Drive frame shall have welded wire or formed channels and fan panels shall have pre-punched mounting holes, formed flanges, and a deep formed one-piece inlet venturi.

E. Disconnect Switches:

1. NEMA rated: 4X

2. Positive electrical shut-off

3. Wired from fan motor to junction box

4. Dampers:

a. Type: Gravity
b. Prevents outside air from entering back into the building when fan is off
c. Balanced for minimal resistance to flow
d. Galvanized frames with pre-punched mounting holes

5. Dampers Guards:

a. Guard material: Galvanized
b. Shall completely enclose the damper or wall opening on the discharge side of the fan.

F. Manufacturers and Products:

1. Greenheck; SE1-12
2. Or equal

2.4 MOTORS

A. General:

1. Provide integral self-resetting overload protection on single-phase motors.
2. Motors shall not operate into service factor in any case.

B. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:

1. Electrically commutated, permanent magnet type
2. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily
3. Solid state electronics
4. Shaft Type: Solid, carbon steel
5. Mounting: As required for fan arrangement

2.5 ACCESSORIES

A. Equipment Identification Plates: Furnish 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 3/8-inch high engraved or die-stamped block type equipment identification number and letters indicated in this Specification and as shown on Drawings. All units shall include factory installed permanently attached nameplate displaying unit model and serial number.

B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fans level and plumb.

B. Labeling: Label fans in accordance with Article Accessories.

C. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.

D. Connections:

1. Refer to Section 23 31 13, Metal Ducts and Accessories.
2. Isolate duct connections to fans.
3. Install ductwork adjacent to fans to allow proper service and maintenance.

3.2 FIELD QUALITY CONTROL

A. Functional Tests:

1. Verify blocking and bracing used during shipping are removed.

2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.

3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.

4. Verify that cleaning and adjusting are complete.

5. Verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.

6. Verify lubrication for bearings and other moving parts.

7. Verify manual and automatic volume control and dampers in connected ductwork are in fully open position.

B. Performance Tests:

1. Starting Procedures:

a. Energize motor and adjust fan to indicated revolutions per minute.
b. Measure and record motor voltage and amperage.

2. Operational Test:

a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.

c. Test and adjust control safeties.

d. Replace damaged and malfunctioning controls and equipment.

3.3 CLEANING

A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

B. On completion of installation, internally clean fans according to Manufacturer’s written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

3.4 SUPPLEMENT

A. Not used.

END OF SECTION

SECTION 23 31 13 - METAL DUCTS AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Movement and Control Association (AMCA): 500, Test Methods for Louvers, Dampers and Shutters

2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook

3. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems

4. Association of the Nonwoven Fabrics Industry (INDA): IST 80.6, Water Resistance (Hydrostatic Pressure)

5. ASTM International (ASTM):

   a. A36/A36M, Standard Specification for Carbon Structural Steel

   b. A90/A90M, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

   c. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

   d. A176, Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip

   e. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

   f. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

   g. A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

   h. A653/A653M, Standard Specifications for Steel Sheet, Zinc- Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

   i. A700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment

   j. A924/A924M, Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process

k. A1008/A1008M, Standard Specification for Steel, Sheet, Cold- Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

l. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High- Strength Low- Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

m. B209, Standard Specification for Aluminum and Aluminum- Alloy Sheet and Plate

n. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

o. C916, Standard Specification for Adhesives for Duct Thermal Insulation

p. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)

q. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications

r. E84, Standard Test Method for Surface Burning Characteristics of Building Materials

s. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials

6. National Air Duct Cleaners Association (NADCA): General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems

7. National Fire Protection Association (NFPA):

   a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems

   b. 90B Standard for the Installation of Warm Air Heating and Air- Conditioning Systems

   c. 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

   d. 255, Standard Method of Test of SurfaceBurning Characteristics of BuildingMaterials

   e. 259, Standard Test Method for Potential Heat of Building Materials

   f. 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):

   a. Duct Construction Standards
   b. Guidelines for Seismic Restraints of Mechanical Systems
   c. Fibrous Glass Duct Construction Standards
   d. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems
   e. HVAC Air Duct Leakage Test Manual

9. Underwriters Laboratories Inc.(UL):

    a. 181, Standard for Safety Factory-Made Air Ducts and Connectors
    b. 214, Standard for Tests for Flame-Propagation of Fabrics and Films
    c. 555, Standard for Safety Fire Dampers
    d. 555S, Standard for Safety Smoke Dampers

1.2 DEFINITIONS

A. The following is a list of abbreviations which may be used in this section:

1. CFM: cubic feet per minute
2. FPM: feet per minute
3. PCF: pounds per cubic foot
4. WC: water column

B. Sealing Requirements: For the purpose of duct systems sealing requirements specified in this section, the following definitions apply:

1. Seams: Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on perimeter are deemed to be joints.

2. Joints, duct surface connections including:

    a. Girth joints
    b. Branch and subbranch intersections
    c. Duct collar tap-ins
    d. Fitting subsections
    e. Louver and air terminal connections to ducts
    f. Access door and access panel frames and jambs
    g. Duct, plenum, and casing abutments to building structures

1.3 SUBMITTALS

A. Action Submittals:

1. Ductwork Product Data: Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, hangers and supports, seam and construction details, and finishes.

    a. Ductwork Accessories: Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, and finishes.

B. Informational Submittals: Seismic anchorage and bracing drawings, cut sheets, and calculations as required by Section 01 88 15, Anchorage and Bracing.

PART 2 PRODUCTS

2.1 GENERAL

A. Specified components of this ductwork system, including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.

B. Ductwork material shall be aluminum or galvanized steel, minimum thickness 24-gauge.

C. Duct Sealants: Adhesives, cements, and sealants shall be as recommended by Duct Manufacturer for industrial applications.

D. Ductwork Interior Surfaces:

1. Smooth

2. No sheet metal parts, tabs, angles, or other items may project into air ducts, unless otherwise specified.

3. Seams and joints shall be external.

2.2 SHEET METAL MATERIALS

A. Construct supply and exhaust duct systems from aluminum or galvanized steel construct odor control duct systems from stainless steel as specified herein.

B. Galvanized Steel Ductwork:

1. Comply with ASTM A653/A653M and ASTM A924/924M.

2. Product Name: Steel Sheet, Zinc Coated (Galvanized Steel)

3. Sheet Designation: CS Type B

4. Applicable Specification: ASTM A653/A653M

5. (Zinc) Coating Designation: G90

6. Coating designation in accordance with Test Method A, ASTM A90/A90M and ASTM A924/A924M.

7. Provide mill-phosphatized finish for ducts exposed to view and for ducts scheduled to be painted.

8. Provide sheet metal packaged and marked as specified in ASTM A700.

C. Aluminum Ductwork:

1. Comply with ASTM B209.
2. Aluminum Sheet: Alloy 3003-H14, unless indicated otherwise.
3. Aluminum Connectors and Bar Stock: Alloy 6061-T6, or equivalent.

D. Stainless Steel Ductwork:

1. Not used.

E. Exposed Ductwork: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discoloration, and other imperfections, including those which would impair painting.

F. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.3 DUCT SEALING MATERIALS

A. General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

B. Adhesives, Cements, Sealant, and Installation Accessories: As recommended by Duct Manufacturer for application.

C. Solvent-Based Sealants:

1. Ultraviolet light resistant

2. Mildew resistant

3. Flashpoint: Greater than 70 degrees Fahrenheit (F), SETACC.

4. Manufacturers and Products:

a. Hardcast, Inc.; Versagrip 102
b. Rectorseal; AT-33
c. Childers CP-140

D. Water-Based Sealants:

1. Listed by Manufacturer as nonflammable in wet and dry state.

2. Manufacturers and Products:

a. Foster; Series 32
b. Childers; CP-145A, 146
c. Rectorseal; Airlok 181

E. Do not use silicone sealants at odor control ducting. Instead, utilize expanded Teflon (Gortex), or a Hypalon product.

2.4 DUCTWORK FASTENERS

A. General:

1. Rivets, bolts, or sheet metal screws.
2. Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.

B. Self-Drilling Screws:

1. Galvanized Steel Ductwork System: Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish.

2. Aluminum Ductwork System:

a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated Type 410 stainless steel, complete with bonded metal and fiber washer for dielectric separation.

b. Manufacturers:

1) DB Building Fasteners Inc., Santa Fe Springs, CA
2) Clark Craft Fasteners, Tonawanda, NY

3. Stainless Steel Ductwork System:

a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated, Type 410 stainless steel.

b. Manufacturers:

1) DB Building Fasteners Inc., Santa Fe Springs, CA
2) Clark Craft Fasteners, Tonawanda, NY

2.5 DUCTWORK PRESSURE CLASS

A. Construct duct systems to pressure classifications indicated as follows:

1. Supply Ducts: 3-inch WC
2. Return Ducts: 2-inch WC, negative pressure
3. Exhaust Ducts: 2-inch WC, negative pressure

B. Where no specific duct pressure designations are indicated in Specifications or on Drawings, 2-inch WC pressure class shall be basis of Contract.

2.6 RECTANGULAR DUCTWORK

A. Fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise.

B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20-gauge or less, with more than 10 square feet of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

2.7 RECTANGULAR DUCTWORK FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.

B. Elbows:

1. Fit square-turn elbows with vane siderails.

2. Shop fabricate double blade turning vanes of same material as ductwork.

3. Fabricate with equal inlet and outlet.

4. Rectangular radius elbows with inside radius of 3/4 of duct width in direction of turn.

5. Manufacturers and Products:

a. Elgen; All-Tight
b. Duro-Dyne; Type TR

2.8 RECTANGULAR DUCTWORK BRANCH CONNECTIONS

A. Branch duct connections to rectangular duct mains shall be made using factory fabricated fittings with spot welded tap to main duct connections or with factory fabricated, field installed taps, with spin-in or mechanical fastened tap to main duct connections.

2.9 RIGID ROUND DUCTWORK

A. Construct rigid round ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise.

B. Basic Round Diameter: As used in this Article, is inside diameter of size of round duct.

C. Where space limitations prevent use of round duct or where shown on Drawings, provide ductwork of flat oval construction hydraulically equivalent to round ductwork.

D. Fabricate round ducts with spiral seam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams.

E. Ductwork seams of Snaplock type shall not be used.

2.10 RIGID ROUND DUCTWORK FITTINGS

A. Construct rigid round ductwork fittings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless otherwise specified.

B. 90-Degree Tees, Laterals, and Conical Tees: Fabricate to conform to SMACNA manual with metal thicknesses specified for longitudinal seam straight duct.

C. Diverging Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.

D. Elbows:

1. Fabricate in stamped (die-formed), pleated, or segmented (gored) construction 1-1/2 times elbow diameter. Two-piece segment elbows are not allowed, except with turning vanes.

2. Segmented Elbows: Fabricate with welded construction.

3. Round Elbows 8 Inches and Smaller:

   a. Stamped elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees configuration.

   b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 3-1/2 inches and 4-1/2 inches) elbows with segmented construction.

4. Round Elbows 9 Inches Through 14 Inches:

   a. Segmented or pleated elbows for 30, 45, 60, and 90 degrees.

   b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 9-1/2 inches and 10-1/2 inches) elbows with segmented construction.

2.11 DUCTWORK FLEXIBLE CONNECTIONS

A. General:

1. Factory fabricated metal-edged fabric flexible connectors for commercial or industrial applications.

2. Sheet metal permanently secured to fabric with double fabric fold, double metal crimp.

3. Comply with NFPA 90A and NFPA 90B requirements.

4. Airtight and waterproof.

B. Materials:

1. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

2. Metal Edges: Construct from same material as ductwork, unless otherwise noted.

3. Fabric:

   a. Comply with NFPA 701 or UL 214 (except Teflon coated)
   b. Woven polyester or nylon

C. Construction:

1. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.

2. Standard Metal Edged Connectors: Strip of fabric 3 inches wide attached to two strips of 3-inch-wide sheet metal.

3. Wide Metal Edged Connectors: Strip of fabric 4 inches wide attached to two strips of 4-inch-wide sheet metal.

4. Extra Wide Metal Edged Connectors: Strip of fabric 6 inches wide attached to two strips of 6-inch-wide sheetmetal.

D. Manufacturers:

1. Ductmate; PROflex, Commercial
2. Ventfabrics
3. Duro-Dyne

2.12 DUCTWORK HANGERS AND SUPPORTS

A. General:

1. Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed.

2. Duct hanging system shall be composed of three elements: upper attachment to building, hanger itself, and lower attachment to duct.

3. Wire hangers are notacceptable.

4. Hanger Spacing:

a. Ducts Up to 60 inches in Largest Dimension: 10 feet, maximum.
b. Ducts Over 61 inches in Largest Dimension: 8 feet, maximum.

B. Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:

1. Of same material asductwork.

C. Building Attachments:

1. Concrete inserts, powder-actuated fasteners, or structural steel fasteners appropriate for building materials.

2. Do not use powder-actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.

3. Upper Attachment(Concrete):

a. Drive pin fastener and expansion nail anchor may be used for ducts up to 18-inch maximum dimension.

b. Threaded stud fastener may be used for ducts up to 36-inch maximum dimension.

c. Concrete attachments shall be made of steel.

D. Duct Fasteners: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials and conforming to requirements of Article DuctworkFasteners.

E. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36/A36M, hot-dipped galvanized after fabrication.

2.13 DOUBLE WALL DUCTWORK

A. Not used.

2.14 BACDRAFT DAMPERS

A. Greenheck Model: EM-30 or equal.

B. Ratings

1. Leakage: Dampers shall have a maximum leakage of 8.9 cfm/ft^2 @ 1 in. wg. with a width or height of 24 in. or greater. Tested in accordance with AMCA standard 500-D.

2. Differential Pressure: Dampers shall have a maximum differential pressure rating of 4 in. wg.

3. Velocity: Dampers shall have a maximum velocity rating of 3500 fpm.

C. Construction:

1. Frame: Damper frame shall be 18 ga. galvanized steel frame with screwed corners. Blade orientation is horizontal. (GM-30)

2. Blades: Damper blades shall be .070 in. extruded aluminum (6063T5). Blade orientation is horizontal.

3. Seals:Blade seals shall be Vinyl, which are mechanically fastened to each blade.

4. Linkage: On blade, plated steel material. (EM series and GM-30)

5. Axles: Aluminum. (EM series and GM-30)

6. Bearings: Axle bearings shall be synthetic (acetal) sleeve.

7. Finish: Mill finish is standard. Paint coatings are optional. (EM series and GM-30)

D. Factory Tests: Factory cycle damper and actuator assemblies to assure proper operation.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Install sheet metal ductwork and flexible ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B.

2. Install ductwork using Manufacturer’s recommended adhesives, cement, sealant, and insulation accessories.

3. Joints and seams shall be sealedwatertight.

4. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth.

5. Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be installed, sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.

B. Ductwork Location:

1. Locate ductwork runs vertically and horizontally, unless otherwise indicated.

2. Avoid diagonal runs wherever possible.

3. As indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment.

4. In general, install as close to bottom of structure as possible.

5. For ductwork concealed above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.

6. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

7. Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to bottom of structure immediately adjacent to obstruction.

C. Penetrations:

1. Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls, and ceilings.

2. Clearances:

a. For uninsulated ducts, allow 1-inch clearance between duct and sleeve, except at grilles, registers, and diffusers.

b. For insulated ducts, allow 1-inch clearance between insulation and sleeve, except at grilles, registers, and diffusers.

3. Closure Collars:

a. Minimum 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed.

b. Fit collars snugly around ducts and insulation.

c. Same gauge and material as duct.

d. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.

e. Use fasteners with maximum 6-inch centers on collars.

4. Packing: Mineral fiber in spaces between sleeve or opening and duct or duct insulation.

D. Coordination with Other Trades:

1. Coordinate duct installation with installation of louvers, dampers, and ductwork accessories.

2. Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on Drawings.

3. Coordinate ductwork layout to avoid interference with lighting, bridge crane, suspended ceiling, tanks, generator, electrical panels, and all process equipment.

3.2 RECTANGULAR DUCTWORK

A. General:

1. Where possible, install ductwork so seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.

2. If cutting of seams or joints is unavoidable, reinforce cut portion to original strength.

B. Low Pressure Taps:

1. Use bell mouth or conical fittings with integral locking quadrant damper. Spin-in fitting shall be sealed at duct-tap with a gasket or sealed with sealant as specified for medium pressure ductwork.

2. Determine location of spin-in after outlet location is determined.

3. Fitting shall be securely attached to shaft to prevent damper from rotating around shaft.

C. Fittings:

1. Use bell-mouth or conical tee fittings for round duct takeoffs from rectangular mains.

2. Use 45-degree entry fittings conforming to SMACNA requirements for rectangular takeoffs from rectangular or round mains.

3. Make offsets with maximum angle of 45 degrees.

4. Use fabricated fittings for changes in directions, changes in size and shape, and connections.

D. Rectangular Ductwork Transverse Joints:

1. Install each run with a minimum of joints.

2. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

3. Mechanical Joint Option:

    a. Construct transverse joints with Ductmate 25/35 ductconnector systems, Ductmate W.D.C.I. Heavy/Lite duct connector systems, or Ductlok J/E duct connector system. Slip-on duct flange connectors shall have integral sealant pocket with permanently flexible sealant.

    b. When using Ductmate W.D.C.I. Heavy/Lite system, construct ductwork in accordance with the Ductmate W.D.C.I. Heavy J and Light H Assembly Manual and Duct Construction Standards.

    c. When using Ductlok J/E duct connector system, construct ductwork in accordance with Ductlok's Rectangular Duct Construction Manual for Low, Medium, and High Pressure.

    d. For longitudinal seams, use Pittsburgh lock seamsealed internally with permanently elastic sealer such as Ductmate 5511M mastic.

    e. Conform to SMACNA Class A sealing requirements.

3.3 RIGID ROUND OR OVAL DUCTWORK

    a. Not used.

3.4 FLEXIBLE CONNECTIONS

A. Flexible Collars and Connections:

    1. Use between fans and ducts.

    2. For round ducts, securely fasten flexible connections by zinc-coated steel clinch-type draw bands.

    3. For rectangular ducts, lock flexible connections to metal collars.

3.5 DUCTWORK HANGERS AND SUPPORTS

A. Install ductwork with support systems in accordance with SMACNA Manual, unless otherwise noted.

B. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.

C. Install additional bracing on ductwork as required, to prevent ballooning or breathing.

D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

E. Support vertical ducts at maximum interval of 16 feet and at each floor.

F. Upper attachments to structures shall have allowable load not exceeding 1/4 of failure (proof test) load but are not limited to specific methods indicated.

G. In new construction, install concrete insert prior to placing concrete.

3.6 DUCT SEALING

A. Seal duct seams and joints as follows:

1. In accordance with SMACNA requirements.

B. If no specific duct sealing requirements are specified, requirements of SMACNA manual shall govern.

C. Provide additional duct sealing as required to comply with Article Ductwork Leakage Testing.

D. Seal all audible leaks.

3.7 DUCTWORK LEAKAGE TESTING

A. General:

1. Tests shall be conducted on completed ductwork systems.

2. Testing of partial installations or limited sections of ductwork will not be acceptable.

3. All ductwork leakage test procedures and results shall be submitted to Engineer for review.

4. Engineer shall retain the right to witness some or all ductwork leakage testing procedures.

5. Subcontractor shall notify Engineer in writing at least 5 working days prior to ductwork testing.

B. Leakage Criteria:

1. Assemble and install ductwork with maximum leakage limited as follows:

2. Odor Control Systems:

a. Odor Control Ductwork:

1) Operating Pressure: 0- to 2-inch WC.

a) Allowable Leakage: 2 percent of design airflow.

2) Operating Pressure: 3-inch and over WC.

a) Allowable Leakage: 1 percent of design airflow.

C. Leakage Testing Method:

1. Subcontractor shall be responsible for providing all necessary test fans and calibrated measuring devices to accomplish ductwork leakage test and to demonstrate that ductwork systems leakage rate is less than maximum rate specified.

2. Pressure testing shall be accomplished using a pressure blower with a calibrated orifice and manometer.

3. Blower shall maintain SMACNA construction pressure classification during test.

4. Perform testing in accordance with procedures given in SMACNA HVAC Air Duct Leakage Test Manual.

3.8 BALANCING OF AIR SYSTEMS

A. Perform air balancing in accordance with requirements of Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.9 CLEANING

A. Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing in operation.

B. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.

C. If duct systems are found to contain construction debris at time of construction completion Subcontractor shall provide complete ductwork system cleaning in accordance with NADCA Standards.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 09 13 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.1 SUBMITTALS

A. Action Submittals: Manufacturer's product data, catalog cut sheets, installation instructions, and operations and maintenance information for specified products.

PART 2 PRODUCTS

2.1 PRODUCTS

A. General:

1. Specification applies to control dampers except those furnished by Fan Manufacturer as packaged with fan equipment.

2. Dampers shall be two-position, parallel-blade type for open-close service.

2.2 BACKDRAFT DAMPERS

A. Horizontal one-way air flow in the direction of exhaust fan discharge with an opening pressure (differential pressure) no greater than 0.03 in wg.

B. Manufacture: Greenheck, Model EM-30 Series, or equal.

2.3 MOTORIZED CONTROL DAMPER ELECTRIC MOTOR OPERATORS

a. Not used.

2.4 ELECTRIC THERMOSTATS

A. Room Thermostat for Process Spaces:

1. Two-position electric type for heating and cooling applications
2. Temperature Scale: 30 to 110 degrees F, dial type gauge
3. External adjustments
4. Insulating back where exterior wall mounting is indicated
5. Locking wire protective guard

B. Manufacturer: Dayton, Model 4LZ94, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Backdraft Dampers:

1. Install at motorized control damper locations indicated on Contract Drawings and in accordance with Manufacturer's instructions.

2. Install square and free from racking with blades running horizontally.

3. Bracing:

a. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.

b. Install at every horizontal and vertical mullion.

B. Motorized Control Damper Electric Motor Operators:

1. Not used.

3.2 SUPPLEMENTS

1. Not used.

END OF SECTION

SECTION 26 00 50 – ELECTRICAL GENERAL PROVISIONS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified, and required to complete the electrical Work.

B. Coordination:

1. Review installation procedures, drawings and schedules under other Sections and coordinate with other trades the installation of electrical items that must be installed with or within formwork, walls, partitions, ceilings and panels.

2. CONTRACTOR shall be responsible for the installation of all conduits, inserts, and other items to be embedded in the concrete, or built into walls, partitions, ceilings, or panels constructed by other contractors. CONTRACTOR shall provide other contractors with detailed plans or sketches of the location of said conduits and other built-in items as may be required. CONTRACTOR shall keep himself fully informed of the construction where conduits and other built-in items are to be installed. CONTRACTOR shall install said conduits and other built-in items in such a manner and within such time periods as will not unnecessarily delay the work of the other contractors.

C. General:

1. Interpretation of Drawings:

a. Dimensions shown on the Drawings that are related to equipment are based on the equipment of one manufacturer. Conform the dimensions of the equipment furnished to the space allocated for that equipment.

b. The Drawings show the principal elements of the electrical Work. They are not intended as detailed working drawings for the electrical Work, but as a complement to the Specifications to clarify the principal features of the electrical systems.

c. It is the intent of the Drawings and Specifications that all equipment and devices, furnished and installed under this Contract, be properly connected and interconnected with other equipment and devices so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Drawings.

d. It also is the intent of the Contract Documents that similar products be provided by the same manufacturer for uniformity on the Project.

D. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.

1. Section 01 33 00, Submittals.

2. Section 01 78 23, Operation and Maintenance Data.
3. Section 03 41 20, Precast Concrete Booster Pump Station (BPS) Building.
4. Section 26 01 37, Underground Duct Banks.
5. Section 40 60 04, Process Control System General Requirements.

E. Utilities:

1. CONTRACTOR shall furnish and install empty conduits for telephone service. Plywood backboards shall be furnished and installed for telephone service, as required by City. Plywood backboards shall be painted with approved fire-retardant paint. CONTRACTOR shall make all arrangements for the telephone lines and pay all fees.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Permits: Obtain all permits and pay fees required to commence Work and, upon completion of the Work, obtain and deliver to ENGINEER a Certificate of Inspection and Approval from the State Board of Fire Underwriters or other authority having jurisdiction.

2. Codes: Material and equipment shall be installed in accordance with the current standards and recommendations of the National Electrical Code (2017), the National Electrical Safety Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.

3. Tests by Independent Regulatory Agencies: Electrical material and equipment shall be new and shall bear the label of the Underwriters' Laboratories, Inc., or other nationally-recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.

4. Utilities:

5. Arizona Public Service: Work in connection with the electric service and utility metering shall be done in strict conformance with the requirements of APS.

6. City, Information Technology Department:

B. Reference Standards: Electrical material and equipment shall conform in all respects to the latest approved standards of the following:

1. National Electrical Manufacturers Association.
2. The American National Standards Institute.
3. The Institute of Electrical and Electronic Engineers.
4. Insulated Power Cable Engineers Association.
5. National Electrical Code (NEC).
6. National Electrical Safety Code (NESC).
7. City Electrical Code.
8. City, Information Technology Department.

C. Wiring Coordinator:

1. Retain the services of a Wiring Coordinator who shall prepare complete point-to-point interconnection wiring diagrams. The diagrams shall identify all external interconnecting wiring associated with all new and modified existing equipment.

2. Qualifications: Coordinator shall have experience in the development of diagrams of the type specified and shall have served in a similar role on a project of similar size and complexity.

   a. Present qualifications and approach for the project at Pre-submittal Meeting specified under Section 40 60 04, Process Control System General Requirements.

   b. Prepare the items listed below for presentation at the Pre-submittal Meeting. Submit copies to ENGINEER three weeks prior to date of meeting.

   c. List of projects where the Wiring Coordinator developed point-to-point wiring diagrams.

   d. Samples of diagrams that were developed for the listed projects.

   e. Example wiring diagram proposed for the Work with a preliminary list of drawings to be produced.

   f. Plan of how information will be obtained and documented.

3. Responsibilities:

   a. Develop diagrams for performance of the Work and to document terminations. Prepare diagrams in accordance with the requirements specified under this Section. The diagrams shall be in addition to loop diagrams specified in Section 40 60 04, Process Control System General Requirements.

   b. Use information obtained from approved Shop Drawings, Record Drawings and field inspections as required to complete the diagrams.

   c. Attend Pre-submittal Meeting and periodic coordination and progress meetings specified in Section 40 60 04, Process Control System General Requirements.

1.3 SUBMITTALS

A. Refer to General Conditions.

B. Shop Drawings shall include the following information to the extent applicable to the particular item:

1. Manufacturer’s name and product designation or catalog number.

2. Electrical ratings.

3. Conformance to applicable standards or specifications of ANSI, ASTM, ICEA, IEEE, ISA, NEC, NEMA, NFPA, OSHA, UL, or other organizations.

4. Dimensioned plan, section, elevations and panel layouts showing means for mounting, conduit connection, and grounding.

5. Materials and finish specification, including paints.

6. List of components including manufacturer's names and catalog numbers.

7. Internal wiring diagram and drawings indicating all connections to components and numbered terminals for external connections.

1.4 PROJECT CLOSEOUT

A. Operation and Maintenance Data: Submit complete manuals including:

1. Copies of all Record Drawings and Wiring Diagrams, test reports, maintenance data and schedules, description of operation, and spare parts information.

2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01 33 04, Operation and Maintenance Manuals.

B. Record Drawings:

1. System Record Drawings: Include the following:

a. One line wiring diagram of the distribution system.

b. Actual in place conduit and cable layouts with schedule of conduit sizes and number and size of conductors.

c. Layouts of the power and lighting arrangements and the grounding system.

d. Control schematic diagrams, with terminal numbers and all control devices identified, for all equipment.

2. Point-to-Point Interconnection Wiring Diagram Drawings: Include the following:

a. External wiring for each piece of equipment, panel, instrument and other devices and conduit wiring to control stations, lighting panels and motor controllers.

b. Numbered terminal block identification for each wire termination.

c. Identification of the assigned wire numbers for all interconnections.

d. Identification of all conduit wiring by the conduit tag in which the wire is installed.

e. Terminal and pull boxes through which wiring is routed.

f. Identification of all equipment and the Shop Drawing transmittal numbers for equipment from which the wiring requirements and termination information was obtained.

3. The Record Drawings shall reflect final equipment and field installation information.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: CONTRACTOR shall instruct the manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the site.

1.6 JOB CONDITIONS

A. Existing Conditions:

1. CONTRACTOR shall examine the site and existing facilities in order to compare them with the Contract Documents with respect to the conditions of the premises, location of and connection to existing facilities and any obstructions which may be encountered.

2. CONTRACTOR shall perform the Work with due regard to safety and in a manner that will not interfere with the existing equipment or in any way cause interruption of any of the functions of the plant.

3. Work shall be carried out with a minimum amount of disruption to the operation of the existing plant and with prior approval of OWNER. CONTRACTOR shall submit, for approval by OWNER, a detailed written procedure for work which affects operation of the existing plant, a detailed procedure for modifying any existing electrical equipment, and anticipated time required to complete the Work and the required shutdown time, if any.

4. Where the Work of CONTRACTOR ties in with existing installations, CONTRACTOR shall take prior precautions and safeguards in connecting the Work with the existing operating circuits so as to prevent any interruption to the existing operating circuits. The tying in of Work, installed under this Contract, with the existing circuits shall be performed only in the presence of OWNER. Advance notice will be required before any equipment is removed from service. CONTRACTOR shall notify OWNER, in writing, of his intention to do such work, providing full details.

B. Demolition:

1. The demolition of electrical power distribution equipment, instrumentation/ control equipment, conduit, wire and appurtenances shall be in accordance with Section 02 41 00, Demolition.

1.7 CONTROL CABINETS AND PANELS

A. All control cabinet and panel materials shall be as follows, unless otherwise specified or noted on the Drawings. All outdoor panels shall be provided with sunshade structures.

1. NEMA 12 for dry, indoor non-corrosive areas.

2. In all locations except wet or corrosive, NEMA 4X 304 stainless steel. For wet or corrosive locations, NEMA 4X 316 stainless steel.

3. NEMA 7 for explosion proof areas.

1.8 ELECTRICAL EQUIPMENT

A. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, with an ambient outside air temperature of 25°F to 131°F and an elevation of 1,200 feet (MSL).

B. All electrical devices and equipment shall have ratings based on 75°C terminations.

1.9 AREA CLASSIFICATIONS

A. Materials and equipment shall conform to the area classification(s) shown on the Drawings, specified and required.

B. Wet/Corrosive Locations: The following areas shall be considered wet/corrosive locations:

1. All outdoor areas.

2. All indoor areas below grade, unless otherwise specified.

3. Indoor areas above grade where shown on the Drawings.

4. Chemical containment and storage areas.

5. Materials, equipment, and incidentals in areas identified as wet locations shall meet NEC and NEMA requirements for wet or corrosive locations. All equipment enclosures including pull boxes installed in wet or corrosive locations shall be NEMA 4X, Type 316 stainless steel, unless otherwise indicated. Conduits shall be PVC coated galvanized rigid steel and shall be terminated at enclosures with watertight, threaded hubs.

C. Corrosive Locations: The following areas shall be considered corrosive locations:

1. Chlorine Shed.

2. Materials, equipment, and incidentals in areas identified as corrosive shall meet NEC and NEMA requirements for corrosive locations. Conduit systems shall be PVC coated galvanized rigid steel and enclosures shall meet NEMA 4X requirements. Conduits shall be terminated at enclosures with watertight, threaded hubs.

1.10 SCHEMATIC DIAGRAMS

A. Schematic diagrams are provided for CONTRACTOR'S guidance in fulfilling the operational intent of the Contract Documents.

B. It shall be CONTRACTOR'S responsibility to meet all safety and electrical codes, and to provide all equipment, appurtenances and specialty items required to provide for complete and operable systems.

C. Review of control schemes submitted by CONTRACTOR shall not relieve CONTRACTOR of his contractual responsibility to provide complete and successfully operating systems.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Material: Laminated phenolic, incised to show 1/4-inch high letters, Arial. The letters shall be black with white background or match existing.

B. Border: Minimum 1/8-inch around engraved print with extra length for fastening devices.

C. Fasteners: Secured with #4-40, round-head, stainless steel, self-tapping screws.

2.2 WIRE MARKERS

A. Refer to Section 26 01 22, 600 Volt Cable.

2.3 CONDUIT TAGS

A. Refer to Section 26 01 31, Rigid Conduit.
B. Refer to Section 26 01 32, Flexible Conduit.

PART 3 EXECUTION

3.1 EQUIPMENT IDENTIFICATION

A. Provide identification of each electrical item, in addition to the manufacture's nameplates, to identify the item's function and the equipment or system which it serves or controls.

B. Identify equipment by means of nameplates. Re-label existing equipment whose designation has been changed.

C. Color code and identify wires and cables by means of wire markers. Identify power conductors by circuit number, labeled at power source and at the equipment, and phase. Identify each control, signal, and status wire by a unique number. Numbering system shall reflect the actual designations used in the Work and shall be documented on the point-to-point wiring diagrams. Coil spare wiring neatly. Tag each spare wire with conduit number and wire number.

D. Conduit Tags:

1. Conduit tags shall be yellow, 1-1/2-inches round, aluminum tags. Engraved with the conduit number as shown on the Conduit and Cable Schedule. Print shall be 1/4-inch Gothic. The conduit tags shall be manufactured by Brady, Catalog No. 49900, or equal.

2. Each tag shall be attached with nylon-coated 48-mil stainless steel wire and fasteners, as manufactured by Brady, Catalog No. 23310 or equal, and brass wire clamps, double ferrule design, as manufactured by Brady Catalog No. 23312, or equal, to secure the stainless-steel wire.

E. Identify pull and terminal boxes with nameplates. Identify each box by a unique number. Numbering system shall reflect the actual designations used in the field and as documented on wiring diagrams.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 31 05 13 - SOILS FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes range of soil and subsoil materials intended to be referenced by other sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other sections and on Drawing notes.

B. Section includes:

1. Subsoil materials
2. Topsoil materials

C. Related Sections

1. Section 31 05 16, Aggregates for Earthwork
2. Section 31 10 00, Site Clearing
3. Section 31 22 13, Rough Grading
4. Section 31 23 16, Excavation
5. Section 31 23 17, Trenching
6. Section 31 23 18, Rock Removal
7. Section 31 23 23, Fill
8. Section 31 37 00, Riprap

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

B. ASTM International (ASTM):

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

2. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
B. Materials Source: Submit name of imported materials source.
C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Furnish materials of each type from same source throughout the Work.

B. Soil Testing:

1. Soil sampling and testing to be completed by an independent laboratory approved by the Engineer.

2. Frequency of testing shall be determined by the Engineer.

3. All soil testing shall be paid for by the Contractor.

C. Compaction Tests:

1. Maximum density at optimum moisture content determined by ASTM D698 (AASHTO T99).
2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.

D. Soil Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

A. Subsoil Type S1, Select Native Material:

1. Select earth obtained from on-site excavations approved for use by Engineer.

2. Graded.

3. Free of peat, humus, vegetative matter, organic matter, and rocks larger than 6 inches in diameter.

4. Processed as required to be placed in thickness as prescribed and at the optimum moisture content to obtain level of compaction required by these specifications.

B. Subsoil Type S2, Imported Fill Material:

1. Imported earth approved for use by Engineer.
2. Meeting the requirements of Subsoil Type S1.

2.2 TOPSOIL MATERIALS

A. Topsoil Type TS1, Select Native Topsoil Material:

1. Top 6 - 12 inches of existing soil containing organic matter.

2. Engineer decision shall be final as to determination of what material is topsoil quality.

3. Graded.

4. Free of roots, rocks larger than 3/4-inch subsoil, debris, large weeds, and foreign matter.

    a. Screening: Single screened.

B. Topsoil Type TS2, Imported Topsoil Material:

1. Not used.

2.3 SPOILS

A. All excess material not suitable or not required for backfill and grading shall be hauled off site and disposed of at a location provided by the Contractor and approved by the Engineer.

B. Make arrangements for disposal of the material at no additional cost to the Owner.

C. Landfill permit to be obtained by the Contractor and provided to Engineer prior to commencement of disposal.

2.4 SOURCE QUALITY CONTROL

A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698 (AASHTO T99)

B. When tests indicate materials do not meet specified requirements, change material, or vary compaction methods and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.

C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate material of every nature and description to the lines and grades as indicated on the Drawings and/or as required for construction of facilities.

B. Site within clearing limits shall be stripped of topsoil as required to obtain additional topsoil necessary to complete Work indicated in the Drawings or as specified.

C. When practical, do not excavate wet topsoil.

D. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.

E. Remove excess excavated subsoil and topsoil not intended for reuse from Site.

F. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from Site.

3.2 STOCKPILING

A. Stockpile soils [at locations shown in the Drawings] [or] at locations as approved by Engineer for redistribution as specified.

1. Site may not have sufficient area to stockpile excavated material that will be required for fill later in the Project. If additional stockpile area is required to complete the Project on schedule, arrange off-site stockpile areas.

2. No additional payments will be made for stockpiling excavated materials off-site.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Prevent intermixing of soil types or contamination.

E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

1. Grade surface of stockpiles to prevent ponding of water.
2. Cover stockpiles to minimize the infiltration of water.

F. Stockpile unsuitable and/or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 10 00 - SITE CLEARING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes clearing site of incidental paving and curbs, debris, grass, trees, and other plant life in preparation for site or building excavation work.

B. Related Sections:

1. Section 02 41 00, Demolition
2. Section 31 22 13, Rough Grading
3. Section 31 23 18, Rock Removal

1.2 DEFINITIONS

A. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

B. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 12 inches below subgrade.

C. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

D. Limits of Disturbance: Work area boundary as shown on the Drawings.

E. Root Wad: Tree stump and root mass including all roots greater than 1-inch diameter.

F. Stripping: Removal of topsoil remaining after applicable scalping is completed.

1.3 SUBMITTALS

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

B. Clearing, Grubbing, and Stripping Plan: Drawings clearly showing proposed limits to clearing, grubbing, and stripping activities at Site.

C. Certification or disposal permit for landfill and/or waste disposal site.

D. A copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.4 QUALITY ASSURANCE

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

B. Obtain Engineer’s approval of staked clearing, grubbing, and stripping limits prior to commencing clearing, grubbing, and stripping.

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

1. Burning on Project Site will not be permitted.
2. Use of herbicides will not be permitted.

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

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

PART 2 PRODUCTS

2.1 MATERIALS

A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated on the Drawings or specifications.

B. Wound Paint: Emulsified asphalt formulated for use on damaged plant tissues.

PART 3 EXECUTION

3.1 GENERAL

A. Clear, grub, and strip areas needed for waste disposal, borrow, or Site improvements within limits shown in approved Clearing, Grubbing, and Stripping Plan.

B. Remain within the property lines at all times.

C. Do not injure or deface vegetation or structures that are not designated for removal.

3.2 EXAMINATION

A. Verify existing plant life designated to remain is tagged or identified.

B. Identify waste and salvage areas for placing removed materials.

3.3 PREPARATION

A. Carefully coordinate the work of this Section with all other work and construction.

B. Coordinate utility locates with NTUA, not less than three working days before performing Work.

C. Request underground utilities to be located and marked within and surrounding construction areas.

1. Disconnect or arrange for disconnection of utilities (if any) affected by required work.
2. Keep all active utilities intact and in continuous operations.

D. Prepare Site only after:

1. Erosion and sediment controls are in place.

a. Not used.

2. Tree and vegetation protection is installed.

a. Not used.

3. Temporary security fencing is installed along the Limits of Disturbance as required.

4. Notification of utility agencies; disconnect or arrange for disconnection of utilities (if any) affected by required work. Keep all active utilities intact and in continuous operation.

3.4 PROTECTION

A. Utilities: Locate, identify, and protect utilities located by utilities and indicated on the Drawings to remain from damage.

B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.

C. Preservation and Trimming of Trees, Shrubs, and Other Vegetation:

1. Not used.

D. Landscaped Areas:

1. When any portion of the Work crosses private property or landscaped areas, excavate topsoil separately and pile it on the opposite side of the trench from the subsoil.

2. Conduct Work in a manner that will restore original conditions as nearly as practicable.

3. Remove and replace any trees, shrubs, plants, sod, or other vegetative material as needed to complete Work.

4. Wherever sod cannot be saved and restored, the ground must be reseeded and cared for until a stand of grass is reestablished.

5. It is the intent of this paragraph that the Contractor shall leave the surface and plantings in substantially the same conditions as before the Work is undertaken.

E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, and paving,.

F. Repair and Replacement:

1. Damaged items, including but not restricted to those noted above, shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.

2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.5 LIMITS

A. As follows:

1. Excavation: 5 feet beyond top of cut slopes.

2. Trench Excavation: 6 feet from trench centerline, regardless of actual trench width.

3. Fill:

a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
b. Stripping: 2 feet beyond toe of permanent fill.

4. Structures: 15 feet outside of new structures.

5. Roadways: Clearing, grubbing, scalping, and stripping 5 feet from roadway shoulders.

6. Other Areas: As shown.

B. Remove rubbish, trash, and junk from entire area within the Limits of Disturbance as material is generated. Stockpiling shall not be permitted without written approval of Owner.

3.6 CLEARING AND GRUBBING

A. Clear and grub areas within limits shown on drawings.

B. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with the applicable sections of these Specifications.

C. Clearing:

1. Clearing shall be performed in such a manner as to remove all evidence of the presence of vegetative growth from the surface of the Project Site and shall be inclusive of sticks and branches of thickness or diameter greater than 3/8-inch and of grasses, weeds, exceeding 12 inches in height except as otherwise indicated.

D. Grubbing: Clear areas required for access to site and execution of Work and remove all stumps, root wads, and roots over 1-inch diameter to the following depths:

1. Future Structures and Building Areas	24 Inches
2. Roads and Parking Areas	18 Inches
3. All other Areas	12 Inches

3.7 TREE REMOVAL

A. Not used.

3.8 REMOVAL AND DISPOSAL

A. Native vegetation may be mulched and used on Site.

B. Asphalt and Gravel Surfaces:

1. Asphalt, concrete, and gravel surfaces designated for removal shall be done to full depth.

2. Asphalt, concrete, and gravel removed at Site may be reused at Site where shown on the Drawings or following approval of the Engineer.

3. Haul removed asphalt, concrete, and gravel which is unsuitable for reuse or that exceeds quantity required.

C. Remove debris, rock, abandoned piping, and extracted plant life from Site.

D. Remove from the Site all debris, materials, equipment, and items found thereon and materials and debris resulting from the Work, except as otherwise indicated.

1. All existing improvements designated on the Drawings or specified to be removed including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the Work.

2. Unless otherwise specified, any resulting voids shall be thoroughly cracked out for drainage and backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.

E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.

F. Do not burn or bury materials on site. Leave site in clean condition.

G. Removal: All material resulting from demolition, clearing, and grubbing, and trimming operations shall be removed from the Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.

H. Cleanup: During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, and debris.

I. Adjacent areas shall be returned to their existing condition prior to the start of Work.

3.9 CLEANUP

A. During the time Work is in progress, make every effort to maintain the Site in a neat and orderly condition.

B. All refuse, broken pipe, excess fill material, cribbing, and debris shall be removed as soon as practicable.

C. Should the Work not be maintained in a satisfactory condition, the Owner may cause the work to stop until the cleanup of the Work has been done to the satisfaction of the Engineer.

D. The Work will not be considered complete, or the final payment certificate issued until all rubbish, unused material, or equipment shall have been removed and the premises left in a condition satisfactory to the Owner and the Engineer.

END OF SECTION

SECTION 31 05 16 - AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes a range of coarse and fine aggregate materials intended to be referenced by other Sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other Sections and in Drawing notes.

B. Section Includes:

1. Coarse aggregate materials
2. Fine aggregate materials

C. Related Sections

1. Section 31 05 13, Soils for Earthwork
2. Section 31 22 13, Rough Grading
3. Section 31 23 17, Trenching
4. Section 31 23 19, Dewatering
5. Section 31 23 23, Fill
6. Section 31 37 00, Riprap
7. Section 32 11 23, Aggregate Base Courses
8. Section 33 11 10, Water Utility Distribution and Transmission Piping
9. Section 33 41 10, Storm Utility Drainage Piping

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses

2. AASHTO T27 - Sieve Analysis of Fine and Coarse Aggregates

3. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

4. AASHTO TP61 - Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate

B. ASTM International (ASTM):

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

4. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

5. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

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

B. Materials Source: Submit name of imported materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Results of aggregate sieve analysis and standard proctor tests for all granular material.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Aggregate Testing:

1. Aggregate sampling and testing to be completed by an independent laboratory approved by the Engineer.

2. The frequency of testing shall be determined by the Engineer.

3. All aggregate testing shall be paid for by the Contractor.

C. Compaction Tests:

1. Maximum density at optimum moisture content determined by ASTM D698 (AASHTO T99).

2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.

D. Aggregate Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

A. Coarse Aggregate Type A1, Dense-Graded Aggregate: Crushed rock with ¾-inch-0, 1-inch-0, 1-1/2-inch-0, 2-inch-0 and 2-1/2-inch-0 gradation as shown on the Drawings and meeting the requirements provided below.

1. Grading - Dense-graded base aggregate shall be crushed rock, including sand. Uniformly grade the aggregates from coarse to fine.

2. Sieve analysis shall be determined according to AASHTO T27.

3. The aggregates shall conform to one of the grading requirements Table 31 05 16-A below.

Table 31 05 16-A
Grading Requirements for Dense-Graded Aggregate
Separated Sizes
Percent Passing (by weight)

Sieve Size	2-1/2" - 0	2" - 0	1-1/2" - 0	1" - 0	3/4" - 0
3”	100				
2-1/2”	95 - 100	100			
2”	-	95 - 100	100		
1-1/2"	-	-	95 - 100	100	
1-1/4”	55 - 75	-	-	-	
1”	-	55 - 75	-	90 - 100	100
3/4"	-	-	55 - 75	-	90 - 100
1/2"	-	-	-	55 - 75	-
3/8”	-	-	-	-	55 - 75
1/4"	30 - 45	30 - 45	35 - 50	40 - 55	40 - 60
No. 4*	-	-	-	-	-
No. 10	[1]	[1]	[1]	[1]	[1]

[1] Of the fraction passing the 1/4-inch sieve, 40 percent to 60 percent shall pass the No. 10 sieve.
* Report percent passing sieve when no grading requirements are listed.

4. Fracture of Rounded Rock:

   a. Not used.

B. Coarse Aggregate Type A2, Granular Drain Backfill Material: Crushed or uncrushed rock or gravel as shown on the Drawings.

1. Material shall be clean and free draining.

2. Sieve analysis shall be according to AASHTO T27.

3. Grading: Meeting the gradation requirements provided in Table 31 05 16-B below.

Table 31 05 16-B
Grading Requirements for Granular Drain Backfill Material
Separated Sizes
Percent Passing (by weight)

Sieve Size	Separated Sizes 1-1/2-inch – 3/4-inch	Separated Sizes 3/4-inch – 1/2-inch
2-inch	100	
1-1/2-inch	90 - 100	
1-inch	20 - 55	100
3/4-inch	0 - 15	85 - 100
1/2-inch	-	0 - 15
3/8-inch	0 - 5	-

2.2 SAND

A. Sand: Sand material shall consist of granular material, naturally produced, or produced from crushed gravel, or dredge sand that is reasonably free of organic material, mica, clay, fly ash, and other deleterious material, meeting the gradations of Table 31 05 16-C below.

Table 31 05 16-C
Grading Requirements for Sand
Separated Sizes
Percent Passing (by weight)

Sieve Size	Coarse Sand	Medium Sand	Fine Sand
1-inch	100	100	100
3/8-inch	95 - 100	95 - 100	-
#4	80 - 100	70 - 95	90 - 100
#30	10 - 30	10 - 45	-
#100	-	2 - 10	2 - 10
#200	0 - 8	0 - 7	0 - 4
Sand Equivalent	50 min.	50 min.	50 in.

2.3 SOURCE QUALITY CONTROL

A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698 (AASHTO T99).

B. Sand - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698 (AASHTO T99)

C. When tests indicate materials do not meet specified requirements, change material and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.

PART 3 EXECUTION

3.1 STOCKPILING

A. Stockpile materials imported to site [as shown on the Drawings] [or] at locations as approved by Engineer for redistribution as specified.

B. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

C. Prevent intermixing of aggregate types or contamination.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

1. Grade surface of stockpiles to prevent ponding of water.
2. Cover stockpiles to minimize the infiltration of water.

3.2 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 31 23 16 – EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes excavation required for building foundations, [down to pile caps or piers], site structures, or under slabs-on-grade or paving. Excavating for utilities outside building is included in Section 31 23 17, Trenching.

B. Section Includes:

1. Excavating for building foundations
2. Excavating for paving, roads, and parking areas
3. Excavating for slabs-on-grade
4. Excavating for site structures
5. Excavating for landscaping

C. Related Sections:

1. Section 01 45 00 - Quality Control
2. Section 02 41 00 - Demolition
3. Section 31 05 13 - Soils for Earthwork
4. Section 31 05 16 - Aggregates for Earthwork
5. Section 31 10 00 - Site Clearing
6. Section 31 22 13 - Rough Grading
7. Section 31 23 17 - Trenching
8. Section 31 23 18 - Rock Removal
9. Section 31 23 23 - Fill
10. Section 31 50 00 - Excavation Support and Protection
11. Section 33 11 10 - Water Utility Distribution and Transmission Piping.
12. Supplemental Information: Geotechnical report; bore hole locations, and findings of subsurface materials.

1.2 DEFINITIONS

A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. Common Excavation shall further include all debris, junk, broken concrete, and all other material. All excavation shall be classified as Common Excavation, unless provided as Rock for under Section 31 23 18, Rock Removal below.

B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation, excluding rock as defined below.

C. Concrete Excavation: The removal of pieces of concrete larger than 1 cubic yard in volume that requires drilling, splitting and breaking methods, or a necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench. Concrete excavation includes materials composed of Portland cement that are not identified other than manholes, structures, sewer pipe, or other appurtenances.

D. Exploratory Excavation: The removal and replacement of material from locations shown on the Drawings, or as directed for the purpose of investigating underground conditions and identifying potential utility conflict between existing and proposed utilities.

E. Overbreak: Material beyond and outside of the slope limits established by the Owner's Representative, which becomes displaced or loosened during excavation and is excavated.

F. Pothole Excavation: Pothole excavation is the removal and replacement of all materials via coring, vacuum extraction, or similar method, not classified as exploratory excavation, for the purposes of locating an underground utility and to investigate underground conditions.

G. Rock Removal: As defined in Section 31 23 18, Rock Removal.

H. Spoils: Excavated materials from Site unsuitable for use as fill or not required for backfill and grading.

I. Unsuitable Materials: See Spoils.

1.3 REFERENCES

A. Local utility standards when working within 24 inches of utility lines.

1.4 SUBMITTALS

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

B. Excavation Protection Plan: At a minimum, to include the following:

1. Methods and sequencing of mass excavation.
2. Proposed onsite and off-site spoil disposal locations.
3. Anticipated difficulties and proposed resolutions.
4. Proposed routes for Owner's access to Owner's facilities impacted by excavation Work.
5. Proposed haul routes.

1.5 QUALITY ASSURANCE

A. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

B. Provide adequate survey control to avoid unauthorized over-excavation.

C. Weather Limitations:

1. Material excavated when frozen or when air temperature is less than 32 degrees Fahrenheit (F) shall not be used as fill or backfill until material completely thaws.

2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.6 QUALIFICATIONS

Special minimum experience qualifications apply to the subgrade preparation for this Project. A Statement of Qualifications Form shall be submitted to the Engineer for review and approval by those prospective earthwork contractors not already listed as prequalified contractors in Section 00 21 13, Instructions to Bidders. Refer to Section 00 21 13, Instructions to Bidders and Section 00 20 60, Earthwork Contractor Statement of Qualifications Form for prequalification information.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to commencing work in this Section, become familiar with site conditions. In the event discrepancies are found, notify the Engineer as to the nature and extent of the differing conditions.

B. Coordinate utility locates with NTUA not less than 3 working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.

C. Identify required lines, levels, contours, and datum.

D. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.

3.2 SITE CONDITIONS

A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.

B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Engineer to quell dust.

C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.

3.3 EXISTING UNDERGROUND UTILITIES

A. Protect active utilities encountered, located or otherwise, and notify persons or agencies owning same.

B. Remove inactive or abandoned utilities from within the project grading limits in accordance with Section 33 05 50, Existing Pipe Abandonment.

C. For sewer and other miscellaneous drainage facilities, fill and plug pipes as follows:

1. Not used.

3.4 PRESERVATION OF EXISTING IMPROVEMENT

A. Protect adjacent existing structures which may be damaged by excavation work.

1. Conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other improvements, which are to remain in place, will not be damaged. Furnish and install cribbing and shoring or whatever means necessary to support material around existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed.

2. Open slopes shall not be cut within 5 feet of any existing spread footings unless approved by the Engineer.

3. Do not interfere with 45 degree bearing splay of foundations unless approved by the Engineer

4. Excavated material shall not be placed adjacent to existing or proposed structures.

3.5 EXCAVATION

A. General:

1. Method of excavation shall be the Contractor's option, but care shall be exercised as final grade is approached to leave it in undisturbed condition.

2. If the final grade for supporting structures is disturbed, it shall be restored to requirements of these Specifications and satisfaction of the Engineer at no additional cost to Owner.

3. The Contractor is advised that footings should be poured as soon as possible to minimize unfavorable final grade conditions from developing.

4. Provide all measures to ensure public safety.

B. Control of Water:

1. Provide and maintain equipment to remove and dispose of water during the course of the work of this Section and keep excavations dry and free of frost or ice.

2. Bearing surfaces that become softened by water or frost must be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.

3. Grade top perimeter of excavation to prevent surface water from draining into excavation.

4. See additional requirements in Section 31 23 19, Dewatering.

C. Frozen Ground: Frost protection shall be provided for all structural excavation work. Foundation work shall not be placed on frozen ground.

D. Excavate material of every nature and description to the lines and grades as indicated in the Drawings and/or as required for construction of the facility.

1. Allow for forms, shoring, working space, granular base, topsoil, and similar items, wherever applicable.

2. Trim excavations to neat lines. Remove loose matter and lumped subsoil.

E. Excavated Materials: Soils excavated at Site will be treated and used as one of two general categories of material as provided below.

1. Fill:

a. Subsoil Type S1, Select Native Fill, as approved for use by Engineer.

2. Spoils:

a. Ensure there is sufficient suitable material available to complete embankments and other required fillings prior to disposing of any excavated materials.

b. Make arrangements for disposal of spoils and include as part of contract work in preparing of project bids.

c. Landfill permit or written permission from private property owner to be obtained by the Contractor and provided to the Engineer.

F. Shoring:

1. The Contractor shall be solely responsible for excavation protection and worker safety and shall provide sheeting and shoring wherever required, all in accordance with current local, state, and federal laws, codes, and ordinances.

2. Where shoring, sheet piling, sheeting, bracing, lagging, or other supports are necessary to prevent cave-ins or damage to existing structures, it shall be the responsibility of the Contractor to design, furnish, place, maintain, and remove such supports in accordance with applicable ordinances and safety requirements.

3. The design, planning, installation, and removal of all sheeting accomplished in such a manner as to maintain the undisturbed state of the soil below and adjacent to the excavation.

G. Slope existing banks with machine to angle of repose or less until shored.

1. Shape, trim, and finish cut slopes to conform to lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

2. Protection of excavation side slopes:

a. Use excavation methods that will not shatter or loosen excavation slopes.

b. Where practical, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line.

c. Avoid overbreaks. Overbreak is incidental to the Work, except in cases where the Owner's Representative determines that such overbreak was unavoidable.

d. Excavation in rock or rocky cuts:

1) Once completed, thoroughly test the slopes with bars or other approved means to remove all loose, detached, broken, or otherwise unstable material.

2) Remove jutting points. Scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials and provide a safe, trim, neat, and stable condition.

3) Dispose of the materials removed under this subparagraph in the same manner as other excavated material.

e. Remove all exposed roots, debris, and all stones more than 3 inches in size which are loose or could become loosened.

3. Construct slopes free of all exposed roots.

4. Construct slopes free of unstable rock and loose stones exceeding 3 inches in diameter.

5. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend off-site, outside of easements, outside of rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.

6. Trim all surfaces neatly and smoothly.

H. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 17, Trenching and Section 31 23 23, Fill.

I. Notify Engineer of unexpected subsurface conditions.

J. Over-excavation for Unsuitable Foundation Conditions:

1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.

2. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.

3. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.

K. Rock Removal:

1. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section.

2. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.

3. Concrete removal, as defined herein, shall be treated as Rock Removal.

L. Stockpile excavated material in area(s) designated on or off site in accordance with Section 31 05 13, Soils for Earthwork.

3.6 FIELD QUALITY CONTROL

A. Perform excavation and controlled fill operations in accordance with the requirements of this Section.

B. Coordinate the visual inspection and approval of all bearing surfaces by Engineer before installing subsequent work.

3.7 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability and store excavated materials at a distance from top of excavation.

B. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 31 23 17 - TRENCHING

1.1 SUMMARY

A. This Section includes the requirements for excavation and backfill of all utilities, including installation of pipe bedding, pipe zone backfill, trench backfill, and related Work as shown on the Drawings and as specified.

B. Section includes:

1. Excavating trenches for pipe, utility vaults, and other utilities.
2. Compacted fill from top of utility bedding to final grades.
3. Trench and utility vault backfilling and compaction.

C. Related Sections:

1. Section 01 45 00, Quality Control
2. Section 31 05 13, Soils for Earthwork
3. Section 31 05 16, Aggregates for Earthwork
4. Section 31 10 00, Site Clearing
5. Section 31 22 13, Rough Grading
6. Section 31 23 16, Excavation
7. Section 31 23 18, Rock Removal
8. Section 31 23 23, Fill
9. Section 31 23 24, Flowable Fill
10. Section 31 37 00, Riprap
11. Section 33 11 10, Water Utility Distribution Piping

D. Supplemental Information: Geotechnical report

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

B. ASTM International (ASTM):

1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

5. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.3 DEFINITIONS

A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill. Lean cement concrete fill. A self-compacting, cementitious material.

B. Flexible Pipe: For the purposes of these Specifications, tubing between 1/2-inch and 4-inch diameter constructed of polyvinyl chloride (PVC) and high-density polyethylene (HDPE) are considered flexible pipes. HDPE piping 4 inches in diameter and larger is also considered flexible pipe.

C. Geosynthetics: Geotextiles, geogrids, geomembranes, and drainage composite materials.

D. Imported Material: Materials obtained from sources offsite, suitable for specified use.

E. Lift: Loose (uncompacted) layer of material.

F. Obstructions: Items which may be encountered during utility and vault trenching which do not require replacement.

G. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.

2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

H. Pipe Bedding: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 6 inches below the bottom outside surface of pipe, conduit, cable, or duct bank to the trench foundation so as to uniformly support the barrel of the pipe.

I. Pipe Zone: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of [12] [6] inches above the top outside surface of pipe, conduit, cable, or duct bank.

J. Pipe Bedding, Pipe Zone, and Trench Backfill Classifications:

1. Class A: Backfill with suitable native or imported material that is approved to meet the characteristics required for the specific surface loading or other criteria of the backfill zone.

2. Class B: Backfill with imported granular material consisting of gravel or crushed rock meeting the requirements of this Section and Coarse Aggregate Type A1 as specified in Section 31 05 16, Aggregates for Earthwork; typical designated size shall be 1-inch-0 or 3/4-inch-0.

3. Class C: Backfill with Fine Sand, as specified in Section 31 05 16, Aggregates for Earthwork.

4. Class D: Backfill with approved pit run or bar run material, well-graded from coarse to fine; maximum dimension shall be 3 inches.

5. Class E: Backfill with CLSM. See Section 31 23 24, Flowable Fill.

K. Pothole Excavations: Removal and replacement of all materials via coring, vacuum extraction, or similar method for the purposes of locating an underground utility and to investigate underground conditions.

L. Prepared Trench Bottom: The bottom of the trench on which the pipe bedding is to lie, and which provides support for the pipe.

M. Relative Compaction: Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM Standards.

N. Rigid Pipe: For the purposes of these Specifications, pipe constructed of PVC, ductile iron, steel, concrete, and clay pipes are considered rigid pipes.

O. Sewer, Pipes, and Mains: Conduits of circular or other geometric shapes, used to convey liquids or gases, or other material.

P. Trench Backfill: Trench backfill zone for full trench width extending from the top of the pipe zone to pavement base rock, ground surface, or other surface material.

Q. Trench Stabilization: Removal of unsuitable material in the bottom of a trench and replacement with specified material for support of a pipe, main, conduit, structure, or appurtenances.

R. Utility: Any buried pipe, duct, conduit, or cable.

S. Well-Graded: A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.4 SUBMITTALS

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

B. Excavation Protection Plan: At a minimum, to include the following:

1. Methods and sequencing of mass excavation.
2. Proposed on-site and off-site spoil disposal locations.
3. Anticipated difficulties and proposed resolutions.
4. Proposed routes for Owner’s access to Owner’s facilities impacted by excavation Work.
5. Proposed haul routes.

C. Product Data:

1. Geotextile fabric, indicating fabric and construction
2. Marking tapes
3. Tracer wire
4. Connectors for tracer wire and/or marking tapes
5. Tracer wire locate boxes
6. Marker balls
7. Locator stations
8. Ground wires

9. Plastic or copper markers for service laterals.

D. Imported Materials:

1. Materials Source: Submit name and location of imported fill materials suppliers.
2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
3. Submit results of aggregate sieve analysis and standard proctor test for granular material.

1.5 QUALITY ASSURANCE

A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.

B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.

C. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

1.6 QUALIFICATIONS

Special minimum experience qualifications apply to the installation of water mains for this Project. The Water Main Contractor must be qualified by the Engineer. A Statement of Qualifications Form shall be submitted to the Engineer for review and approval by those prospective water main contractors not already listed as prequalified contractors in Section 00 21 13, Instructions to Bidders. Refer to Section 00 21 13, Instructions to Bidders and Section 00 20 50, Water Main Contractor Statement of Qualifications Form for prequalification information.

1.7 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

B. Coordinate trenching and utility installation work with other work at utility construction location occurring near or adjacent to specified herein.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Subsoil Fill: Type S1, Select Native Material as specified in Section 31 05 13, Soils for Earthwork.

B. Imported Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.

C. Drain Rock: Coarse Aggregate Type A2, Granular Drain Backfill Material with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.

D. Sand: As specified in Section 31 05 16, Aggregates for Earthwork.

E. Trench Stabilization Material: Coarse Aggregate Type A1, Dense-Graded Aggregate, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

2.2 MARKING TAPE

A. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.

2. Foil Thickness: Minimum 0.35 mils.

3. Laminate Thickness: Minimum 5 mils.

4. Width: 6 inches.

5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

6. Joining Clips: Tin or nickel-coated furnished by Tape Manufacturer.

7. Manufacturers and Products:

a. Reef Industries; Terra Tape, Sentry Line Detectable
b. Mutual Industries; Detectable Tape
c. Presco; Detectable Tape

B. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities and as specified in NEMA Z535.1, Safety Color Code.

Color	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines

2.3 ELECTRONIC LOCATING MATERIALS

A. Marker Balls:

1. Exterior Material: High-density polyethylene.

2. Size: Maximum 4-1/2 inches in diameter.

3. Range: Locatable with standard electronic marker locating devices at depths up to 5 feet.

4. Field Type: Spherical RF field regardless of orientation.

5. Contain no floating or movable parts, and no batteries or active components.

6. Color: Provide colored marker balls per Article 2.03.B above.

7. Manufacturer and Product: Omni Marker Model 162 (green), Omni Marker Model 161 (blue), or equal.

B. Tracer Wire:

1. Direct burial No. 12 AWG solid, annealed copper-clad steel (CCS) high strength tracer wire.

2. Tensile Breaking Load: 380-pound average.

3. Jacket:

   a. High molecular weight high-density polyethylene complying with ASTM D1248, 30-volt rating.

   b. Color: Provide in colors per Article 2.03.B above.

4. Manufacturer and Product: Copperhead Industries; LLC, 12 CCS high strength reinforced tracer wire, or equal.

C. Tracer Wire Connectors:

1. Waterproof, corrosion proof and suitable for No. 12 AWG solid core wire.

2. Prefilled with silicone and suitable for use with low-voltage tracer lines of less than 50 volts.

3. Lug Connectors:

   a. Waterproof plastic housing that encases the silicone prefilled lug terminals.

   b. Manufacturer and Product: King Innovations; DryConnTM Direct Bury Lug or equal.

4. Twist Connectors:

   a. Waterproof epoxy-filled packaging that encases the silicone prefilled twist connectors.

   b. Manufacturer and Product: 3M Division; DBY Direct Bury Splice Kit 09053 connectors or equal.

D. Ground Wire: No. 12 AWG bare solid copper wire.

E. Locator Station:

1. Test Station:

   a. Lexan® polycarbonate.
   b. Color: Provide in colors per Article 2.03.B above.

2. Terminals suitable for No. 12 AWG leads.

3. Use single (two lead) locator stations with two terminals, one for ground wire and one for tracer wire, when only one tracer wire is terminated in manhole.

4. Use multi-lead locator stations with the appropriate number of terminals when 2 or more tracer wire leads are terminated in manhole.

5. Manufacturer and Product: Cott Manufacturing Company; FlangeFink® Cathodic Protection Test Station.

2.4 VISUAL IDENTIFICATION MATERIALS

A. Tracer Wire Locate Boxes:

1. Material: Polyolefin.

2. Cover:

a. Color: Provide in colors per Article 2.03.B above.

b. Provide box cover identification marking for facility type such as “Sewer Locate Wire”, as approved by Owner.

c. Locking type with a nominal 6-inch opening.

3. Manufacturer and Product: Carson Industries LLC; L Series Model 708 or equal.

B. Service Lateral Plastic or Copper Markers:

1. Service Lateral Plastic or Copper Markers: Use markers of the type that requires installation to be recessed below grade.

a. Material: Plastic or copper. In new concrete, use “new construction” markers; in existing concrete use “retrofit” markers and use adhesive recommended by the Manufacturer.

b. Plastic Pavement Markers:

1) UV stabilized and fade resistant.

2) Material: Meet or exceed a tensile strength of 3,500 psi, and meet test requirements as outlined in ASTM G53, Standard Practice for Light and Water Exposure of Nonmetallic Material.

3) Color: Provide in color per Article 2.03 B above with the words, “WARNING, BURIED [UTILITY TYPE], Call Before You Dig,” molded to the top of marker.

a) Provide wording for specific facility as approved by Owner.

4) Manufacturer and Product: Rhino Marking and Protective Systems; A-TAG pavement markers or equal.

c. Copper Pavement Markers:

1) Material: Copper material chosen by Manufacturer.

2) Diameter: 1-5/32-inch.

3) Wording: Provide facility identification wording stamped on the top such as “Sewer Lateral” as approved by Owner.

4) Manufacturer and Product: Berntsen Concrete Marker; BP2-U or equal.

C. Service Lateral 2-inch by 4-inch Markers:

1. S4S Douglas fir, pressure-treated 2-inch by 4-inch lumber, utility grade or better.
2. Grade stamped by an American Lumber Standards certified inspection agency.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate utility locates with NTUA not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.

3. Maintain and protect above and below grade utilities indicated to remain.

B. Identify required lines, levels, contours, and datum locations.

C. Drawings and/or Specifications cover and govern replacement and restoration of foreseeable damage.

D. The site of an open cut excavation shall be first cleared of all obstructions preparatory to excavation in accordance with Section 31 10 00, Site Clearing.

E. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.

1. Intent of Drawings and Specifications is that all streets, structures, and utilities be left in condition equal to or better than original condition.

2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material, which is satisfactory to Owner.

F. Potholing / Exploratory Test Pits: Dig such exploratory test pits and perform potholing as may be necessary in advance of trenching to determine the exact location and elevation of subsurface structures, pipelines, duct banks, conduits, and other obstructions which are likely to be encountered or need to be connected to and shall make acceptable provision for their protection, support, and maintenance of their continued operation.

G. Paved or Surfaced Streets:

1. Wherever paved or surfaced streets are cut, saw wheel, or approved cutting devices shall be used.

2. Width of pavement cut shall be as shown on the Drawings.

3. Any cut or broken pavement shall be removed from site during excavation.

H. Traffic:

1. Maintain street traffic at all times as required by the Drawings and as specified herein.

2. Erect and maintain barricades, warning signs, traffic cones, and other safety devices during construction in accordance with the latest edition of Manual of Uniform Traffic Control Devices (MUTCD), Part 6, to protect the traveling public in any area applicable.

3. Provide flaggers as required during active work in roadway areas.

I. Operations shall be confined to rights-of-way and easements provided. Avoid encroachment on, or damage to, private property or existing utilities unless prior arrangements have been made with copy of said arrangement submitted to Engineer.

3.2 EASEMENTS

A. Where portions of the Work are located on private property, easements and permits will be obtained by the Owner. Easements shall provide for the use of property for construction purposes to the extent indicated on the easements.

B. Copies of these easements and permits will be available from the Owner for inspection by the Contractor. It shall be the Contractor's responsibility to determine the adequacy of the easement obtained in every case.

C. Confine construction operations to within the easement limits or street right-of-way limits or make special arrangements with the property owners for the additional area required and notify the Engineer with a copy of the written approval from property owners of any such conditions.

D. Any damage to private property, either inside or outside the limits of right-of-way or easements provided by the Owner, resulting from Work shall be the responsibility of the Contractor. Before the Engineer will authorize final payment, the Contractor will be required to furnish the Owner with written releases from property owners where the Contractor has obtained special agreements or easements or where the Contractor's operations, for any reason, have not been kept within the construction right-of-way obtained by the Owner.

3.3 PROTECTION

A. Existing Facilities:

1. It is the intent of these specifications that all streets, structure, and utilities be left in a condition equal to or better than original condition at the completion of the Project.

2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material to the satisfaction to the Engineer.

3. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.

B. Removal of Water:

1. As specified in Section 31 23 19, Dewatering.

2. At all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the Work.

3. Keep all excavations dry until the utilities or vaults to be placed therein are completed. In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.

4. Dispose of water from the Work in a suitable legal manner without damage to adjacent property or structures.

C. Trench Protection:

1. Provide the materials, labor, and equipment necessary to protect trenches at all times.

2. Trench protection shall provide safe working conditions in the trench and protect the Work, existing property, utilities, pavement, etc.

3. The method of protection shall be according to the Contractor's design.

4. The Contractor may elect to use a combination of shoring, overbreak, tunneling, boring, sliding trench shields, or other methods of accomplishing the work provided the method meets the approval of all applicable local, state, and federal safety codes.

5. Damages resulting from improper shoring, improper removal of shoring, or from failure to shore shall be the sole responsibility of the Contractor.

3.4 LINES AND GRADES

A. Trench excavation for piping, utility vaults, and other utilities shall be performed to the alignment and grade as indicated on the Drawings.

B. Where grades are not shown on the Drawings, utilities shall be laid to grade between control elevations shown.

C. Water mains shall be installed with a minimum cover of 42 inches.

D. The Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.

E. Changes in the grade and horizontal alignment of the pipeline as shown on the Drawings or as provided elsewhere in the Specifications may be necessary due to unanticipated interferences or other reasons.

1. No additional compensation will be allowed the Contractor for changes in horizontal alignment.

2. No additional compensation will be allowed for changes in grade which require additional depth of trench excavation and backfill up to 2 feet from those shown on the Drawings.

F. Use laser-beam instrument with qualified operator to establish lines and grades.

3.5 OBSTRUCTIONS

A. Obstructions to the construction of the trench, such as tree roots, stumps, abandoned pilings, abandoned buildings and concrete structures, logs, rubbish, and debris of all types shall be removed without additional compensation from the Owner.

B. The Engineer may, if requested by the Contractor or Owner, make changes in the trench alignment to avoid major obstructions if such alignment changes can be made within the perpetual easement and right-of-way and without adversely affecting the intended function of the facility or increasing costs to the Owner.

3.6 INTERFERING ROADWAYS AND STRUCTURES

A. Remove, replace and/or repair any damage done during trenching activities to fences, buildings, cultivated fields, drainage crossings, and any other properties without additional compensation from the Owner.

1. Replace or repair these structures to a condition as good as or better than their pre-construction condition prior to commencing work in the area.

B. Paved Roadways:

1. Where paved roadways are cut as part of trenching activities, Class D trench backfill will be required to the bottom of pavement base.

2. New pavement shall be equal to or better than the existing paved surface.

3. New surface shall not deviate by more than 1/4-inch from the existing finish elevation.

C. Existing Structures:

1. If existing structures are encountered as part of trenching activities which will prevent construction and are not adequately shown on the Drawings, the Contractor shall notify the Engineer before continuing with the Work.

2. The Engineer may make such field revisions to the utility alignment as necessary to avoid conflict with the existing conditions.

3. The cost of waiting or “down time” during such field revisions shall be borne by the Contractor without additional cost to the Owner or liability to the Engineer.

4. If the Contactor fails to so notify the Engineer when a conflict of this nature is encountered, but proceeds with construction despite this interference, the Contractor shall do so at the Contractor’s own risk with no additional payment.

3.7 TRENCHING

A. Excavate subsoil as required for construction of utilities to elevations shown on the Drawings.

B. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.

C. Open Trench Limit:

1. Do not advance open trench beyond the distance which will be backfilled and compacted the same day.

2. A maximum length of open trench shall not exceed 100 feet at any one time.

3. Temporary resurfacing shall be completed within 300 feet of the associated open trench limit for each main pipe laying operation.

4. Cover or backfill excavations at the end of each day.

5. If the trench is not backfilled at the end of each working day:

    a. Provide means to prevent caving of excavation sides, as necessary, during non-working hours.

    b. Cover the excavation with a system as needed to provide public safety and prevention of entry during non-working hours.

    c. Provide signed and stamped submittal of caving prevention system and cover system.

6. New trenching shall not be started when earlier trenches need backfilling, or the surfaces of streets or other areas need to be restored to a safe and proper condition.

D. Utility Crossings: Avoid horizontal and vertical conflicts with existing utilities.

1. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.

2. Vertical clearance between the new pipe and existing utilities shall be 12 inches minimum, unless otherwise noted on the Drawings.

3. Where existing utility lines are damaged or broken during trenching activities, the utility shall be repaired or replaced. For water or sewer bearing lines, care being taken to insure a smooth flow line and absolutely no leakage at the new joints.

4. All expenses involved in the repair or replacement of leaking or broken utility lines that have occurred due to the Contractor's operations shall be borne by the Contractor, and the amount thereof shall be absorbed in the unit prices of its bid.

E. Water Lines Crossing Sewer Lines: Whenever water lines cross sewer lines, the Contractor shall comply with local Health Department requirements.

1. Wherever possible, the bottom of the water line shall be 18 inches or more above the top of sewer pipe. One full length of the water line pipe shall be centered at the crossing.

2. For clearances less than 1-1/2 feet, the Contractor shall replace the existing sewer pipe with ductile iron or PVC of equal size, centered at the utility crossing, or shall encase existing sewer pipe with concrete for a minimum of 10 feet on both sides of crossing, as directed by the Engineer, at no additional cost to the Owner.

F. Excavate trenches to width and depth as indicated on Drawings. No additional payment will be provided for trenching activities beyond dimensions shown on the Drawings.

1. Excavation for trenches in which pipelines are to be installed shall provide adequate space for workers to place and joint the pipe properly and safely, but in every case the trench shall be kept to a minimum width.

2. The width of the pipe trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall not exceed 8 inches on either side of the pipe.

3. Excavation for utility vaults and other structures shall be wide enough to provide 18 inches between the structure surface and the sides of the excavation.

4. For pipe or utility vaults to have bedding material, excavate to a depth of 6 inches below the bottom of the pipe or utility vault. Care shall be taken not to excavate below depths required.

5. If over digging occurs, the trench bottom shall be filled to grade with compacted bedding material.

G. Remove water or materials that interfere with Work.

1. The trench at all times shall be kept free from water to facilitate fine grading, the proper laying and joining of pipe, and prevention of damage to completed joints.

2. Adequate pumping equipment shall be provided to handle and dispose of the water without damage to adjacent property.

3. Water in the trench shall not be allowed to flow through the pipe while construction work is in progress unless special permission to do so has been given by the Engineer.

4. An adequate screen shall be provided to prevent the entrance of objectionable material into the pipe.

5. Remove and dispose of existing abandoned sewer pipe, structures, and other facilities as necessary to construct the improvements.

   a. Where the excavation activities require the removal of portions of an abandoned pipeline, masonry plugs shall be installed in the open ends of the pipe, unless otherwise noted on the Drawings or by the Engineer.

   b. Coordinate with Engineer prior to plugging.

   c. For plugs less than 36 inches in diameter, 8-inch-deep masonry units shall be used. For plugs in larger pipelines, 12-inch-deep masonry units shall be used.

6. The costs associated with the removal of water and materials noted above will be considered incidental to trench excavation and backfill.

H. Do not interfere with 45 degree bearing splay of foundations.

I. Over-excavation for Unsuitable Trench Foundation Conditions:

1. Cross-sectional dimensions and depths of excavations shown on the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.

2. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.

3. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.

4. Install nonwoven geotextile under trench stabilization material, over the soft or yielding excavated surface.

   a. Install the nonwoven geotextile ahead of placement of the trench stabilization material, continuously along the excavation bottom and centered on the pipe centerline.

   b. Use nonwoven geotextile width equal to the pipe diameter plus 2 feet.

   c. Place laps or splices in the geotextile in the direction of the pipe laying.

J. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

K. Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic or interfere with the function of existing drainage facilities or system operation.

L. Remove excess subsoil not intended for reuse from site.

M. Stockpile excavated material in area designated on site in accordance with Section 31 05 13, Soils for Earthwork.

3.8 TUNNELING

A. Not used.

3.9 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, new and existing structures, and adjacent and neighboring properties and to prevent caving, erosion, settlement, and loss of surrounding subsoil.

B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.

C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

E. Design sheeting and shoring to be removed at completion of excavation work, unless shown otherwise on the Drawings.

F. Construction Sheeting Left in Place:

1. Furnish, install, and leave in place construction sheeting and bracing when specified or when indicated or shown on the Drawings.

2. Construction sheeting and bracing originally intended for temporary installation, placed by the Contractor to protect adjacent and neighboring structures, may be left in place if desired by the Contractor and approved by the Engineer. All such sheeting and bracing left in place shall be included in the cost for excavation.

3. Any construction sheeting and bracing which the Contractor has placed to facilitate its work may be ordered in writing by the Engineer to be left in place. The right of the Engineer to order sheeting and bracing left in place shall not be construed as creating an obligation on its part to issue such orders. Failure of the Engineer to order sheeting and bracing left in place shall not relieve the Contractor of its responsibility under the contract.

4. For sheeting and shoring to be left in place as part of the completed Work, cut off minimum 18 inches below finished grade.

3.10 COMPACTION

A. Testing will be required to show specified densities of compacted backfill are being achieved by the Contractor's compaction methods.

B. Moisture Control:

1. Moisture condition backfill material to within 2 percent of optimum moisture content required for compaction throughout each lift of the fill.

2. Add moisture to granular backfill by sprinkling during compaction operation.

3. Compaction by ponding or jetting is not permitted.

C. Compact all materials and areas that are not accessible for in-place density testing, as determined by the Engineer, in place by whatever equipment and method is practicable or specified, and as approved by the Engineer.

1. Perform compaction at such moisture content as is required to produce well-filled, dense, and firm material in place that will show no appreciable deflection or reaction under the compacting equipment.

3.11 BEDDING

A. All utility vaults, potable water pipe 4-inch nominal diameter and over, all steel pipe, all concrete sewer pipe, all plastic pipe, all pipe under existing or future structures or roadways, and any and all utilities at a depth greater than 6 feet shall be laid in pipe bedding material.

B. Unless otherwise noted on the Drawings, pipe, or conduit of less than 4-inch diameter, outside structure lines and at a depth of less than 6 feet shall be bedded in native material properly shaped as specified below, all as detailed on the Drawings.

C. Compacted bedding material shall be placed the full width of the excavated trench to a depth as shown on the trench detail included on the Drawings.

1. In lieu of a detail, the depth shall be 6 inches.

D. Spread the bedding smoothly over entire width of trench to the proper grade so that the pipe is uniformly supported along the barrel.

E. Hand grade and compact each lift to provide a firm, unyielding surface along the entire pipe length. For rigid pipe, compact to at least 90 percent relative compaction.

F. Excavate bell holes at each joint to permit proper assembly and inspection of the joint.

G. Check grade and correct irregularities in bedding material.

H. Center pipes horizontally in trench width.

3.12 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen fill materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

C. Maintain optimum moisture content of fill materials to attain required compaction density.

D. Place fill material, with the exception of CLSM, in continuous layers and compact in 6- to 8-inch lifts.

1. Prevent pipe from moving either horizontally or vertically during placement and compaction of pipe zone material.

2. Where trenches are under existing or future structures, paved areas, road shoulders, driveways, or sidewalks, or where designated on the Drawings or specified elsewhere in these specifications, the trench backfill shall be Class B or Class E and pipe zone backfill shall be Class B or Class E. Class B backfill shall be compacted to 95 percent of maximum density at optimum moisture content.

3. Where trenches are outside existing or future structures, paved areas, road shoulders, driveways, or sidewalks, or where designated on plans or specified elsewhere, the trench backfill shall be Class A and pipe zone backfill in these areas shall be Class B. For these locations, compaction of Class B backfill shall be to not less than 90 percent of maximum density at optimum moisture content. Class B backfill shall be compacted to not less than 95 percent of maximum density at optimum moisture content.

E. Employ placement method that does not disturb or damage nearby or adjacent foundation perimeter drainage or utilities in trench.

F. Do not use power-driven impact compactors to compact pipe zone material.

G. Backfill Immediately: All trenches and excavations shall be backfilled immediately after pipe or conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible, unless otherwise directed by the Engineer.

H. Under no circumstances shall water be permitted to rise in open trenches after pipe has been placed.

I. Do not allow backfill material to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.

J. Use hand compactors for compaction until at least 2 feet of backfill is placed over top of pipe. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.

K. Placement of Sand:

1. Place medium sand in lifts not exceeding 8 inches in uncompacted thickness.

2. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.

L. New trenching shall not be started when earlier trenches need backfilling, or the surfaces of streets or other areas need to be restored to a safe and proper condition.

M. Do not leave trench open at end of working day.

3.13 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of all buried piping, install 24 inches below finished grade. Coordinate with piping installation Drawings.

3.14 ELECTRONIC LOCATING FACILITY INSTALLATION

A. Marker Balls:

1. Install according to Manufacturer's recommendations and as shown or directed and according to the following requirements:

a. Install marker balls directly above the pipe alignment at a depth no less than 3 feet and no more than 4-1/2 feet below final surface grade.

b. Install marker balls during trench backfill operations by placing the marker ball in compacted backfill.

c. Cover marker ball with a minimum of 6 inches of backfill and compact backfill before continuing trench backfill operations.

d. Install markers balls with trenchless pipe installations by core-drilling hole of a minimal diameter needed to allow clearance for placement of marker ball. Backfill with approved trench backfill, pavement base and pavement, as applicable.

2. Water Marker Ball Locations: Install at locations as required by Sewer Marker Ball Locations specified herein.

B. Tracer Wire and Terminal Appurtenances:

1. Tracer Wire:

a. Install as shown or directed directly over the pipe centerline and on top of the pipe zone in all sewer trenches, including mainline sewers, service laterals and storm sewer inlet leads.

b. Connect mainline and service lateral tracer wires using either an approved direct-bury lug connector or direct-bury twist connector.

c. Extend tracer wire to locator stations in manholes, locator boxes, storm inlets, or other visually identifiable terminal appurtenances, allowing for access with electronic locating equipment, as shown or directed and according to the following requirements:

2. Locator Stations:

a. Install locator stations as shown within manholes.

b. Mount locator station to manhole wall within 18 inches of manhole rim with two stainless steel expansion anchors.

c. Drill a minimum 3/8-inch diameter hole through the manhole wall within 18 inches of the finish grade of the manhole rim.

d. Extend the tracer wire from the pipe trench in one continuous piece up the outside of the manhole and through the hole and into a locator station and attach to one of the lugs in the locator station.

e. When multiple tracer wires are terminated in manhole install a multi-lead locator station.

f. Extend a ground wire from the locator station through a minimum 3/8-inch diameter hole in the manhole wall.

g. Install ground wire approximately 3 feet deep and extend from the outside manhole wall a minimum of 3 feet horizontally in any direction.

h. Seal all holes drilled in manhole walls with silicone sealant.

3.15 VISUAL IDENTIFICATION FACILITIES

A. Tracer Wire Locate Boxes: Install tracer wire locate boxes directly over service laterals at property line, service boundary, or other location as shown or directed by the Engineer.

B. Service Lateral Plastic or Copper Markers:

1. Install plastic or copper markers in the concrete curb directly over the centerline of the service lateral, as shown or directed by the Engineer.

2. Either plastic or copper markers may be used.

3. If there is not suitable concrete curb for marker placement, then install a lateral cleanout as close to property line as practical at location approved by Engineer.

3.16 FIELD QUALITY CONTROL

A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Contractor.

B. Perform laboratory material tests in accordance with ASTM D698 (AASHTO T99).

C. In-place compaction testing of pipeline backfill materials shall be performed at 2-foot elevation increments, one test per [200] <___> lineal feet of pipeline trench as measured along pipe centerline.

1. The Engineer may reduce the frequency when satisfied with method of compaction.

2. The Engineer may direct testing at a higher frequency at no additional cost to the Owner upon failure to obtain specified densities or if the Contractor changes compaction equipment or methods of compaction.

3. The Engineer shall determine all test locations.

D. Perform in place compaction tests in accordance with the following:

1. Density Tests: ASTM D6938
2. Moisture Tests: ASTM D3017

E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

3.17 SURFACE RESTORATION AND CLEANUP

A. Open Trenches: At the end of each workday, all open trenches shall be backfilled and all trenches within streets shall be temporarily paved or covered to the satisfaction of the Engineer and the local permitting agency.

1. Temporary paving shall be replaced with permanent street paving at the completion of construction within street rights-of-way, or sooner, if deemed necessary by the Engineer.

2. No gravel-filled trenches shall be left open within the street right-of-way at the end of the workday.

B. Topsoil:

1. Where trenches cross lawns, garden areas, pastures, cultivated fields, or other areas on which reasonable topsoil conditions exist, remove the topsoil to the specified depth and place the material in a stockpile.

2. Topsoil shall not be mixed with other excavated material.

3. After the trench has been backfilled, the topsoil shall be replaced.

C. Clean up and remove all excess materials, construction materials, debris from construction, etc. Replace or repair any fences, mailboxes, signs, landscaping, or other facilities removed or damaged during construction. Replace all lawns, topsoil, shrubbery, flowers, etc., damaged or removed during construction. The Contractor shall be responsible for seeing that lawns, shrubs, etc. remain alive and leave premises in condition equal to original condition before construction.

3.18 SCHEDULE

1. Not used.

END OF SECTION

SECTION 31 22 13 - ROUGH GRADING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes rough grading and filling associated with contouring of Site in preparation for building excavation and subsequent site work.

B. Section Includes:

1. Excavating topsoil
2. Excavating subsoil
3. Cutting, grading, filling, and rough contouring of Site

C. Related Sections:

1. Section 01 45 00, Quality Control
2. Section 31 05 13, Soils for Earthwork
3. Section 31 05 16, Aggregates for Earthwork
4. Section 31 10 00, Site Clearing
5. Section 31 23 16, Excavation
6. Section 31 23 17, Trenching
7. Section 31 23 18, Rock Removal
8. Section 31 23 23, Fill

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

B. ASTM International (ASTM):

1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))
3. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
4. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
5. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

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

B. Soils for Earthwork: As specified in Section 31 05 13, Soils for Earthwork.

C. Aggregates for Earthwork: As specified in Section 31 05 16, Aggregates for Earthwork.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

PART 2 PRODUCTS

2.1 MATERIALS

A. Subsoil Fill: Type S1 and S2 as specified in Section 31 05 13, Soils for Earthwork.

B. Topsoil: As specified in Section 31 05 13, Soils for Earthwork.

1. Type TS1, Select Native Topsoil Material, as may be available.
2. TS2, Imported Topsoil Material, as may be required.

C. Structural Fill: Type A1, Dense-Graded Aggregate as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate shall be ¾”-0”.

D. Granular Fill: Type A2, Granular Drain Backfill Material as specified in Section 31 05 16, Aggregates for Earthwork. Size of aggregate shall be 1-1/2”-3/4”.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

A. Coordinate utility locates with NTUA not less than 3 working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

2. Notify Engineer of any potential conflicts resulting from utility locations and the Drawings.

3. Notify utility company to remove and relocate utilities, as may be necessary.

B. Identify required lines, levels, contours, and datum.

C. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with the Work of this Section.

3.3 TOPSOIL EXCAVATION

A. Excavate and stockpile topsoil as specified in Section 31 05 13, Soils for Earthwork.

3.4 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded as shown on the Drawings.

B. When practical, do not excavate wet subsoil. When wet subsoil must be excavated and is to be reused on site for the Work, process wet material to obtain optimum moisture content.

C. Stockpile excavated material in area designated onsite in accordance with Section 31 05 13, Soils for Earthwork.

D. When excavating through roots, perform Work by hand and cut roots with sharp axe.

E. Benching Slopes: Horizontally bench existing slopes greater than 1:2 to key placed fill material to slope to provide firm bearing.

F. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 FILLING

A. General:

1. Grading and filling operations shall not take place when weather conditions and moisture content of fill materials prevent the attainment of specified density.

2. Vertical curves or roundings at abrupt changes in slope shall be established as approved by Engineer.

3. Bring all graded areas to a relatively smooth, even grade and slope by blading or dragging. Remove high spots and fill depressions.

B. Fill areas to contours and elevations shown on the Drawings with unfrozen materials.

C. Topsoil Fill:

1. Scarify prepared subgrade to depth of **[4] [ ]** inches immediately prior to placing topsoil.

2. Place topsoil in areas to be seeded to depths indicated on the Drawings, minimum depth of 6 inches.

3. Place topsoil material loose; do not compact, do not place in wet or muddy conditions.

D. Place material in continuous layers as follows:

1. Subsoil Fill: Maximum 8 inches compacted depth.
2. Structural Fill: Maximum 12 inches compacted depth.

3. Granular Fill: Maximum 12 inches compacted depth.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.

G. Make grade changes gradual. Blend slope into level areas.

H. Repair or replace items indicated on the Drawings to remain which are damaged by excavation or filling. All costs shall be borne by the Contractor.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 0.1 ft from required elevation.

3.7 FIELD QUALITY CONTROL

A. Perform laboratory material tests in accordance with AASHTO T99.

B. Perform in place compaction tests in accordance with the following:

1. Density Tests: ASTM D6938

2. Moisture Tests: ASTM D3017

C. Frequency and location of testing is dependent upon type of material placed. See Section 01 45 00, Quality Control for testing requirements.

D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

END OF SECTION

SECTION 31 25 00 – EROSION AND SEDIMENT CONTROLS

PART 1 GENERAL

1.1 SCOPE

A. This section covers the requirements for temporary and permanent erosion and sedimentation control necessary to prevent migration of sediment and silt laden water to adjacent surface water bodies and drainage structures.

B. The Contractor shall provide all materials, labor, and equipment necessary to install adequate erosion and sedimentation controls.

1.2 QUALITY CONTROL

The work will not disturb more than one acre at each site and an erosion control permit is not required.

A. Erosion control provisions for each site shall conform to regulatory requirements of the following agencies.

1. Federal Clean Water Act – Section 402 and title 33, Sect 1251 et seq.

1.3 SUBMITTALS

A. Not used.

1.4 SCHEDULE

A. Required temporary erosion and sedimentation control Best Management Practices (BMPs) must be constructed and in operation prior to land clearing or other construction activities to ensure that sediment laden water does not leave the site.

B. Temporary sediment facilities shall be maintained in a satisfactory condition until such time that permanent ESC facilities are in place or sufficient vegetation has been established and potential for on-site erosion has passed.

C. The implementation, maintenance, replacement, and additions to erosion/sedimentation control systems shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 CHECK DAM SAND OR GRAVEL BAGS

A. Bags to be either burlap or woven “Geotextile” fabric filled with gravel or sand.

2.2 JUTE MATTING

A. Be of a uniform open plain weave of unbleached, single jute yarn treated with a fire-retardant chemical.

B. The yarn shall be of a loosely twisted construction and shall not vary in thickness by more than one-half of its normal diameter.

C. Furnished in rolled strips 48 inches wide by approximately 50 yards long.

D. Average weight of 0.92 pounds per square yard with an allowable tolerance of plus or minus 1 inch in width and 5 percent in weight.

2.3 FILTER FABRIC FENCE

A. Filter Fabric

1. Filter fabric for the erosion protection barriers shall be Mirafi 140, or equivalent.

B. Wire

1. Wire for the erosion protection barriers shall be 2 by 2 mesh, 12-gauge galvanized wire.

C. Support Posts

1. Support posts for the erosion protection barriers shall be minimum 2-inch by 2-inch, Douglas Fir No. 1, or better wood posts.

2.4 CLEAR PLASTIC COVERING

A. Clear plastic covering for protection of slopes and cuts shall meet the requirements of the ASTM D2103 for Polyethylene sheeting having a minimum thickness of 6 mil.

2.5 INLET PROTECTION

A. All new and existing stormwater inlets which collect stormwater runoff from a construction site shall be protected from sediment by the use of filters.

2.6 STABILIZED CONTRUCTION ENTRANCE

A. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.

PART 3 EXECUTION

3.1 EROSION CONTROL

A. Erosion control provisions shall meet or exceed the requirements of the local agency having jurisdiction.

B. When provisions are specified and shown on the drawings, they are the minimum requirements.

C. Contractor shall not permit sediment-laden waters to leave the site.

D. As construction progresses and seasonal conditions dictate, more siltation control facilities may be required. It shall be the responsibility of the Contractor to address new conditions that

may be created and to provide additional facilities over and above minimum requirements as may be required.

E. Provide temporary erosion control measures to prevent erosion from piles of topsoil or fill material. Before completing the Contract, any areas of bare soil shall be permanently seeded.

F. Additional measures may be necessary depending on construction activity and weather. Contractor will be responsible for carrying out the erosion control provisions of the approved ESC Plan.

1. Keep streets and paved surfaces clean of mud and debris. Install gravel construction entrances as shown on the Plans and maintain them for the duration of the construction period.

3.2 SILTATION CONTROL

A. Siltation control is required. Check dams or silt fences may be placed in streams or ditches receiving stormwater from areas disturbed by construction.

3.3 FILTER FABRIC FENCES

A. Filter fabric fence shall consist of filter fabric fastened to wire fabric with staples or wire rings.

B. Wire shall be fastened to posts set at 6 foot-maximum centers.

C. Fabric shall be buried into ground a minimum of 4 inches to prevent silt from washing under fabric.

D. Fence shall be located to catch silt and prevent discharge to drainage courses.

3.4 EROSION CONTROL CHECK DAM

A. Sand or gravel filled bags shall be installed in drainage way to catch silt.

B. Spillway shall be lower than outer edge of dam. Leave a one sandbag gap in top row to provide spillway.

3.5 PLACING JUTE MATTING

A. Seed and fertilizer shall be placed prior to placing of matting.

B. Jute matting shall be unrolled parallel to the flow of water. Where more than one strip of jute matting is required to cover the given area, it shall overlap the adjacent mat a minimum of 4 inches. The ends of matting shall overlap at least 6 inches with the upgrade section on top.

C. The up-slope end of each strip of matting shall be staked and buried in a 6-inch-deep trench with the soil firmly tamped against the mat. Three stakes per width of matting (one stake at each overlap) shall be driven below the finish ground line prior to backfilling of the trench.

D. Engineer may require that any other edge exposed to more than normal flow of water or strong prevailing winds be staked and buried in a similar manner.

E. Check-slots shall be laced between the ends of strips by placing a tight fold of the matting at least 6 inches vertically into the soil. These shall be tamped and stapled the same as up-slope ends. Check-slots must be placed so that one check-slot or one end occurs within each 50 feet of slope.

F. Edges of matting shall be buried around the edges of catch basins and other structures as herein described. Matting must be spread evenly and smoothly and in contact with the soil at all points.

G. Matting shall be held in place by approved wire staples, pins, spikes, or wooden stakes driven vertically into the soil. Matting shall be fastened at intervals not more than 3 feet apart in three rows for each strip of matting, with one row along each edge and one row alternately spaced in the middle. All ends of the matting and check-slots shall be fastened at 6-inch intervals across their width. Length of fastening devices shall be sufficient to securely anchor matting against the soil and driven flush with the finished grade.

3.6 PLACING CLEAR PLASTIC COVERING

A. Clear plastic covering shall be installed on erodible embankment slopes.

B. The clear plastic covering shall be installed immediately after completion of the application of roadside seeding. It is the intent of this specification that clear plastic covering will be in place before the fall rainfall begins.

C. Maintain the cover tightly in place by using sandbags or ties on slopes with a minimum of 10-foot grid spacing in all directions. All seams shall be taped or weighted down full length. There shall be at least a 12-inch overlap of all seams.

D. Immediately repair all damaged areas.

3.7 EXISTING DRAINAGE FACILITIES

A. Should a storm sewer or culvert become blocked or have its capacity restricted due to siltation from Contractor's operations, the Contractor shall make arrangements with the jurisdictional agency for the cleaning of the facility at no additional expense to the Owner.

B. Contractor shall install catch basin inserts in existing catch basins in the vicinity of, or adjacent to, clearing or construction activities to prevent sediment from entering the on-site stormwater conveyance system.

3.8 DRAINAGE DIVERSION

A. Contractor may divert up-gradient surface runoff water around the site as required. Contractor will be responsible for routing diverted surface water to its original flow path downstream of the site and providing energy dissipation and/or dispersion as needed to mimic pre-diverted flow characteristics, as required by the Engineer.

B. Drainage shall be restored to condition existing prior to construction unless otherwise shown on the drawings.

END OF SECTION

SECTION 31 23 23 – FILL

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes backfilling required at building perimeter and site structures to subgrade elevations, fill under interior and exterior slabs-on-grade or pavement, and fill under landscaped areas. Backfilling for utilities within building proper is included within this section; backfilling for utilities outside building is included in Section 31 23 17, Trenching.

B. Section includes:

1. Backfilling building perimeter to subgrade elevations.
2. Backfilling site structures to subgrade elevations.
3. Fill under slabs-on-grade.
4. Fill under paving.
5. Fill for over-excavation.

C. Related Sections:

1. Section 31 05 13, Soils for Earthwork
2. Section 31 05 16, Aggregates for Earthwork
3. Section 31 22 13, Rough Grading
4. Section 31 23 16, Excavation
5. Section 31 23 17, Trenching
6. Section 31 23 24, Flowable Fill
7. Section 31 25 00, Erosion and Sediment Controls
8. Section 31 37 00, Riprap
9. Section 33 11 10, Water Utility Distribution and Transmission Piping
10. Section 33 31 13, Public Sanitary Utility Sewerage Piping
11. Section 33 41 10, Storm Utility Drainage Piping

D. Supplemental Information: Geotechnical report

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop.

B. ASTM International (ASTM):

1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance

2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).

3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

5. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

1.3 DEFINITIONS

A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill elsewhere in these Specifications. A self-compacted, cementitious material.

B. Imported Material: Materials obtained from sources offsite, suitable for specified use.

C. Lift: Loose (uncompacted) layer of material.

D. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.

2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

1.4 SUBMITTALS

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

B. Imported Materials:

1. Materials Source: Submit name and location of imported fill materials suppliers.
2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
3. Submit results of aggregate sieve analysis and standard proctor test for granular material.

C. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.5 QUALITY ASSURANCE

A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.

B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.

C. CLSM:

1. In-place testing: In accordance with ASTM C403.
2. Compressive testing: In accordance with ASTM D4832.

D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Subsoil Fill: Type S2, Imported Fill Material, as specified in Section 31 05 13, Soils for Earthwork.

B. Imported Granular Fill: Coarse Aggregate Type A1, Dense-Graded Aggregate with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.

C. Concrete:

1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).

2. Structural concrete as specified in Section 03 30 00, Cast-in-Place Concrete. Compressive strength as required by the application or as noted in the Drawings.

D. Drain Rock: Coarse Aggregate Type A2, Granular Drain Backfill Material with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.

E. Foundation Stabilization Material: Coarse Aggregate Type A1, Dense-Graded Aggregate, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

A. Prior to Work in this Section, become familiar with Site conditions. In the event discrepancies are found, notify Engineer as to the nature and extent of the differing conditions.

B. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.

C. Verify underground vaults are anchored to their own foundations to avoid flotation after backfilling.

D. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 SITE CONDITIONS

A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.

B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Engineer to quell dust.

C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.

D. See provisions for Work in Section 31 25 00, Erosion and Sediment Controls.

3.3 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Control of Water:

1. Excavated areas shall be kept free of water and frost.

2. Bearing surfaces which become softened by water or frost shall be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.

3. See Section 31 23 19, Dewatering for additional details.

C. Compact subgrade to density requirements for subsequent backfill materials.

D. Cut out soft areas of subgrade not capable of compaction in place and replace with specified granular fill material. See Article 3.5, Over-excavation for Unsuitable Foundation Conditions in Section 31 23 16, Excavation for additional details.

E. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

F. Subgrade to be approved by Engineer prior to placement of structures and commencement of backfill activities.

G. Do not allow or cause any work performed or installed to be covered up or enclosed prior to required tests and approvals. Should any Work be enclosed or covered up, uncover at Contractor's expense.

3.4 BACKFILLING

A. Backfill areas to contours and elevations shown in the Drawings with unfrozen materials.

B. Do not place materials when weather conditions and/or moisture content prevent attainment of specified density.

C. Maintain optimum moisture content of backfill materials to attain required compaction density.

D. Employ placement method that does not disturb or damage other work.

E. Mechanical tampers permitted in confined areas.

F. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

G. Foundation Base for Structures:

1. Bring excavation to required subgrade elevation shown in the Drawings.

2. Place foundation base material to required grade shown in the Drawings.

3. Place foundation base material in lifts and compact to percent maximum dry density specified below.

4. Booster Pump Stations Sites:

    a. Concrete Slabs, mat foundations and flatwork areas: Place an 8-inch minimum layer of Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation under all concrete slabs.

H. Backfill for Structures:

1. Prior to placing backfill, remove forms, temporary construction, and debris below grade.

2. Backfill shall not be placed against poured concrete until 28 days have passed from completion of original concrete pour, unless otherwise approved by Engineer.

3. Heavy compactors and large pieces of construction equipment shall be kept away from any embedded wall a distance of a least 5 feet in order to avoid the build-up of excessive lateral pressures.

    a. Over-compaction of fill near walls should be avoided.

4. Compaction within 5 feet of the walls shall be accomplished using hand-operated vibratory plate compactors or tamping units.

5. The maximum particle size of granular material placed against buried structures shall be limited to no greater than 1-1/2-inch diameter.

6. Structural fill backfill material shall be brought up on all sides of the walls and footings in such a manner as to avoid adverse differential lateral earth pressures on the vertical surfaces.

7. Appropriate lift thickness will depend on the type of compaction equipment used and the type of material being placed. All material shall be compacted to at least 95 percent of the standard maximum dry density.

    a. For moderate- to heavy-weight compactors, a maximum loose lift thickness of 12 inches shall be used.

    b. For hand-operated or small compactors, a maximum loose lift thickness of 8 inches shall be used.

8. Particular care must be taken to avoid damage to the pipe connections to the structure.

9. Utility trench backfill within 10 feet of all structural perimeters shall meet the requirements for structural fill.

I. For areas receiving surface structures or existing paved areas to be constructed or replaced, such as driveways, parking lots, and sidewalks.

1. Place Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation in 6-inch lifts.

2. Compact with vibratory equipment to 95 percent maximum density, unless otherwise specified or shown in the Drawings.

J. Permanent Embankment Fill:

1. Not used.

K. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise in the Drawings.

L. Make gradual grade changes. Blend slope into level areas.

M. Remove surplus backfill materials from Site in accordance with Section 31 23 16, Excavation.

3.5 FIELD QUALITY CONTROL

A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Contractor.

B. Perform laboratory material tests in accordance with ASTM D698 (AASHTO T99).

C. In-place compaction testing for structural fill material shall be performed at 2-foot elevation increments in the fill material with at a minimum of one test per each <___> square feet of material placed. The Engineer shall be provided with the results of each compaction test at the time of testing.

D. Perform in place compaction tests in accordance with the following:

1. Density Tests: ASTM D6938.

2. Moisture Tests: ASTM D3017.

E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

F. When testing of subgrade is not possible or feasible as detailed above, proof roll compacted fill surfaces under slabs-on-grade, pavers, paving, and as may be otherwise required by the Engineer.

3.6 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic.

3.7 SCHEDULE

1. See compaction requirements in geotechnical report.

END OF SECTION

SECTION 31 37 00 - RIP RAP

PART 1 GENERAL

1.1 SCOPE

This Section consists of furnishing and placing an erosion-resistant cover material for protecting slopes and basins at locations shown or as directed.

A. Related Sections:

1. Section 03 60 00, Grouting
2. Section 31 22 13, Rough Grading
3. Section 31 23 18, Rock Removal

1.2 DEFINITIONS

A. Filter Blanket - A layer of graded granular material placed between the area prepared for it and the riprap.

B. Grouted Riprap - Loose riprap with all or part of the spaces filled with Portland cement mortar.

C. Keyed Riprap - Loose riprap placed on prepared slope, riprap geotextile, or filter blanket, as specified, and keyed in place by slapping the surface with a piece of armor plating.

D. Loose Riprap - Specified classes of graded rock placed on prepared slope, riprap geotextile, or filter blanket, as specified.

E. Riprap Backing - An option of using either riprap geotextile or a filter blanket placed between the area prepared for it and the riprap.

F. Riprap Basin - Energy dissipater consisting of loose riprap placed at pipe outlets as specified.

G. Riprap Geotextile - A geotextile placed between the area prepared for it and the riprap.

1.3 SUBMITTALS

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

B. Materials Source: Submit name of imported materials suppliers.

C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

D. Results of aggregate sieve analysis and standard proctor tests for all granular material.

PART 2 MATERIALS

2.1 RIPRAP GEOTEXTILE

Furnish riprap geotextile as shown in the Drawings.

2.2 RIPRAP REQUIREMENTS

A. General - Furnish rock for loose riprap meeting the following requirements:

1. Meet the test requirements of provided herein.

2. Be angular in shape. Thickness of a single rock shall not be less than 1/3 its length. Rounded rock will not be accepted unless authorized by the Engineer.

3. Meet the gradation requirements for the class specified.

4. Be free from overburden, spoil, shale, and organic material. Non-durable rock, shale, or rock with shale seams is not acceptable.

B. Test Requirements - Furnish the rock meeting the following test requirements:

Material Test	Requirement
Apparent Specific Gravity (AASHTO T 85)	2.50 Min.
% Absorption (AASHTO T 85)	6.0 Max.
Degradation (ODOT TM 208A)	
Passing No. 20 Sieve	35.0% Max.
Sediment Height	8.0" Max.
Soundness (AASHTO T 104)	
Average Loss of 2 1/2" - 1 1/2" and	
1 1/2" - 3/4" fraction after 5	16.0% Max.
alternations	

C. Gradation Requirements - Grade loose riprap by class and weight of rock according to the following:

Class 50	Class 100	Class 200	Class 700	Class 2000	
Weight of Rock (pounds)					Percent (by Weight)
50 - 30	100 - 60	200 -	700 -	2000 -	20.0
30 - 15	60 - 25	140	500	1400	30.0
15 - 2	25 - 2	140 - 80	500 -	1400 -	40.0
2 - 0	2 - 0	80 - 8	200	700	10.0 - 0
		8 - 0	200 - 20	700 - 40	
			20 - 0	40 - 0	

Uniformly grade each load of riprap from the smallest to the largest weight specified. Control of gradation will be by visual inspection.

1. Control Sample - If directed, provide, at a satisfactory location near the Project Site, a rock sample of at least 5 tons meeting the gradation for the class specified. This sample will be used as a frequent visual reference for judging the gradation of the riprap supplied.

2. Sampling and Testing Assistance - Any difference of opinion between the Engineer and the Contractor shall be resolved by dumping and checking the gradation of two random truckloads of rock. Mechanical equipment, a sorting site, and labor needed to assist in checking gradation shall be provided by the Contractor at no additional cost to the Owner.

D. Grouted Riprap

1. Furnish rock for grouted rip rap meeting the requirements of stated herein for class and size specified.

2. Furnish non-shrink Portland cement grout meeting the requirements of Section 03 60 00, Grouting.

E. Filter Blanket - Furnish filter blanket material meeting the following requirements according to riprap class:

Riprap Class	Filter Blanket
Class 2000	16-inch layer of Class 50 riprap conforming to the requirements of this section
Class 700	9-inch layer of 6-inch - 0 stone embankment meeting the test requirements of this section
Class 200	6-inch layer of 4-inch - 0 stone embankment meeting the test requirements of this section
Class 100	No filter blanket required
Class 50	No filter blanket required

PART 3 EXECUTION

3.1 PREPARATION

A. Remove brush, trees, stumps, and other organic material from slopes to be protected by riprap and dress to a smooth surface.

B. Remove all unsuitable material to the depth shown or directed and replace with approved material.

C. Compact filled areas as specified in Section 31 23 23, Fill.

D. Provide riprap protection as early as the structure foundation construction permits. Prepare the surfaces to be protected as shown.

E. Maintain the trench slopes, riprap geotextile, or filter blanket until the riprap is placed.

3.2 RIPRAP GEOTEXTILE

A. Install riprap geotextile as shown in the Drawings or as directed by the Engineer.

3.3 FILTER BLANKET CONSTRUCTION

A. If required, place the filter blanket on the prepared area to the full specified thickness in one operation, using methods which will not cause segregation.

B. The surface of the finished layer shall be reasonably even.

3.4 RIPRAP BACKING

A. When indicated on the Drawings, the Contractor shall have the option of placing either riprap geotextile or a filter blanket behind the riprap.

B. Install the backing per these specifications or as shown in the Drawings.

3.5 RIPRAP

A. General - Unless otherwise directed, place the riprap protection as the embankment is constructed. Its placement shall lag behind embankment construction only as necessary to allow proper embankment construction and prevent mixture of embankment and riprap material.

B. Loose Riprap - Place riprap on the prepared area:

1. With a clamshell, orange-peel bucket, skip, or similar approved device which will contain the riprap material to its final destination. Do not open the bucket until it has been lowered to the slope on which the material is being placed.

2. To its full course thickness in one operation.

3. According to the compaction requirements of Section 31 23 23, Fill if riprap is placed on geotextile

4. By methods that do not cause segregation of riprap or displace the underlying material.

5. To produce a compact riprap protection in which all sizes of material are placed in their proper proportion.

6. With some hand placing, or rearranging of individual stones by mechanical equipment, or some other approved means to provide a smooth finished surface.

Where filter material and/or riprap are placed under water, increase their thicknesses as shown or as directed.

C. Keyed Riprap - After placing loose riprap material, key the riprap into place by slapping the surface with a piece of armor plating (approximately 4 feet by 5 feet in size with a weight of approximately 5,000 pounds) or other approved means which will produce a nearly smooth surface.

D. Grouted Riprap - Place loose riprap material. If the depth specified for grouting is more than 12 inches, place the riprap in lifts of 12 inches or less and grout each lift before placing the next lift. Construct and grout the succeeding lifts before the grout in the previous lift has hardened.

Thoroughly moisten the stones and sluice any excess fines to the underside of the riprap before grouting. Deliver the grout to the place of final deposit by any means that will ensure uniformity and prevent segregation of the grout. Spade or rod the grout into the spaces to completely fill the voids in the riprap. Control pressure grouting and do not unseat the stones. Penetration of the grout shall be to the depth shown on the plans. If a rough surface is specified, brush the stone until 25 percent to 50 percent of the depth of surface stone is exposed. For a smooth surface, grout the crevices to within 5/8-inch of the surface.

Provide weep holes through the riprap as shown or as directed.

Place and cure grout according to 03 60 00, Grouting, except as provided above.

E. Riprap Basins - Excavate, backfill, and construct riprap basins, without a riprap geotextile or filter blanket, at pipe outlets with Class 50 riprap as shown or as directed.

3.6 MAINTENANCE

Maintain the riprap protection until accepted. Replace any material displaced by any cause at no additional cost to the Owner.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 31 23 18 - ROCK REMOVAL

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes removal of subsurface rock during excavation by mechanical method.

B. Section Includes:

1. Removing identified and discovered rock during excavation.
2. Expansive tools to assist rock removal.
3. [Explosives to assist in rock removal.]

C. Related Sections:

1. Section 31 22 13, Rough Grading
2. Section 31 23 16, Excavation: Building excavation
3. Section 31 23 17, Trenching: Trenching and backfilling for utilities
4. Section 31 23 23, Fill: Backfill materials
5. Section 31 37 00, Riprap

D. Supplemental Information: Geotechnical report

1.2 REFERENCES

A. National Fire Protection Association:

1. NFPA 495 - Explosive Materials Code.

1.3 DEFINITIONS

A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. All excavation shall be classified as Common Excavation, unless provided for under Rock Removal below.

B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation, excluding rock as defined below.

C. Rock: Solid mineral material, including boulders, solid bedrock, or ledge rock, with volume in excess of 1/2 cubic yard or solid material which, by actual demonstration, cannot be reasonably excavated with suitable machinery as defined herein. The Engineer may waive the requirements for actual demonstration if the material encountered is well-defined rock.

D. Rock Removal: Removal of rock as defined herein by systematic and continuous drilling, hammering, breaking, splitting, or other methods approved by the Engineer.

E. Suitable Machinery: A track-mounted hydraulic excavator of the 52,800- to 72,500-pound class equipped with a single shank ripper.

1.4 SUBMITTALS

A. Section 01 33 00, Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate proposed method of rock removal.

C. Equipment: Manufacturer information regarding pound class of machinery proposed for rock removal.

D. Survey Report: Submit survey report mapping extent and locations of rock encountered, to be used in calculating total volume of rock removal.

1.5 QUALITY ASSURANCE

A. Not used.

1.6 PROJECT CONDITIONS

A. Conduct survey of rock uncovered in excavation for structures or trenching for utilities prior to removal of material.

1.7 SCHEDULING

A. Not used.

PART 2 PRODUCTS

2.1 MATERIALS

A. Not used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions and note subsurface irregularities affecting Work of this section.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Engineer Approval for Rock Removal:

1. Prior to commencement of rock removal, expose all material anticipated to be rock by removing the common material above it and then notify the Engineer.

2. The Engineer, in association with the Contractor or the Contractor’s representative, will measure the amount of material to be removed in an effort to reach a mutually agreeable volume for anticipated rock removal.

3. Prior to commencing the proposed rock removal, the Contractor must receive written approval by the Engineer stating the approximate volume of excepted rock removal to receive payment.

4. During rock removal activities, should it become apparent the previously agreed upon volume of rock removal will be exceeded, notify the Engineer immediately. Should the Contractor proceed with rock removal in excess of the previously agreed upon volume, the Contractor will do so at their own risk and expense.

3.3 ROCK REMOVAL BY MECHANICAL METHOD

A. Excavate and remove rock by mechanical method.

1. Use single shank ripper to fracture rock.
2. Drill holes and use expansive tools and wedges to fracture rock.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove shaled layers to provide sound and unshattered base for footings and foundations.

D. In utility trenches, excavate to 6 inches below invert elevation of pipe and 24 inches wider than pipe diameter.

E. For vaults and other structures, excavate to the depth necessary to install the structure and to a maximum of 18 inches beyond the outside walls of the vault or structure.

F. Remove excavated materials [from site.] [and reuse for site landscaping.]

G. Correct unauthorized rock removal associated with structural excavations in accordance with backfilling and compacting requirements of Section 31 23 16, Excavation and as directed by Engineer.

H. Correct unauthorized rock removal associated with utility work in accordance with backfilling and compacting requirements of Section 31 23 17, Trenching and as directed by Engineer.

I. If material which would be classified as rock as defined herein is mechanically removed with equipment of a larger size than specified as Suitable Machinery herein, it shall be understood that any added costs for the removal of rock by this method shall be included in the unit price for common excavation and not paid for under this pay item. If material which would be classified as rock as defined herein is mechanically removed without hammering, breaking, or splitting, it will be considered common excavation and not paid for under this pay item. If equipment larger than the suitable machinery as defined herein is brought on the Project Site for the sole purpose of rock removal without hammering, breaking, or splitting, then such excavation will be considered rock removal.

3.4 ROCK REMOVAL BY EXPLOSIVE METHODS

A. Not used.

3.5 FIELD QUALITY CONTROL

A. Request visual inspection of foundation bearing surfaces by Engineer before installing subsequent work.

END OF SECTION

SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes chain link steel fencing and gates as shown on the Drawings or specified elsewhere. All fences and gates shall be furnished with top rails and knuckled periphery edges.

B. Section includes:

1. Chain link fabric
2. Posts
3. Rails
4. Tension wires
5. Braces
6. Fittings
7. Gates
8. Lock assemblies and gate stops

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Chain Link Fence Manufacturer's Institute:

1. Galvanized Steel Chain Link Fence Fabric
2. Industrial Steel Specifications for Fenceposts, Gates, and Accessories

B. ASTM International (ASTM):

1. A121, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
2. A313, Standard Specification for Stainless Steel Spring Wire
3. A392, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
4. A491, Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
5. A497, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
6. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
7. A780, Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
8. A824, Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use with Chain Link Fence
9. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

10. C94, Standard Specification for Ready-Mixed Concrete
11. C150, Standard Specification for Portland Cement
12. C387, Standard Specifications for Packaged, Dry, Combined Materials for Mortar and Concrete
13. F552, Standard Terminology Relating to Chain Link Fencing
14. F567, Standard Practice for Installation of Chain-Link Fence
15. F626, Standard Specification for Fence Fittings
16. F900, Standard Specification for Industrial and Commercial Swing Gates
17. F1043, Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
18. F1083, Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
19. F1183, Standard Specifications for Aluminum Alloy Chain Link Fence Fabric
20. F1184, Standard Specifications for Industrial and Commercial Horizontal Slide Gates
21. F1916, Standard Specification for Selecting Chain Link Barrier Systems with Coated Chain Link Fence Fabric and Round Posts for Detention Applications

C. Conflicts in requirements shall use this Section to take precedence.

1.3 SUBMITTALS

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

B. Shop Drawings:

1. Product Data: Include construction details, material descriptions, dimensions of individual components, and finishes for chain link fences and gates.
2. Fence, gate posts, rails, and fittings.
3. Chain link fabric.
4. Gates and hardware.

C. Manufacturer’s recommended installation instructions.

D. Evidence of Supplier and installer qualifications.

1.4 QUALITY ASSURANCE

A. Use skilled workers thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Provide each type of steel fence and gate as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings, and fastenings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in undamaged condition.

B. Store materials off the ground to provide protection against oxidation caused by ground contact.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fabric

1. Continuous chain link fence.
2. Height: As shown on the Drawings.
3. Mesh: 2-inch. All mesh shall have knuckled periphery to eliminate sharp appendages.
4. #9-gauge steel core wire.
5. Top and bottom selvage: Knuckled finish.
6. Galvanized after weaving.
7. Zinc coating shall not be less than 0.9 ounces per square foot.

B. Line Posts

Line posts shall be hot dipped galvanized 2.375-inch outside diameter hot dipped galvanized pipe, weighing 3.12 pounds per lineal foot.

C. Terminal Posts

End, corner, and pull posts shall be hot dipped galvanized pipe 2.875 inches outside diameter and weighing not less than 4.64 pounds per lineal foot.

D. Top Rail

1. Top rail shall be hot dipped galvanized 1.660-inch outside diameter pipe, weighing 1.83 pounds per lineal foot.

2. Furnish in random lengths of approximately 20 feet.

3. Jointed using a pressed steel or malleable sleeve, not only allowing for expansion and contraction, but also providing a continuous brace from end to end of each stretch of fence.

E. Tension Wire

Bottom tension wire shall be #6-gauge heavy galvanized high carbon steel coil spring wire, securely fixed to the fabric, line posts, and terminal posts.

F. Braces

1. All terminal posts shall be braced with 1.660-inch outside diameter. horizontal pipe bracing of the same material as the top rail, securely attached to the terminal and first line post with malleable iron fittings.

2. Braces shall be truss-braced from the first line post to the bottom of the terminal post, with a 3/8-inch galvanized truss rod assembly.

3. Corner posts shall be braced in both directions.

G. Fittings

1. Malleable, cast iron, or pressed steel.
2. Hot dip galvanized.

H. Fabric Ties

1. #11-gauge galvanized wire ties shall be used to tie the fabric to the line posts and rails.

I. Chain Link Gates

1. Frames:

   a. Made of heavy galvanized 1.90-inch outside diameter pipe, weighing 2.28 pounds per lineal foot.

   b. Welded or assembled with corner fittings.

2. Corner fittings, ball and socket hinges, catch stops, and center rest to be heavy galvanized malleable iron.

3. Hinges as required.

4. Provide diagonal cross-bracing.

J. Gate Posts

Posts shall be hot dipped galvanized pipe 2.875-inch outside diameter weighing 4.64 pounds per lineal foot.

K. Framework Material

All posts, rails, and braces to be heavy galvanized.

L. Lock Assembly and Gate Stop

1. Provide for each gate one double-hasp drive gate drop rod lock assembly set in concrete and one gate stop set in concrete.

2. All lock assemblies and gate stops shall be fabricated from heavy galvanized malleable iron.

3. Provide one vandal-proof keyed lock and three keys for each gate assembly.

PART 3 EXECUTION

3.1 INSTALLATION

A. All materials and workmanship shall be first class in all respects and shall be done in a neat and workmanlike manner.

B. Installation shall be conducted in accordance with the requirements of the Chain Link Fence Manufacturers Institute and these Drawings and Specifications.

C. All line, terminal, gate stops, gate drop, and gate posts shall be fixed with a minimum of 3-foot embedment in concrete poured into a 1-foot diameter hole and plumb upon curing of the concrete.

D. Line posts shall be spaced not further than 10-foot on-center.

E. Gates shall have 3-inch clearance above ground surface and sized for the application shown.

F. Space ties at 14 inches on center.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 32 11 23 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes construction of an aggregate subbase and base course for placement under asphalt or concrete paving, unit paving, or placed and left exposed.

B. Section Includes:

1. Aggregate subbase
2. Aggregate base course

C. Related Sections:

1. Section 31 22 13 - Rough Grading
2. Section 31 23 17 - Trenching
3. Section 31 23 23 - Fill
4. Section 31 37 00 - Riprap
5. Section 31 05 16 - Aggregates for Earthwork
6. Section 32 12 16 - Asphalt Concrete Paving

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications

2. T11, Standard Method of Test for Materials Finer Than 75μm (No. 200) Sieve in Mineral Aggregates by Washing

3. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates

4. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

B. ASTM International (ASTM):

1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method

3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

4. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports

5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities and standing water, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform cross-section thickness.

C. Keystone: Fine aggregate used to aid in binding of loose surface stone.

1.4 SUBMITTALS

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

B. Product Data:

1. Submit data for geotextile fabric and herbicide.

C. Materials Source: Submit name of aggregate materials suppliers.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 SHOULDER AGGREGATE

A. Of the size shown on the Plans.

B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 32 05 16, Aggregates for Earthwork.

2.2 DENSE-GRADED BASE AGGREGATES

A. Of the size shown on the Plans.

B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 32 05 16, Aggregates for Earthwork.

2.3 OPEN-GRADED BASE AGGREGATES

A. Of the size shown on the Plans.

B. Coarse Aggregate: Type A2, Granular Drain Backfill Material as specified in Section 32 05 16, Aggregates for Earthwork.

2.4 SOURCE QUALITY CONTROL

A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.

B. Final approval of aggregate material will be based on test results of installed materials.

C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

2.5 EQUIPMENT

A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

2.6 ACCESSORIES

A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

A. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.

B. Verify compacted substrate is dry and ready to support paving and imposed loads.

1. Proof roll substrate with equipment approved by the Engineer in minimum two perpendicular passes to identify soft spots.

2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23.

3.2 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place base course or surfacing materials in snow or on soft, muddy, or frozen subgrade.

3.3 HAULING AND SPREADING

A. Hauling Materials:

1. Do not haul over surfacing in process of construction.

2. Loads: Of uniform capacity.

3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.

2. Produce even distribution of material on prepared surface without segregation.

3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.

4. Maintain consistent gradation of material. Widely varying gradation will be cause for rejection.

3.4 CONSTRUCTION OF COURSES

A. Untreated Aggregate Base Course:

1. If the required compacted depth of the base course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

2. Completed Course Total Thickness: As shown on the Plans, 8-inch minimum.

3. Spread lift on preceding course to required cross-section. Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.

4. Lightly blade and roll surface until thoroughly compacted.

5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:

a. Use 3/4-inch leveling course or surfacing material as keystone.

b. Spread evenly on top of base course, using spreader boxes or chip spreaders.

c. Roll surface until keystone is worked into interstices of base course without excessive displacement.

d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.

6. Blade or broom surface to maintain true line, grade, and cross-section.

B. Gravel Surfacing and Leveling Course:

1. Place shoulder aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.

2. Spread on preceding course in accordance with cross-section shown.

3. Blade lightly and roll surface until material is thoroughly compacted.

4. Complete Total Thickness: As shown on the Plans, 8-inch minimum.

3.5 ROLLING AND COMPACTION

A. Commence compaction of each layer of base immediately after spreading operations and continue until density of 95 percent of maximum density has been achieved as determined by AASHTO T99.

B. Roll each layer of material until there is no appreciable reaction or yielding under the compactor before succeeding layer is applied.

C. Shape and maintain the surface of each layer during compaction operations. Commence rolling at outer edges and continue toward center; do not roll center of road first.

D. Apply water as needed to obtain specified densities.

E. Place and compact each lift to the required density before succeeding lift is placed.

F. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.

G. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.6 SURFACE TOLERANCES

A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

B. Finished Surface of Untreated Aggregate: Within plus or minus 0.04-foot of grade shown at any individual point.

C. Overall Average: Within plus or minus 0.04-foot from crown and grade specified.

3.7 FIELD QUALITY CONTROL

A. Quality control testing shall be performed by an independent testing laboratory provided by the Owner.

B. Refer to table below for minimum sampling and testing requirements for aggregate base course and surfacing. The Owner reserves the right to complete additional testing.

Property	Test Method	Frequency	Sampling Point
Gradation	AASHTO T11 and AASHTO T27	One sample every 500 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)	AASHTO T99	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	AASHTO T310	One for each 500 ton but at least every 10,000 square feet of area	In-place completed, compacted area

3.8 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate. Restore per Specifications as applicable.

END OF SECTION

SECTION 32 91 21 - FINISH GRADING AND SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil Preparation
2. Fertilizing
3. Seeding
4. Mulching
5. Hydroseeding
6. Hydromulching
7. Erosion Control Blanket
8. Maintenance and Establishment Period

B. Related Sections:

1. Section 31 22 13 - Rough Grading
2. Section 31 23 17 - Trenching
3. Section 32 05 13 - Soils for Exterior Improvements
4. Section 32 93 00 – Plants
5. Section 32 84 00 - Irrigation

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

1. Not used.

1.3 REFERENCES

A. ASTM International (ASTM):

1. ASTM C602 - Standard Specification for Agricultural Liming Materials.
2. 7 USC 1551-1611 - Federal Seed Act.
3. Navajo Nation Range Management Handbook.
4. Navajo Department of Agriculture Re-seeding Requirements.

1.4 DEFINITIONS

A. Certified Seed: A grass or legume seed named variety that has been reviewed and accepted into the State Certified Seed program. Currently certified seed is individually sold in bags with a Certification Tag.

B. Pure Live Seed (PLS): Is a measure used to describe the percentage of a quantity of seed that will germinate. PLS is obtained by multiplying the purity percentage by the percentage of total viable seed, then dividing by 100.

C. Establishment Period: A period when planting work has been performed and initially accepted, and there is a contract requirement to care for the planted areas in some way until the period ends.

D. Sensitive Areas: Defined areas such as wetlands, natural water and riparian resources, special environmental zones, or where certain activities are restricted such as the use of chemicals.

E. Weeds: Vegetative species other than specified species to be established in given area.

F. Invasive Plants: Any species that appears on the State of Arizona current noxious weed list, plus any known problem species. The last crop plants (if listed as non-native on United States Department of Agriculture (USDA) Plants Database) are considered invasive if it comprises more than 15 percent in any newly established vegetation.

G. Weed Control: Removal and prevent regrowth of specified weeds, weed parts, and weed seeds from area within the Project limit.

1.5 SUBMITTALS

A. Product Data: Submit data for seed mix, mulch, tackifier, erosion control blanket, soil amendment materials, pesticides, herbicides, and other accessories. The product should meet or exceed all product requirements specified herein.

B. Grass Seeds Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1. Certification of seed analysis, germination rate, and inoculation. Include the year of production and date of packaging. Certify that each lot of seed has been tested by a testing laboratory certified in seed testing within 12 months of delivery date. Also include:

a. Name and address of laboratory

b. Date of test

c. Lot number for each seed certified

d. Test Results: Name, percentages of purity and of germination, and weed content for each seed mix.

C. Operation and Maintenance Data: Include maintenance instructions and weed control.

1.6 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

B. Pesticide shall not be used in this Project.

1.7 QUALIFICATIONS

A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum 3 years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 2 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.

B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. Deliver tackifier sealed containers showing weight, chemical analysis, and name of manufacturer.

1.9 MAINTENANCE SERVICE

A. Maintain seeded areas immediately after placement for 12 months from Date of Substantial Completion. Grass shall be well established and exhibits vigorous growing condition.

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Suppliers:

1. Coordinate with the respective Tribal Authority.

B. Seed Mixes: See Table 1 in 3.10 Schedules.

2.2 ACCESSORIES

A. Straw Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.

B. Wood and Bark Mulching Material: Chipped wood and bark, sawdust, and ground wood mulch should be free of growth or germination inhibiting ingredients.

C. Compost: Commercially manufactured fine and medium compost materials.

D. Tackifier: Commercial tackifier containing no agent toxic to plant life and exhibits no growth or germination inhibiting factors at one of the following forms:

1. Liquid Stabilizer Emulsion - Tackifier with a base material of liquid containing not less than 55 percent total solids by weight. It should allow exchange of air and moisture to the seeds and have an effective life of 1 year or more.

2. Dry Powder Tackifier - Tackifier base consisting of one or more active hydrocolloids from natural plant sources, which hydrates in water and blends with other slurry materials, and upon application tacks the slurry particles to the Soil surface.

E. Fertilizer: Commercial grade; recommended for grass to eliminate deficiencies of topsoil and suitable for application with equipment designed for that purpose.

1. Deliver fertilizers in separate or mixture containers that have the percentage of total nitrogen, available phosphoric acid, and water-soluble potash (NPK) in the amounts specified. Label each container with a quality compliance certificate.

2. Application rate shall be determined by the soil conditions, as indicated in analysis to determine the proportions of Nitrogen percent, phosphoric acid percent, soluble potash percent.

F. Lime: ASTM C602, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.

G. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of grass.

H. Erosion Control Blanket shall be open, flexible, and dimensionally stable network of fully-biodegradable, bonded, interlocking fibers. The blanket shall have a functional longevity of up to 12 months. Blanket fibers shall be turf green color or natural wood/straw color.

I. Pesticides/Herbicide: Not used.

2.3 SOURCE QUALITY CONTROL

A. Analyze soil to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

B. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of soil testing.

C. Testing is not required when recent tests and certificates are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.

B. Planting Season: Plant seeds when growing conditions are conducive to seed germination and quick but thorough establishment of seedlings.

1. The best time for seeding most of the Navajo rangelands is from June 15th to July 1st or in the month of October.

2. Avoid planting seed on any site or soil when it is extremely dry or between November 15th through June 15th.

3. Dormant seed varieties may be planted during the months of November through December 15th.

C. Weed Control Coordinator - Not used.

D. Pesticide Applicator – Not used.

E. Conduct soil analysis to determine soil fertility. The soil test should at least analyze the current nitrogen, phosphorus, potassium, and PH rates in the soil. Accordingly, the soil test result would suggest the proper soil amendment application including the rates of fertilizers and lime. Obtain the Engineer approval before applying soil amendment.

F. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Engineer and replace with new planting soil.

G. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

2. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.

3. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3.2 SOIL PREPARATION

A. Prepare area for seeding while generally considering the following:

1. Remove any matter detrimental or toxic to the growth of plants, including weeds, clods, rocks, or debris.

2. Application rates of fertilizer or lime shall be based on soil testing results.

3. Prepare a tilled, fine, but firm seedbed.

4. The soil shall have a pH range of 5.5 to 8.0.

3.3 WEED CONTROL

A. Not used.

3.4 SEEDING

A. Apply Seed mix at the PLS per acre as shown in Table 1, 3.10 Schedules.

3.5 HYDROSEEDING AND HYDROMULCHING

A. Mix seeds, fertilizers, mulch, and tackifier with water in specific tank as follows:

1. Hydraulic Equipment should continuously mix and agitates the slurry providing a continuous, non-fluctuating delivery.

2. Provide a uniform distribution of the slurry.

3. Place seed, fertilizer, mulch, and tackifier in the hydroseeder tank no more than 30 minutes prior to application.

B. Hydroseeding operation: Perform hydroseeding according to the following:

1. One-Step Operation - Apply materials in one step only for the following situations:

a. When seeding in conjunction with erosion control matting. Apply seed, fertilizer, and tracer before installing matting.

b. When treating small areas that are 1,500 square feet or less and totaling no more than 0.5 acre, double the amount of seed to compensate for seed suspended above Soil by the mulch.

2. Two-Step Operation – for areas over 0.5 acre, use the two-step method for all hydroseeding/hydromulching operations:

a. Step 1 - Apply seed, fertilizer, and tracer.
b. Step 2 - Apply mulch and tackifier.

C. Seed -Thoroughly mix seeds when more than one kind is to be used.

D. Mulch - Apply at the following rates based on dry fiber weight:

1. Slopes Flatter Than 1V:2H - Apply cellulose fiber that includes a tackifier at a rate of 2,000 pounds per acre.

2. Slopes 1V:2H or Steeper - Apply cellulose fiber that includes a tackifier at a rate of 3,000 pounds per acre.

E. Tackifier for Cellulose Fiber Applications – apply dry tackifier to water tank at the following rates unless the Manufacture recommends a greater rate of application:

1. Slopes Flatter Than 1V:2H - 60 pounds per acre mixed with hydromulch fibers at the rate specified.

2. Slopes of 1V:2H or Steeper - 100 pounds per acre mixed with hydromulch fibers at the rate specified.

3.6 MECHANICAL SEEDING

A. Seeding, fertilizing, and covering: The following may be used to stabilize small, disturbed areas that are 1,500 square feet or less and totaling no more than 0.5 acre:

1. Seeds and fertilizer - Seed the disturbed area with the seed mix at the specified rate by mechanical spreader.

2. Cover - Cover seeded areas with one of the following:

a. Straw mulch at a rate of 100 pounds per 1,000 square feet. Spread the mulch uniformly approximately 2 inches deep, in loose condition, which requires roughly 2-1/2 tons per acre of dry mulch. Do not use straw mulch on slopes of 1V:1.5H or steeper.

b. Bark mulch spread uniformly at an approximate depth of 1/2-inch. Use well-decomposed mulch for seed mulching. Do not use bark mulch on slopes of 1V:1.5H or steeper.

c. Suitable open-weave, biodegradable erosion control matting installed according to Manufacturer's instructions.

3.7 SEEDING OVER MULCHED AREAS

A. If an area has been previously mulched for erosion control or temporary seed and mulch is present on the soil surface, double the pound rate for each seed type used. Apply seed and fertilizer hydraulically or mechanically and add a green dye to the mixture to visibly aid uniform application. Upon approval, fertilizer and seed may only be applied after mulching if one of the following conditions apply:

1. Mulch is punched into the soil by mechanized means. Avoid heavy equipment that may compact the soil. Roll seeded area with roller not exceeding 112 pounds/linear foot.

2. Mulch that is held down with netting or like material.

3. Mulch is removed prior to seeding.

3.8 WORK QUALITY

A. After application, apply water with fine spray immediately after each area has been hydroseeded Apply water with fine spray immediately after each area has been mulched.

B. Drift - Prevent drift and displacement of seed and fertilizer regardless of equipment and methods used.

C. Displacement - Prevent seed, fertilizer, and mulch from falling or drifting onto other areas where grass is detrimental. Remove material that falls on plants, roadways, gravel shoulders, structures, and other surfaces where material is not specified.

D. Damage - Prevent damage to prepared areas and to completed fertilizer, seed, and mulch work. Replace all material that becomes displaced before acceptance of the work.

3.9 MAINTENANCE

A. Immediately reseed areas showing bare spots.

B. Repair washouts or gullies.

C. Protect seeded areas with warning signs during maintenance period.

D. Ensure that each seeded area has a uniform, healthy and weed-free stand of grass or other seeded plants growing at the end of the Establishment Period. The minimum living plant coverage standards for acceptance of seeding in a planted area are as follows:

1. Temporary Seeding:

a. West of the Cascades - 70 percent coverage of ground surface.

b. East of the Cascades - 30 percent coverage of ground surface.

2. Permanent Seeding:

a. West of the Cascades - 90 percent coverage of ground surface.
b. East of the Cascades - 30 percent coverage of ground surface.

E. Protection - Protect seeded areas from trespassing and other hazards of damage. Use protective fences and signs at no additional cost to the Agency. Obtain approval of protective methods used.

F. Fertilizing and Watering - Apply fertilizer according to grass and soil requirements. Apply water according to good horticultural practice under the prevailing conditions, as required to promote a healthy stand of plants. Obtain water at no additional cost to the Agency.

G. Mowing – If mowing is required, do the first mowing of grass when soil is firm enough to prevent rutting and grass is about 3 inches tall. After mowing, leave grass that is approximately 2 inches tall. At each subsequent mowing, leave about 1-1/2 inches of growth. After the second mowing, grass clippings may be left in place upon written approval.

H. Repair and Restore - Repair and restore soil grades and re-seed damaged, settled, or unproductive areas to the specified conditions of this Section at no additional cost to the Agency.

I. Finishing and Cleaning Up Cleanup - Remove weeds, trash, debris, stones, and other extraneous matter from seeded areas as directed and dispose of.

3.10 SCHEDULES

A. Table 1. Seed mixes for community types.

Table 1. Seed mixes for community types. VNS= Variety not specified. NA=Not Applicable.

Common Name	*Scientific Name*	Variety	Season	Form	PLS lbs./acre[1]
Reduced Palatability seed mix (for Sagebrush and Greasewood Communities south of Canon Largo)					
Rubber rabbitbrush	*Ericameria nauseosa*	VNS	NA	Shrub	2.00
Fourwing saltbush	*Atriplex canescens*	VNS	NA	Shrub	2.00
Fringed sage	*Artemisia frigida*	VNS	NA	Sub-shrub	2.00
Purple threeawn	*Aristida purpurea*	VNS	Warm	Bunch	3.00
Indian ricegrass	*Achnatherum hymenoides*	Paloma or Rimrock	Warm	Bunch	3.50
Blue grama	*Bouteloua gracilis*	Alma or Hachita	Warm	Sod	2.00
Sand dropseed	*Sporobolus cryptandrus*	VNS	Warm	Bunch	0.25
Scarlet globemallow	*Sphaeralcea coccinea*	VNS	Warm	Shrub	0.25
Rocky Mountain beeplant	*Cleome serrulata*	VNS	Warm	Shrub	0.25
Hairy false goldenaster	*Heterotheca villosa*	VNS	Warm	Shrub	0.25
Pinyon—Juniper wooded shrubland seed mix					
Antelope bitterbrush	*Purshia tridentata*	VNS	Cool	Shrub	2.00
Westem wheatgrass	*Pascopyrum smithii*	Arriba	Cool	Sod	2.00
Needle-and-thread grass	*Hesperostipa comata*	VNS	Cool	Bunch	3.00
Indian ricegrass	*Achnatherum hymenoides*	Paloma or Rimrock	Warm	Bunch	3.50
Blue grama	*Bouteloua gracilis*	Alma or Hachita	Warm	Sod	2.00
Sand dropseed	*Sporobolus cryptandrus*	VNS	Warm	Bunch	0.25
Scarlet globemallow	*Sphaeralcea coccinea*	VNS	Warm	Shrub	0.25
Greasewood seed mix					
Fourwing saltbush	*Atriplex canescens*	VNS	NA	Shrub	4.00
Shadscale saltbush	*Atriplex confertifolia*	VNS	Cool	Shrub	2.00
Indian ricegrass	*Achnatherum hymenoides*	Paloma or Rimrock	Warm	Bunch	3.00
Sand dropseed	*Sporobolus cryptandrus*	VNS	Warm	Bunch Bunch	0.50
Slender wheatgrass	*Elymus trachycau/um*	VNS or Tusas	Cool	Sod	3.00
Western wheatgrass	*Pascopyrum smithii*	Arriba	Cool	Sod	3.00
Blue grama	*Bouteloua gracilis*	Alma or Hachita	Warm	Bunch/Sod	2.00
Galleta	*Pleuraphis jamesii*	Viva or Florets	Warm		3.00
Riparian—Wetland active floodplain and surrounding area seed mix					
Inland saltgrass	*Distichlis spicata*	LK517f	Warm	Sod	6.00
Sand dropseed	*Sporobolus cryptandrus*	VNS	Warm	Bunch	0.50

Indian ricegrass	*Achnatherum hymenoides*	Paloma or Rimrock	Warm	Bunch	4.00
Alkali sacaton Baltic rusht	*Sporobolus airoides*	VNS	Cool	Bunch	4.00
Baltic rush[2]	*Juncus arcticus*	NA	Cool	Sod	4.00

Woody Plants					Replacement Ratio/Planting Grid
Cottonwood	Populus deltoides SSP. wislizeni	Native pole	NA	Tree	3 to 1/20-ft. grid
Coyote willow	*Salix exigua*	Native whip	NA	Shrub/small tree	10 to 1/2.5-ft. grid
Tree-size willow[2]	*Salix sp.*	Native whip	NA	Shrub/small tree	10 to 1/2.5-ft. grid

1 - Based on 60 pur live seeds (PLS) per square foot. Double this rate (120 PLS/sf) if broadcast or hydroseeded.

2 - mmhos/cm=Millimhos per centimeter. Millimhos is an electrical conductivity measurement used to determine the total concentration of soluble salts in soil.

END OF SECTION

SECTION 33 05 50 - EXISTING PIPE ABANDONMENT

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the removal of existing buried piping and abandonment in place of existing buried piping.

B. Section includes:

1. Pipe removal.
2. In-place abandonment of pipe.

C. Related Sections:

1. Section 31 23 16, Excavation.
2. Section 31 23 17, Trenching.
3. Section 31 23 19, Dewatering.

Section 31 23 23, Fill.

1.2 SUBMITTALS

A. Provide all submittals in accordance with Section 01 33 00, Submittal Procedures.

B. Piping Abandonment Plan:

1. Identify locations specified for pipe abandonment.

2. Provide method to be utilized to abandon the pipe, including whether the pipe will be left in place or removed in its entirety.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

A. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the work described herein.

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

1.4 PROTECTION OF EXISTING WORK

A. Carefully examine the Contract Documents to determine the extent of the work of this Section.

B. Carefully coordinate the work of this Section with all other work and construction.

C. Take all necessary precautions to prevent damage to existing facilities or utilities which are to remain in place and be responsible for any damages to existing facilities or utilities, which are caused by the operations.

1.5 REPAIR OF DAMAGE

A. Work procedures shall provide for safe conduct of the work; careful removal and disposition of materials and equipment; protection of facilities, utilities and property which are to remain undisturbed; coordination with existing facilities and utilities to remain in service.

B. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired to acceptance of Engineer.

C. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.

1.6 EXISTING CONDITIONS

A. If the pipe material contains any hazardous materials, such as asbestos, requiring special handling upon removal, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 OWNERSHIP OF EXISTING MATERIALS

A. All materials, equipment, miscellaneous items, and debris involved, occurring, or resulting from pipe removal work shall become the property of the Contractor at the place of origin, unless otherwise specified in the Drawings or by the Engineer.

2.2 CONTROLLED LOW STRENGTH MATERIAL

A. As specified in Section 31 23 24, Flowable Fill.

PART 3 EXECUTION

3.1 PIPE REMOVAL

A. Where identified on the Drawings, remove, and dispose of all pipe material and associated appurtenances.

1. All fire hydrants, air release valves service lines and appurtenances being abandoned shall be removed to 36 inches below finished grade.

2. Existing service line appurtenances, including valve and meter boxes, shall be removed to 36 inches below finished grade.

B. All exposed ends of pipes and fittings to remain in service shall be capped or plugged with an appropriate ductile iron blind flange, cap or plug and restrained.

1. A pipe shall be considered in service if it is possible to flood the pipe with water by opening valves in the water system.

C. All excavation and backfilling associated with pipe removal shall be performed in accordance with 31 23 17, Trenching.

3.2 IN-PLACE ABANDONMENT OF PIPING

A. Where identified on the Drawings, abandon pipe in place.

B. All exposed ends of pipes being abandoned in place shall be cut and plugged with a minimum of two (2) feet of non-shrink grout.

C. Prior to placing grout, roughen interior pipe surface and apply epoxy bonding agent.

3.3 FILLING PIPE WITH CLSM

A. Where identified on the Plans, pipes greater than 12 inches in diameter to be abandoned-in-place shall be filled with CLSM.

B. CLSM shall be placed in a manner to ensure complete filling of the pipe, leaving no cavities or voids.

C. Install hot taps, saddles, fill lines and appurtenances as necessary for pumping CLSM from the surface into the pipe being filled.

D. CLSM shall be pumped up grade from fill lines rigidly connected to the pipes being filled.

E. Placement of CLSM by free flowing (non-pumped) methods will not be acceptable.

F. Fill lines shall be located at elevations lower than the pipe being filled.

G. As the CLSM is being placed, use other fill lines as view ports to ensure complete filling of the pipes.

H. Relocate pumping equipment as necessary to complete filling of the pipes.

I. Excavate and cut access holes in the pipes as necessary to complete filling operations.

J. Perform pipe filling operations in a manner to eliminate all air pockets.

K. Submit volume calculations for CLSM placed in each filled segment of piping to verify that pipelines have been completely filled.

3.4 CLEANUP

A. During and upon completion of work of this Section, promptly remove all unused tools and equipment, surplus materials, and debris.

B. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 33 12 16 - WATER UTILITY DISTRIBUTION AND TRANSMISSION VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes valves and valve boxes for installation with buried water distribution and transmission main, including fire hydrants and tapping sleeves.

B. Section Includes:

1. Valves.
2. Valve boxes.
3. Valve operator extensions.

C. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for thrust restraints
2. Section 33 11 10 - Water Utility Distribution and Transmission Piping: Piping trenching, backfilling, and compaction requirements.
3. Section 33 12 13 - Water Service Connections: Pipe materials, fittings, and service connection appurtenances and installation requirements.
4. Section 33 12 19 - Fire Hydrants: Execution requirements for fire hydrants.
5. Section 33 13 00 - Testing and Disinfecting of Water Utility Piping: Flushing and disinfection requirements.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
3. ASME 1.20.1 - General Purpose Pipe Threads (Inch)

B. American Water Works Association (AWWA):

1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.
2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service
3. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants
4. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
5. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

C. ASTM International (ASTM):

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings

2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications

D. NSF International (NSF):

1. NSF 61 - Drinking Water System Components - Health Effects
2. NSF 372 - Drinking Water System Components - Lead Content

1.3 COORDINATION

A. The Contractor shall cause the Supplier of valves to coordinate installation such that all pipes, valves, fittings, appurtenances, and equipment are compatible and capable of achieving the performance requirements specified in the Contract Documents.

B. Coordinate Work of this Section with NTUA standards and utilities within construction area.

1.4 SUBMITTALS

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

B. Product Data: Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Lining and coating data.

F. Valve Labeling: Schedule of valves to be labeled indicating in each case the valve location and the proposed labeling for the valve.

G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves.

B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Not used.

1.7 QUALITY ASSURANCE

A. Cast Manufacturer's name, maximum working pressure, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, American National Standards Institute (ANSI), ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

E. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves and accessories for shipment according to applicable AWWA standards.

B. Seal valve and ends to prevent entry of foreign matter.

C. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

D. Storage:

1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.

E. Handle products carefully to prevent damage to interior or exterior surfaces.

F. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT WEDGE GATE VALVES

A. As specified in Section 40 05 51.16, Gate Valves.

B. Connecting Hardware:

1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.

C. Gaskets:

1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 DOUBLE-DISC GATE VALVES

A. Not used.

2.4 SOLID WEDGE, METAL SEATED GATE VALVES

A. Not used.

2.5 RUBBER-SEATED BUTTERFLY VALVES

A. As specified in Section 40 05 51.18, Butterfly Valves.

B. Operation:

1. All buried valves shall be provided with 2-inch square operating nuts.

C. Connecting Hardware:

1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.

D. Gaskets:

1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.6 ACTUATORS

A. Unless otherwise indicated, all valves shall be furnished with manual actuators.

B. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.

C. All gear-assisted valves that are buried and submerged shall have the actuators hermetically sealed and grease-packed.

D. All valves 6 inches to 30 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

2.7 VALVE BOXES

A. Provide all buried valves with valve boxes, covers and risers.

B. Valve Boxes:

1. Materials: Cast iron.

2. Construction:

a. Walls not less than 3/16-inch thick at any point.
b. Internal diameter not less than 5 inches.

3. Type: Two-piece extension.

4. Manufacturers:

a. Tyler Union, Model 6850
b. Or, approved equal.

C. Covers:

1. Construction:

a. Prevents dislodging and rotation from traffic.
b. Allows a hand-held pry bar to be applied for easy removal.

2. Materials: Cast iron.

3. Lid Inscription: "WATER" cast into lid.

4. Manufacturers: Matching that of valve box.

D. Riser:

1. Polyvinyl Chloride (PVC) Pipe:

a. ASTM D3034, SDR 35 PVC.
b. White, Schedule 40, 8-inch diameter.
c. Length as shown on details in the Drawings.

2.8 VALVE OPERATOR EXTENSIONS

A. As shown in the Drawings.

B. Provide operator extensions to a maximum of 12 inches below grade where depth to valve exceeds 36 inches.

2.9 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 30 00 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.1 PREPARATION

A. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.

B. Identify required lines, levels, contours, and datum locations.

C. Locate, identify, and protect from damage utilities to remain.

D. Access:

1. All valves shall be installed to provide easy access for operation, removal, and maintenance.

2. Avoid conflicts between valve operators and above grade construction such as structural members or handrails.

E. Valve Accessories:

1. Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly.

2. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.2 INSTALLATION

A. General:

1. All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the Manufacturer's written instructions and as shown in the Drawings and as specified herein.

2. Valves shall be firmly supported to avoid undue stresses on the pipe.

3. Stem extensions shall be braced at no greater than 10 feet intervals and be provided with double universal joints to allow for misalignment, where applicable.

B. Perform trench excavation, backfilling, and compaction as specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

C. Install valves in conjunction with pipe laying.

D. Set valves plumb.

E. Provide buried valves with valve boxes installed flush with finished grade.

1. Valves installed out of paved or otherwise hard-surfaced areas shall be set in a concrete pad at finished grade.

2. Concrete valve box pads shall be 18 inches square and be not less than 6 inches thick.

F. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.3 FIELD QUALITY CONTROL

A. Pressure test valving for water distribution system according to AWWA C600 and in accordance with Section 33 13 00, Testing and Disinfection of Water Utility Piping.

B. Field Testing of Valves:

1. All valves 24-inch diameter or larger[, and all in-line transmission main valves,] shall be pressure and leakage tested at the Site and shall pass the field testing prior to installation.

2. Valves shall be tested at 1.5 times normal operating pressure, 150 pounds per square inch (psi) minimum.

3. No valve shall be accepted for installation that fails to pass the field pressure test. Any valves failing field pressure tests shall be replaced by the Contractor at no additional cost to the Owner.

4. Engineer shall witness field testing.

3.4 ATTACHMENTS

A. Not used.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 33 11 10 - WATER UTILITY DISTRIBUTION AND TRANSMISSION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Work under this Section applies to furnishing and installation of pipe materials, fittings, and appurtenances normally encountered with water distribution and transmission systems, including potable water and fire water systems.

B. Section includes:

1. Pipe and fittings
2. Flexible couplings
3. Flanged coupling adapters
4. Insulating flanged joints
5. Tapping sleeves and valves
6. Flexible expansion joints
7. Bedding and cover materials
8. Geomembrane for gas line crossings
9. Concrete thrust blocks

C. Related Requirements:

1. General

a. Furnish and install all piping systems shown and specified in accordance with the requirements of the Contract Documents.

b. Each buried piping system shall be complete, with all necessary fittings, valves, accessories, lining and coating, testing, excavation, backfill and encasement, to provide a functional installation.

c. Piping layouts shown on the Drawings are intended to define the general layout, configuration, and routing for pipe, as well as the size and type of piping to be installed. The piping plans are not pipe construction or fabrication drawings.

d. The Contractor shall cause the Supplier of pipes, valves, fittings, and appurtenances to coordinate piping installation such that all equipment is compatible and is capable of achieving the performance requirements specified in the Contract Documents.

e. It is the Contractor’s responsibility to develop the details necessary to construct all piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, valves, gaskets, fittings, appurtenances etc., for a complete and functional system.

D. Related Sections:

1. Section 03 11 00, Concrete Work
2. Section 31 05 13, Soils for Earthwork
3. Section 31 05 16, Aggregates for Earthwork

4. Section 31 23 16, Excavation
5. Section 31 23 17, Trenching
6. Section 31 23 23, Fill
7. Section 31 23 24, Flowable Fill
8. Section 33 12 16, Water Utility Distribution and Transmission Valves
9. Section 33 12 19, Fire Hydrants
10. Section 33 13 00, Testing and Disinfecting of Water Utility Piping

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T99 - Standard Specification for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

B. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250

2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys

3. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges

4. ASME B31.10 - Standards of Pressure Piping

C. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel

2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

3. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications

4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

5. ASTM A536 - Standard Specification for Ductile Iron Castings.

6. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))

7. ASTM D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

8. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

9. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

10. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

12. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

13. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

D. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems

3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast

7. AWWA C153 - Ductile-Iron Compact Fittings

8. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe

9. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

10. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

11. AWWA C606 - Grooved and Shouldered Joints

12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution

E. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves

F. NSF International (NSF):

1. NSF Standard 61 - Drinking Water System Components – Health Effects
2. NSF Standard 372 - Drinking Water System Components – Lead Content
3. NSF 600 - Health Effects Evaluation and Criteria for Chemicals in Drinking Water

G. International Organization for Standardization (ISO)

1. ISO 8179-1:2017 Ductile iron pipes, fittings, accessories and their joints – External zinc-based coating – Part 1: Metallic zinc with finishing layer.

1.3 SUBMITTALS

A. Section 01 33 00, Submittal Procedures.

B. Product Data: Submit data on pipe materials, pipe fittings, restrained joint systems, and accessories.

C. Lining and coating data.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer’s handling, delivery, storage, and installation requirements.

F. Field Quality-Control Submittals:

1. Pipeline hydrostatic testing plan.
2. Indicate results of Contractor-furnished tests and inspections.

G. Preconstruction Photographs:

1. Submit digital files of colored photographs of Work areas and material storage areas.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for submittals.

B. Record Drawings:

1. Record actual locations of piping mains, valves, connections, thrust restraints, appurtenances, and invert elevations.

2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Materials:

1. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner’s Representative.

3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.

4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.

B. Markings:

1. Pipes and Fittings: Mark each pipe and fitting at plant. Include date of manufacture, Manufacturer's identification, specification standard, inside diameter of pipe, dimension ratio as applicable, pipe class as applicable, pipe number for laying purposes as applicable, and other information required for type of pipe.

2. Bolting materials (washers, nuts, and bolts) shall be marked with material type.

C. Testing:

1. Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Industry Specifications and Standards.

1.6 MATERIAL DELIVERY, STORAGE, AND HANDLING

A. In accordance with the Manufacturer's written recommendations and as specified in these Contract Documents.

B. Pipe, specials, and fittings delivered to Project Site in damaged condition will not be accepted.

C. Storage:

1. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.

2. Pipe and fittings shall not be stored on rocks, gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.

3. Do not store materials in direct sunlight.

4. For storage in cold weather, locate products to prevent coating from freezing to ground.

5. Gaskets: Do not allow contact with oils, fuels, petroleum, or solvents.

D. Handling:

1. Pipe and appurtenances shall be handled in accordance with Manufacturer's recommendations or requirements contained in this section or subsequent sections dealing with the specific pipe material, whichever is more stringent.

2. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.

3. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.

4. Flange gasket surfaces shall have securely attached metal, hardboard, or wood protection.

5. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.

6. Under no circumstances shall pipe materials be dropped or dumped into the trench.

E. Pipe Plugs:

Provide and install a cap or plug on each end of pipe during transportation and onsite storage to protect linings and coatings from debris. Install watertight plug-in end of installed pipe at the end of the workday, when active pipe installation is delayed for more than an hour and when ground water is present.

PART 2 PRODUCTS

2.1 WATER PIPING

A. General

1. All piping materials and specials shall meet the specifications of this Section and of the appropriate AWWA Standard Specifications. In the case of conflict, the more stringent specifications shall apply.

2. All coatings and materials specified herein which may come in contact with potable water shall conform to National Sanitation Foundation (NSF) Standard 61, 372 and 600.

3. Minimum Pressure Ratings: Unless otherwise specified herein or shown on the Drawings, the minimum working pressure rating of all water works materials specified herein shall be 1-1/2 times the operating pressure or 150 pounds per square inch (psi) minimum.

4. Gaskets:

   a. Gaskets in contact with potable water shall be NSF 61 certified.

   b. Material: Styrene Butadiene Rubber (SBR) composition.

   c. Mechanical and Proprietary Restrained Joints; Water Service: conforming to the requirements of ANSI/AWWA C110/A21.10, C111/A21.11, or C153/A21.53 shall be of a design that causes the gasket to deflect approximately 30 percent during assembly of the mechanical joint. The gasket material shall be certified to meet the requirements of NSF/ANSI 61 and NSF/ANSI 372 and conform to the requirements of ANSI/AWWA C111/A21.11, section 11-6.4, of the latest revision.

   d. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.

B. Ductile Iron (DI) Pipe:

1. Centrifugally cast, conforming to AWWA Standard C151.

2. Coating:

   a. Asphaltic exterior coating in accordance with AWWA Standard C151.

3. Pipe Mortar Lining: Shop-applied NSF 61 cement mortar lining, smoothed finish, complying with AWWA C104.

4. Pipe Thickness Class:

    a. Comply with AWWA C151.

    b. Class 52, unless shown to be greater on the Drawings.

        1) The Contractor shall be aware ductile iron piping with thickness class greater than Class 52 may have long fabrication and supplier lead times. The Contractor shall be responsible for coordinating product submittal and delivery times accordingly such as not to delay construction.

5. Pipe Corrosion Protection:

    a. Coatings: See Section 09 90 00, Painting and Coating, for details on coating requirements.

    b. Polyethylene Encasement:

        1) Comply with AWWA C105.

        2) Polyethylene film shall be minimum 8-mil thick virgin linear low-density polyethylene (LLDPE).

        3) Secure in place with 10-mil polyethylene tape.

    c. Insulating Flanges:

        1) Complete with bolt insulators, dielectric gasket, bolts, nuts. Bolt insulating sleeves shall be provided full length between insulating washers. Contractor shall be responsible for fit-up of all components of insulated flange assembly to provide a complete functioning installation. AWWA C207 steel flanges may be drilled oversize up to 1/8-inch to accommodate insulating sleeves. No less than minimum thread engagement in accordance with specified bolting standards will be permitted to accommodate thicknesses of all required washers, flanges, and gasket.

        2) Flange Insulating Kits:

            a) Gaskets: Full-face, Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.

            b) Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA LI-1, G-10 grade).

            c) Insulating Washers: Plated, hot-rolled steel, 1/8-inch thick.

                (1) Provide two washers per bolt for flange diameters equal to or less than 36-inch.

                (2) Provide four washers per bolt for flange diameters larger than 36-inch.

d) Manufacturers and Products:

(1) Dielectric Flanges:

(a) Allied Corrosion Industries, Marietta, GA.
(b) Advance Products and Systems, Lafayette, LA.
(c) Or equal.

6. Joints:

a. Joint types shall be provided as identified on the Drawings and as required for the application.

b. Deflection:

1) The maximum pipe deflection shall not exceed one-half of the Manufacturer's stated joint deflection allowance.

c. Mechanical Joints:

1) Comply with AWWA C111.

d. Push-on Joints:

1) Comply with AWWA C111.

2) Manufacturers:

a) Tyton Joint by U.S. Pipe Company and McWane.
b) Fastite Joint by AMERICAN (American Cast Iron Pipe Company).
c) Or equal

e. Restrained Joints:

1) Joint restraint for pipe shall be accomplished with an integral lock mechanism, except as may be otherwise specified.

a) Any such system shall be a manufacturer's standard proprietary design, shall be as recommended by the Manufacturer for the application, and shall be performance proven.

2) Restraining components:

a) Ductile iron complying with AWWA C110 and/or C153, with the exception of a manufacturer's proprietary design dimensions.

b) Push-on joints for such fittings shall comply with AWWA C111.

3) Manufacturers:

a) For pipe larger than 12-inch:

(1) "TR Flex", McWane and U.S. Pipe Company.

(2) “Flex-Ring”, AMERICAN (American Cast Iron Pipe Company).
(3) “HDSS”, U.S. Pipe Company.
(4) Or equal.

b) For pipe 12-inch and smaller:

(1) “Field-Lok”, U.S. Pipe Company.
(2) “Fast Grip”, AMERICAN (American Cast Iron Pipe Company).
(3) “TR Flex”, McWane and U.S. Pipe Company.
(4) “Flex-Ring”, AMERICAN (American Cast Iron Pipe Company).
(5) “HDSS”, U.S. Pipe Company.
(6) “Piranha”, Romac Industries, Inc.
(7) Or equal.

c) For all pipe sizes:

(1) Wedge-type Restraint System – “MEGALUG”, EBBA Iron, Inc. or equal.

(a) Where any restrained joint system requires the use of a wedge-type mechanical restraint gland for restraint, the glands shall be provided in quantities as may be required and shall be considered incidental to the joint restraint system.

(b) Wedge-type mechanical restraining glands shall not be used to restrain the plain end of plain end ductile iron or cast-iron fittings.

4) “Foster Adaptor”, Infact Corporation:

a) Where specified, mechanical joint (MJ) valves and fittings shall be connected using a bolt-through positive restraint mechanism manufactured of ductile iron conforming to ASTM A536, 65-45-12.

b) The positive restraint device shall connect the valves and/or fittings at a linear distance not to exceed three (3) inches and without attachment to pipe.

c) The device shall come complete with all accessories, including standard styrene butadiene rubber (SBR) MJ gaskets conforming to the latest revision of AWWA C111/ASTM F-477 and weathering steel (Corten) bolts conforming to AWWA C111/A21.11 and ASTM A242.

d) Nuts for 3 through 12-inch sizes shall be SAE Grade 5 steel with black oxide coating. Nuts for 14-inch and larger adaptors shall be heavy hex Corten steel conforming to ASTM A242.

e) MJ positive restraining device shall be supplied with NSF 61, 7-mil. fusion bonded epoxy conforming to AWWA C116/A21.16-09 as well as the coating, surface preparation and application requirements of ANSI/AWWA C550.

f) The device shall be used with standard mechanical joint fittings (AWWA C110 or C153) and valves and shall be Infact Corporation Foster Adaptor or equal.

f. Flanged Joints:

1) Flat faced, complying with AWWA C111 and C115, unless otherwise specified.

2) Bolt hole drilling according to ASME/ANSI B16.1, Class 125, or ASME/ANSI B16.1, Class 250, where specified. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.

3) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain mating pipe, valve, and fitting flanges match in bolt pattern.

4) Pressure rating of flange joints shall not exceed the rating of the pipe or fitting of which they are a part, and the maximum pressure rating of the joint shall be 250 psi.

5) Flange joint connections shall not be exposed to test pressures greater than 1-1/2 times their rated working pressure.

6) Threaded flanges:

a) Ductile iron pipe spools with threaded flanges shall conform to AWWA C115.

b) Installed only on pipe with a minimum Class 53 wall thickness.

7) Buried flanges:

a) Flanged connections shall not be buried unless shown as such on the Drawings.

b) Buried flanges shall be wrapped with 2 layers of 10-mil tape along edges of flanges.

8) Gaskets:

a) Full faced, composed of SBR and 1/8-inch thick, hardness 80 (Shore A), rated to 180 degrees F, conforming to ASME B16.21, AWWA C207, and ASTM D 1330, Grades 1 and 2, and NSF 61 certification.

b) Ring gaskets for flange joints 14 inches and larger, and/or specify a gasket with annular rings, like a Toruseal, Flange-Tyte gasket, or equal.

C. Polyvinyl Chloride (PVC):

1. All PVC pressure pipe shall be manufactured with an integral bell design capable of receiving an elastomeric gasket.

2. All PVC pressure pipe shall be dimensionally compatible with standard cast/ductile iron fittings produced according to AWWA C110 or AWWA C153, as applicable.

3. Deflection:

a. The maximum pipe deflection shall not exceed one half of the Manufacturer's stated allowance for longitudinal bending and joint deflection.

4. Joints:

    a. Solvent-cement couplings are not permitted.

5. Gaskets: Comply with ASTM F477.

6. Size: 4-inch through 12-inch diameter

    a. Comply with AWWA C900, DR 14, Class 305, unless shown otherwise on the Drawings or specified elsewhere.

7. Size: 14-inch through 48-inch diameter

    a. Comply with AWWA C900, DR 18, Class 235, unless shown otherwise on the Drawings or specified elsewhere.

8. There are proprietary PVC restrained joint system available through JM Eagle Loc 900 and Certa-Lok.

9. Restrained Joints:

    a. For push-on pipe joint at pipe bells:

        1) Material:

            a) Body: Ductile iron. Comply with ASTM A536.
            b) Bell Restraint Systems: Corten steel tie rods.

        2) Coatings: Shop-applied liquid epoxy.

        3) Construction:

            a) A split serrated ring shall be used behind the pipe bell. A split serrated ring shall also be used to grip the pipe and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring.

            b) System shall be designed for a minimum 2 to 1 safety factor.

        4) Manufacturers:

            a) 4-inch through 12-inch diameter: EBAA Iron, Inc. - Series 1900 Bell Restraint Harness.

            b) 14-inch through 48-inch diameter: EBAA Iron, Inc. - Series 2800 Bell Restraint Harness.

    b. At mechanical joint fittings:

        1) Material: Ductile iron. Comply with ASTM A536.

        2) Coatings: Shop-applied liquid epoxy.

3) Construction:

a) Restraint accomplished by a restraint device consisting of a follower gland utilizing multiple gripping wedges.

b) The restraint system shall have a sufficient number of fastening bolts to connect the ring to the mechanical joint.

c) System shall be designed for a minimum 2 to 1 safety factor.

4) Fasteners:

a) T-bolts and nuts: High strength, low alloy steel.
b) Comply with AWWA C111.

5) Manufacturers:

a) EBAA Iron, Inc. - MEGALUG, Series 2000PV
b) Romac Industries, Inc. – 470 Series Pipe Restraining System

2.2 FITTINGS

A. Material: Ductile iron, complying with AWWA Standard C110.

1. Fittings conforming to AWWA C153. AWWA C110 fittings are also acceptable.

B. Fittings used for joining ductile iron and PVC pipe shall be of the type, size, and strength designated on the Plans, elsewhere in the specifications.

1. Fittings shall be mechanical joint, push-on type, flanged or plain-end as required and shown on the Drawings.

2. All restraint systems and flanged fittings shall be provided with bolts and gaskets as specified herein.

C. Pressure ratings: As specified for joining pipe above and as shown on the Drawings.

D. Coating and Lining:

1. Asphaltic exterior coating in accordance with AWWA Standard C110.

2. Cement Mortar Lining: Comply with AWWA C104.

3. Wax Tape Coating System (Field Coating): Petrolatum wax tape coating system where specified or shown on the Drawings:

a. General: Apply a wax tape coating system generally per AWWA C217 and consists of three parts: surface primer, wax-tape, and outer covering. All three parts shall be the product of the same manufacturer.

b. The primer shall be a blend of petrolatum, plasticizer, and corrosion inhibitors having a paste like consistency. It shall have a pour point of 100-degrees F to 110-degrees F and a flash point of 350-degrees. Use Trenton Wax-Tape Primer or equal.

c. The wax-tape shall consist of a synthetic-fiber felt, saturated with a blend of high melt microcrystalline wax, solvents, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces and which firms up after application. The tape shall have a saturant pour point between 125-degrees F and 130-degrees F and a dielectric strength equal to a minimum of 100-volts per mil. Tape thickness shall be 50-mils to 90-mils in 6-inch-wide rolls. Use Trenton No. 1 wax-tape or equal.

d. The outer covering shall consist of two layers of a plastic wrapper at total of one 150 gauge or three 50 gauge wound together as a single sheet. The plastic wrapper material shall consist of clear polyvinylidene chloride, high cling membranes wound together as a single sheet. Use Trenton Poly-Ply or equal.

E. Following information cast upon fittings:

1. Manufacturer's identification.
2. Country of manufacture.
3. Pressure rating.
4. For bends, number of degrees and/or fractions of a circle.

F. Owner may require additional metallurgical documentation or other certifications.

2.3 NUTS, BOLTS, AND WASHERS

A. All bolts shall have heavy hex head with heavy hex nuts.

B. For operating pressures greater than 150 psi:

1. Bolts: Steel alloy composition. Comply with ASTM A193.
2. Nuts: Comply with ASTM A194, Grade 2H.
3. Washers: Comply with ASTM F436.

C. For operation pressures of 150 psi or less:

1. Bolts: Low-carbon steel composition. Comply with ASTM A307, Grade B.
2. Nuts: Comply with ASTM A563A, Heavy Hex.
3. Washers: Comply with ASTM F844.

D. Higher-strength bolts with higher torque values as specified above for operation pressures greater than 150 psi shall not be used for assembly of flange joints including gray-iron flanges.

2.4 FLEXIBLE COUPLINGS

A. General

1. All flexible couplings shall be constructed to inside diameters that properly fit the connecting pipes.

2. The Contractor shall be responsible for selecting sleeve lengths appropriate to the application, subject to review and approval of the Engineer, recognizing that longer sleeves allow for larger deflections and may ease installation.

B. Flexible Couplings:

1. Description:

a. Comply with AWWA C219.

b. Type: Bolted, sleeved.

c. Configuration: Straight, transition, or reducing as shown in the Drawings.

d. Center rings and end rings: Ductile iron. Comply with ASTM A536.

e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

f. Bolts and nuts: High strength low alloy steel. Comply with AWWA C111.

g. Lining and coating: Factory-applied fusion bonded epoxy.

h. Working pressure: Up to 260 psi.

2. Manufacturers:

a. For 2-inch to 24-inch diameter:

1) Romac Industries, Inc. – Style 501 or equal.

b. For 12-inch diameter and larger:

1) Romac Industries, Inc. – 400 Series or equal.

C. Insulating Flexible Couplings:

1. The Contractor shall be responsible for selecting couplings appropriate to the application, subject to review and approval of the Engineer, recognizing that different pipe materials will require specific sizing and material selection for couplings.

2. Description:

a. Comply with Flexible Coupling specifications above.

b. Insulating Boot: Ethylene propylene diene monomer (EPDM) compounded for water service. Comply with ASTM D2000.

3. Manufacturers:

a. For 4-inch to 14-inch diameter:

1) Romac Industries, Inc. – Style IC501 or equal.

b. For 12-inch to 96-inch diameter:

1) Romac Industries, Inc. – Style IC400 or equal.

D. Restrained Flexible Couplings:

1. Description:

a. Body: Steel. Comply with ASTM A36.

b. Restrained gland: Ductile iron. Comply with ASTM A536, Grade 65-45-12.

c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

d. Bolts and nuts: All-thread rod, at a minimum complying with ASTM A193 Grade B7. Nuts per ASTM A194 Grade 2H.

e. Lining and coating: Factory-applied fusion bonded epoxy.

f. Working pressure: [250] [350] psi. Test pressure: [400] [500] psi.

2. Manufacturers:

a. Romac Industries, Inc. – Style 400RG.
b. EBAA Iron – 3800 MEGA-COUPLING.
c. Or equal.

2.5 FLANGED COUPLING ADAPTERS

A. Flanged Coupling Adapters:

1. All flanged coupling adapters shall be constructed to diameters that properly fit the connecting plain end pipe and the flanged fitting.

2. Description:

a. Comply with AWWA C219.

b. Flange: AWWA Class D [E][F] Steel Ring Flange, compatible with ANSI Class 125 and 150 bolt circles.

c. End ring and body:

1) Steel. Comply with ASTM A36.
2) Ductile iron. Comply with ASTM A536, Grade 65-45-12.

d. Flange: Compatible with ANSI Class 125 and 150 bolt circles.

e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

f. Bolts and nuts: High strength low alloy steel bolts and nuts. Comply with AWWA C111 composition requirements.

g. Lining and coating: Factory-applied fusion bonded epoxy.

h. Working pressure rating: Equal to the maximum rating of the flange.

3. Manufacturers:

a. Romac Industries, Inc.

1) Style FCA501 or equal.

a) For 3-inch to 16-inch diameter.

2) Style FC400 or equal.

a) For 12-inch to 96-inch diameter.

B. Restrained Flanged Coupling Adapters:

1. Description:

a. Gland and flange body: Ductile iron. Comply with ASTM A536.

b. Flange: Compatible with ANSI Class 125 and 150 bolt circles.

c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.

d. Restraining bolts and lugs: Ductile iron. Comply with ASTM A536.

e. T-bolts, Bolts, and nuts: High strength low alloy steel. Comply with AWWA C111 composition requirements.

f. Lining and coating: Factory-applied fusion bonded epoxy.

2. Manufacturers:

a. Romac Industries, Inc. – RFCA Restrained Flanged Coupling Adapters.
b. EBAA Iron – MEGAFLANGE Restrained Flange Adapter.
c. Or equal.

2.6 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:

1. Description:

a. Type: Dual compression.

b. Material:

1) Body: Stainless steel, Type 304.
2) Flanged outlet: Stainless steel, Type 304.

c. Outlet Flange Dimensions and Drilling: Comply with ASME B16.1, Class 150, and MSS SP-60.

d. Outlet Gasket:

e. Provide with Type 304 stainless steel test plug.

f. Nuts, bolts, and washers: Stainless steel, Type 304.

2. Manufacturers:

a. Romac Industries, Inc. – Model STS 420
b. JMC Industries, Inc.
c. Or equal.

B. Tapping Valves:

1. Resilient wedge gate valves specified in Section 40 05 51.15, Gate Valves.

2.7 FLEXIBLE EXPANSION JOINTS

1. Not used.

2.8 UNDERGROUND PIPE MARKERS

A. Marking tape, as specified in Section 31 23 17, Trenching.

2.9 UNDERGROUND ELECTRONIC LOCATING MATERIALS

A. Tracer wire, as specified in Section 31 23 17, Trenching.

2.10 CONCRETE ENCASEMENT, CRADLES AND THRUST BLOCKS

A. Concrete:

1. As specified in Section 03 30 00, Cast-in-Place Concrete.
2. Type: reinforced, air entrained as shown on the Drawings.
3. Compressive Strength: Minimum 3,000 psi at 28 days.
4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 20 00, Concrete Reinforcing.

2.11 BEDDING AND COVER MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown on the Drawings.

2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown on the Drawings.

3. Trench Backfill from Pipe Zone to Finish Grade:

a. Material type varies by location, as shown on the Drawings.

b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown on the Drawings.

c. Subsoil Type S1 and/or S2, as specified in Section 31 05 13, Soils for Earthwork.

2.12 GEOMEMBRANE FOR GAS LINE CROSSINGS

A. Furnish 40 mil reinforced geomembrane with 300V/mil dielectric strength and minimum 150# puncture resistance and 150# tensile strength. Geomembrane shall be XR-5 as manufactured by Seaman Corporation or equal.

2.13 ACCESSORIES

A. Concrete for Thrust Restraints: As specified in Section 03 30 00, Cast-in-Place Concrete.

B. Manhole and Cover: As specified in Section 33 05 13, Manholes.

C. Miscellaneous Steel Rods, Bolt, Lugs, and Brackets:

1. Comply with ASTM A36 or ASTM A307.
2. Grade A carbon steel.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that existing utility water main size, location, and invert are as indicated on the Drawings.

3.2 PREPARATION

A. Preconstruction Site Photos:

1. Not used.

B. Inspection:

1. All pipe sections, specials, and jointing materials shall be carefully examined for defects.

2. No piping or related materials shall be laid that are known to be defective. Any defective piece installed shall be removed and replaced with a new pipe section in a manner satisfactory to the Engineer at the Contractor's expense.

3. Defective material shall be marked and removed from the job site before the end of the day.

C. Pipe Cutting:

1. Cut pipe ends square, ream pipe and tube end to full pipe diameter, and remove burrs.

2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.

3. Grind edges smooth with beveled end for push-on connections.

4. Prior to assembly of field cut pipe, the reference mark shall be re-established with a pencil or crayon. The location of the reference mark at the proper distance from the bevel end shall be in accordance with the Manufacturer's recommendations.

D. Remove scale and dirt on inside and outside before assembly. Cleaning of each pipe or fitting shall be accomplished by swabbing out, brushing out, blowing out with compressed air, or washing to remove all foreign matter.

E. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Bedding:

1. Excavation:

a. Excavate pipe trench as specified in Section 31 23 17, Trenching for Work of this Section.

b. All pipe trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the Drawings.

c. Remove large stones or other hard matter which could damage pipe or impede consistent pipe bedding backfilling or compaction.

d. Trench base shall be inspected prior to placement of pipe.

e. Hand trim excavation for accurate placement of pipe to elevations as indicated on the Drawings.

2. Dewater excavation as specified in Section 31 23 19, Dewatering to maintain dry conditions and to preserve final grades at bottom of excavation.

3. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.

4. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth and compact to 95 percent of maximum density.

B. Piping:

1. Install pipe according to AWWA C600 or C605.

2. Handle and assemble pipe according to Manufacturer instructions and as indicated on the Drawings.

3. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

4. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.

5. Sanitary Sewer Separation:

    a. Install new water lines and appurtenances in compliance with local and state regulations governing the horizontal and vertical separations between water and sewer facilities.

    b. Variance:

        1) If a variance is proposed due to requested design revisions or if an existing facility has been installed at a different location or elevation than indicated on the Plans, submit written proposal for review and approval by the Engineer.

        2) Include the reason for the variance, type of material and condition of the sewer line, location of the water and sewer facilities, horizontal and vertical skin-to-skin clearances and corrective measures proposed.

        3) Each variance will be considered on a case-by-case basis.

        4) Review Time: Allow a minimum of 5 working days review and response to each proposal.

6. Install ductile iron fittings according to AWWA C600.

7. Joints:

    a. Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining.

    b. Lubricants, primers, adhesives, etc. shall be used as recommended by the Pipe or Joint Manufacturer's specifications.

    c. The jointing materials or factory-fabricated joints shall then be placed, fitted, joined, and adjusted in such a manner as to obtain a watertight joint.

    d. Trenches shall be kept water-free and as dry as possible during bedding, laying, and jointing.

    e. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.

8. Flanged Joints: Not to be used in underground installations except within structures, unless shown otherwise on the Drawings.

9. Deflection:

    a. PVC pressure pipe may be deflected both horizontally and vertically at the joints and by longitudinal bending after assembly.

    b. The maximum pipe deflection shall not exceed one half of the Manufacturer's stated allowance for longitudinal bending and joint deflection.

    c. Set a laser, string line, or other approved alignment guide along the centerline of previously installed pipe to the point where pipe joint deflection is required. The

approved alignment guide shall extend to the end of the proposed subsequent pipe length. A measurement will be taken from the alignment guide to the centerline of the subsequent pipe length to determine the amount of pipe joint deflection proposed. Measured deflection shall not exceed the specified allowable deflection for the purposes of aligning the pipe.

10. Install pipe and fittings to the line and grade specified on the Drawings, with joints centered, pipe properly supported and restrained against movement, and all valve stems plumb. Re-lay pipe that is out of alignment or grade.

11. High Points:

    a. Install pipe with no high points, unless otherwise shown on the Drawings.

    b. If unforeseen field conditions arise that necessitate high points, install air release valves as directed by the Engineer.

12. Bearing:

    a. Install pipe to have bearing along entire length of pipe.

    b. Excavate bell holes to permit proper joint installation where necessary or as directed by Engineer.

    c. Do not lay pipe in wet or frozen trench.

13. Prevent foreign material from entering pipe during placement.

14. Install pipe to allow for expansion and contraction without stressing pipe or joints.

15. Close pipe openings with watertight plugs during Work stoppages.

16. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.

17. Install access fittings to permit disinfection of water system performed under Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

18. Cover:

    a. Establish elevations of buried piping with not less than the minimum cover shown on drawings.

    b. Measure depth of cover from final surface grade to top of pipe barrel.

19. Pipe Markers:

    a. Install as specified in Section 31 23 17, Trenching.

C. Tapping Sleeves and Valves:

1. As indicated on Drawings and according to Manufacturer instructions.

D. Polyethylene Encasement:

1. Encase piping in polyethylene where indicated on the Drawings to] prevent contact with surrounding backfill material.

2. Comply with AWWA C105.

E. Thrust Restraints:

1. Provide valves, tees, reducers, bends, caps, and plugs with concrete thrust blocks at locations shown on the Drawings and as required to facilitate testing of lines.

2. Pour concrete thrust blocks against undisturbed earth.

3. Locate thrust blocks to ensure that pipe and fitting joints will be accessible for repair.

4. Provide thrust restraint bearing area on subsoil as shown in details on the Drawings.

5. Install tie rods, clamps, setscrew retainer glands, or restrained joints.

6. Protect metal-restrained joint components against corrosion with polyethylene film or wax tape as specified herein.

7. Avoid encasing mechanical and flanged joints in concrete. Provide clearance between concrete and mechanical and flange joints to allow future bolt removal.

F. Backfilling:

1. Backfill of piping systems shall be as specified in Section 31 23 17, Trenching.

G. Testing and Disinfection of Potable Water Piping System:

1. In accordance with AWWA C600 AWWA C605, AWWA C651 and as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.

2. All chlorinated water used in disinfection of the water main shall either be discharged through an approved connection to a public sanitary sewer system or shall be dechlorinated to limits acceptable by the Arizona Department of Environmental Quality (ADEQ) prior to discharge into any storm drainage system or open drainage way.

3. No chlorinated water shall be discharged into a storm drainage system or open drainage way without a dechlorination under a plan meeting ADEQ requirements.

3.4 FIELD QUALITY CONTROL

A. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

END OF SECTION

SECTION 33 12 19 - FIRE HYDRANTS

PART 1 GENERAL

1.1 SUMMARY

A. This Section addresses dry-barrel fire hydrants used in water supply service.

B. Section includes:

1. Fire hydrants used in water main installations.

C. Related Sections:

1. Section 31 05 16 - Aggregates for Earthwork
2. Section 31 23 17 - Trenching
3. Section 33 13 00 – Testing and Disinfection of Water Utility Piping

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA C502 - Dry-Barrel Fire Hydrants
2. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

B. National Fire Protection Association (NFPA):

1. NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants

1.3 COORDINATION

A. All hydrants supplied for the Project shall be of like kind from a single manufacturer.

1.4 SUBMITTALS

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

B. Product Data: Submit Manufacturer's latest published literature, including illustrations, installation and maintenance instructions, and parts lists.

C. Shop Drawings: Submit description of proposed installation.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of fire hydrants and service valves.

B. Operation and Maintenance Data: Submit data for hydrants.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare hydrants and accessories for shipment according to AWWA standards.

B. Seal hydrant and ends to prevent entry of foreign matter.

C. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

D. Storage:

1. Store materials in areas protected from weather, moisture, or potential damage.
2. Do not store materials directly on ground.

E. Handle materials in a way that prevents damage to interior and exterior surfaces.

PART 2 PRODUCTS

2.1 FIRE HYDRANTS

A. Manufacturers:

1. Mueller Company, A-411 2-1/8”
2. Or, approved equal.

B. Post Type Dry-Barrel Breakaway:

1. Comply with AWWA C502.
2. Body: Cast iron.
3. Valve: Compression type.
4. Burial Depth: As indicated on Drawings.
5. Inlet Connection Size: 4 inches.
6. Valve Opening: 2-1/8” in diameter.
7. End Connections: Mechanical joint or bell end.
8. Bolts and Nuts: Galvanized steel.
9. Interior Coating: Comply with AWWA C550.
10. Direction of Opening: Counterclockwise unless otherwise indicated.

C. Hose Connections:

1. One 2-1/2-inch diameter hose nozzle.
2. Obtain thread type and size from local fire department.
3. Attach nozzle caps by separate chains.

D. Finishes:

1. Primer and two coats of enamel.
2. Color: Per NTUA standards.

2.2 NSF INTERNATIONAL (NSF) REQUIREMENTS

A. All fire hydrants must be NSF/ANSI Standard 61 certified and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.

2.3 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 11 00, Concrete Work.

B. Aggregate: Aggregate for hydrant drainage as specified in Section 31 05 16, Aggregates for Earthwork.

2.4 OUT OF SERVICE COVERS/OUT OF SERVICE RINGS

A. Provide orange plastic bag with reflective tape, or red plastic hydrant out of service rings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify location and size of hydrants from Drawings. Final location of hydrants to be determined by Engineer in the field.

B. Obtain clarification and directions from Engineer prior to execution of Work.

C. If installing a hydrant on an existing water system, verify invert elevation of existing piping is as indicated on Drawings prior to excavation and installation of fire hydrant.

3.2 PREPARATION

A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.

B. Identify required lines, levels, contours, and datum locations.

C. Locate, identify, and protect from damage utilities to remain.

D. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

1. Notify Owner and Engineer not less than 48 hours in advance of proposed utility interruption.

2. Do not proceed without written permission from Engineer.

3. Only District staff shall operate valves in existing system.

3.3 INSTALLATION

A. Perform trench excavation, backfilling, and compaction as specified in Section 31 23 17, Trenching.

B. Install pier support block and drainage gravel for fire hydrants; do not block drain hole.

1. Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.

2. Place textile fabric to cover drain rock prior to placement of backfill.

3. Setting shall allow the hydrant barrel to drain into drainage gravel at base of hydrant.

C. Set fire hydrants plumb with hose nozzle facing roadway or as shown on drawings.

D. Set fire hydrants with centerline of pumper nozzle 18 inches (450 millimeters) above finished grade, and with safety flange not more than 6 inches (150 millimeters) nor less than 2 inches (50 millimeters) above grade. Install hydrant extensions where required and as approved.

E. Paint hydrants according to color scheme of local authorities having jurisdiction. Touch up paint after hydrant installation and testing.

F. After hydrostatic testing, flush hydrants, and check for proper drainage.

G. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

A. Pressure test water distribution system according to AWWA C600 and Section 33 11 10, Water Utility Distribution and Transmission Piping, Field Quality Control.

3.5 CONCRETE HYDRANT PADS

A. When hydrant is place within sidewalks, form and pour-in-place 36-inch by 36-inch by 6-inch, 4,000 pounds per square inch (psi) concrete pad around the hydrant after the hydrant has been installed and set to grade.

B. Center hydrant pad on the hydrant. Set hydrant pad so top of pad is flush with surrounding surface, or as directed by the Engineer.

C. Hydrant pads may be adjusted to reach the back of curb if the hydrant pad is no less than 1-foot in any one direction.

3.6 OUT-OF-SERVICE HYDRANT PADS

A. To indicate that the fire hydrant is NOT operational, secure reflective tape, an orange plastic bag over the entire hydrant assembly or an approved out-of-service cover.

B. An out-of-service ring may also be used in addition to the bag or cover in case of removal of the cover.

C. Maintain the plastic bag up until the waterline is accepted by the Owner.

END OF SECTION

SECTION 33 13 00 - TESTING AND DISINFECTION OF WATER UTILITY PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes hydrostatic pressure testing, disinfection, and purity testing of potable water systems piping, fittings, valves, and domestic water services.

B. Section Includes:

1. Pressure testing and disinfection of potable water distribution and transmission piping systems and appurtenances.

2. Testing and reporting of results.

C. Related Sections:

1. Section 33 11 10 - Water Utility Distribution and Transmission Piping
2. Section 33 12 16 - Water Utility Distribution and Transmission Valves
3. Section 33 12 19 - Fire Hydrants

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA B300 - Hypochlorites
2. AWWA B301 - Liquid Chlorine
3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
4. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings
5. AWWA C651 - Disinfecting Water Mains
6. AWWA C655 - Field Dechlorination

1.3 SUBMITTALS

A. Section 01 33 00 –Submittals Procedures: Requirements for submittals.

B. Product Data: Submit procedures, proposed chemicals, and treatment levels.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Pipeline Testing and Disinfection Plan: To be submitted for review and approval by the Engineer a minimum of 1 month before testing is to start. As a minimum, the plan shall include the following:

1. Testing schedule.

2. Hydrostatic Testing Plan:

a. Narrative of the proposed process.
b. Proposed equipment to be used.
c. Disposal location for excess water used to fill mains.

3. Disinfection Plan:

    a. Narrative of the proposed process.

    b. Proposed chemicals and equipment (including list of all pumps and meters) to be used.

    c. Calculations for the amount of chlorine required to achieve required chlorine residual levels.

    d. Proposed method of mixing, injecting, and distributing of chlorine solution throughout all portions of the new water system facilities.

    e. Proposed plan for testing chlorine levels throughout the length of pipeline.

4. Proposed testing locations.

5. Proposed plan for water conveyance, including flow rates.

6. Proposed plan for water control.

7. Proposed plan for water disposal, including flow rates. Include proposed plan for dechlorination of disinfection water, including discharge points.

8. Proposed measures to be incorporated in the Project to minimize erosion while discharging water from the pipeline.

1.4 CLOSEOUT SUBMITTALS

A. Disinfection Report:

1. Type and form of disinfectant used.

2. Date and time of disinfectant injection start and time of completion.

3. Test locations.

4. Name of person collecting samples.

5. Initial and 24-hour disinfectant residuals in treated water in parts-per million (ppm) for each outlet tested.

6. Date and time of flushing start and completion.

7. Disinfectant residual after flushing in ppm for each outlet tested.

1.5 QUALITY ASSURANCE

A. Perform Work according to AWWA C651.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future functions.

B. All temporary thrust restraint and equipment and facilities required for hydrostatic testing will be considered incidental.

C. As a minimum, furnish the following equipment and materials for the testing:

Amount	Description
2	Graduated containers approved by the Engineer.
1	Hydraulic pump approved by the Engineer with hoses, valves, and fittings as needed and required for the testing and disinfection of the facilities.
1	High range chlorine test kit, as approved by Engineer, with digital readout. Range of detection shall be between 5 and 200 ppm. Accuracy of 3 percent.
2	Pressure gauges with pressure range at least 120 percent greater than the required maximum test pressure with graduations in 2 pounds per square inch (psi) increments. Gauges shall have been calibrated with 90 days of pressure testing.

2.2 DISINFECTION CHEMICALS

A. Chemicals:

1. Hypochlorite: Comply with AWWA B300.
2. Liquid chlorine: Comply with AWWA B301.

2.3 DECHLORINATION CHEMICALS

A. Chemicals:

1. Comply with AWWA C655.

PART 3 EXECUTION

3.1 HYDROSTATIC TESTING OF WATER PIPING

A. Make all necessary provisions for conveying water to the points of use and for the disposal of test water.

B. No section of the pipeline shall be hydrostatically tested until backfill has been placed, compacted, and passed required density testing and all field-placed concrete or mortar has attained full strength.

1. At the Contractor's option, early strength concrete may be used when the full-strength requirements conflict with schedule requirements.

2. All such substitutions and installations shall be approved by the Engineer prior to installation.

C. Provide 72-hour notification to the Engineer and Owner prior to conducting hydrostatic testing.

1. Provide coordination and scheduling required for the Owner and Engineer to witness and provide necessary labor for operating Owner's existing system during hydrostatic testing and disinfecting procedures.

2. The Contractor shall not operate any part of the existing water systems.

D. Pipe Filling:

1. Fill pipes slowly from the lowest elevation to highest point along test section with potable water.

2. Take all required precautions to prevent entrapping air in the pipes.

3. Allow for natural absorption of water by the lining of the pipe to occur.

4. Apply specified test pressure by pumping.

E. Testing of Mains:

1. Ductile Iron: In accordance with AWWA C600.

2. Polyvinyl chloride (PVC): In accordance with AWWA C605.

3. General:

a. Tests shall be conducted under a hydrostatic test pressure not less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section, minimum 150 psi, unless otherwise shown in the Drawings.

b. In no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.

c. Testing shall be performed by applying the specified test pressure by pumping.

d. Once the test pressure has been attained, the pump shall be valved off.

e. The test will be conducted for a 2-hour period with the allowable leakage not to exceed the value as calculated per the Allowable Leakage formula below.

f. During the test period, there shall be no appreciable or abrupt loss in pressure.

4. Allowable Leakage:

a. Flanged Joints: Pipe, fittings, and valves with flanged joints shall be completely watertight. No leakage allowed.

b. Mechanical or Push-on Joints: Pipe, fittings, and valves with rubber gasketed joints shall have a measured loss not to exceed the rate given in the following Allowable Leakage formula:

$$AL = \frac{LD(P)^{1/2}}{148{,}000}$$

In the above formula:

AL = Allowable leakage, in gallons per hour
L = Length of pipe tested, in feet
D = Nominal diameter of pipe, in inches
P = Average test pressure during the leakage test, in pounds per square inch.

5. Maintaining Pressure:

a. During the test period, operate the pump as required to maintain pressure in the pipe within 5 psi of the specified test pressure at all times.

b. At the end of test period, operate the pump until the specified test pressure is again obtained.

1) The pump suction shall be in a clean, graduated barrel, or similar device or metered so that the amount of water required to restore the test pressure may be accurately measured.

2) Sterilize this makeup water by adding chlorine to a concentration of 25 milligrams per liter (mg/L).

c. The Engineer will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.

d. Each hour's loss stands on its own and will not be averaged.

6. Defects, Leakage, Failure:

a. If the test reveals any defects, leakage in excess of the allowable, or failure, furnish all labor, equipment, and materials required to locate and make necessary repairs.

b. Correct any visible leakage regardless of the allowable leakage specified above.

c. All leaks shall be repaired in a manner acceptable to the Engineer.

d. The testing of the line shall be repeated until a test satisfactory to the Engineer has been achieved.

3.2 DISINFECTION OF WATER PIPING

A. Disinfection shall be in accordance with the latest version of AWWA C651 following Engineer's acceptance of hydrostatic testing.

B. Chlorination by means of tablets or powders (calcium hypochlorite) placed in each length of pipe during installation is specifically prohibited.

C. Flush all foreign matter from the pipeline, branches, and services.

1. Provide at no additional cost to the Owner, hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.

2. Flushing velocities shall be at least 2.5 feet per second (fps).

3. For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipe in place from the inside by brushing and sweeping, then flush the line at a lower velocity.

D. Chlorine Application:

1. Fill the test section of main from the lowest elevation and maintain a steady flow rate while injecting the water main with chlorinated water.

2. Flow (bleed) a blow-off, standpipe or hydrant at the water main's high point(s) to allow air to escape and ensure all interior pipe surfaces are wetted.

E. Chlorine Residual:

1. Measure chlorine residual with a high-range chlorine test kit at a point near to the injection point while filling the main.

2. Adjust the dose rate as necessary to maintain the target dose rate.

F. Potable water piping shall be disinfected with a solution containing a minimum 25 ppm and a maximum 50 ppm chlorine.

1. Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 200 feet of main and once for each main branch, 2-inch service, or as directed by the Engineer.

2. The chlorine solution shall remain in the piping system for a period of 24 hours, after which time the sterilizing mixture shall have a strength of at least 10 ppm of chlorine.

3. If check samples fail to produce acceptable results, the disinfection procedure shall be repeated at the expense of the Contractor until satisfactory results are obtained.

G. Flush piping, branches, and services with municipal potable water until the chlorine residual is below 1.5 ppm and approximately the same as the source water.

1. There is no minimum flushing velocity for this step.

H. Disposal of any water containing chlorine shall be performed in accordance with the latest edition of AWWA C651 and C655, and all state or local requirements.

1. Disposal may be made into existing sanitary sewer systems providing approvals are obtained from the respective system owners.

2. Any chlorinated water discharged to open stream channels must be dechlorinated prior to discharge to levels acceptable by Arizona Department of Environmental Quality (ADEQ).

3.3 DISINFECTION AND TESTING OF WATER MAIN END CONNECTIONS AND TIE-INS

A. Disinfection of potable water piping and appurtenances at end connections and tie-ins to the existing system which are required to remain in service due to restrictions in allowable shutdown time shall be disinfected as described below.

B. Prior to connecting new potable water piping and appurtenances with existing piping and appurtenances, the interior of all new pipe, fittings, valves, and appurtenances shall be swabbed or sprayed with a 1 percent to 5 percent calcium hypochlorite solution.

C. In accordance with AWWA C651, swabbing or spraying of connection piping is allowed only if the total length of piping is equal to or less than one pipe length (18 feet). All runs of new piping over 18 feet in total length will require hydrostatic pressure testing, flushing and disinfection as detailed elsewhere in this Section.

D. Following the disinfection procedures described above, connection of the new piping and appurtenances to the existing water system shall be made.

1. During the system startup, the Engineer and Contractor shall visually inspect all new fittings, piping, valves, and appurtenances for evidence of leakage.

2. Any leakage observed during this period shall be promptly repaired by the Contractor, at Contractor's expense, as required by the Engineer.

3.4 FIELD QUALITY CONTROL

A. Bacteriological Sampling and Testing:

1. The Owner will collect samples after the line is flushed in accordance with the latest edition of AWWA C651.

a. The locations for sample collection shall be at the sole discretion of the Owner and Engineer.

b. The chlorine residual must be below 1.5 ppm or restored to the level maintained in the Owner's distribution system, when the sample is taken.

2. Bacterial Testing: After completing the chlorination procedure, test the main according to the following:

a. Bacterial Sampling

1) Option A:

a) Take an initial set of samples using sampling site procedures outlined herein.

b) Resample after a minimum of 24 hours' time has elapsed using sampling site procedures outlined herein.

c) Both sets of successive samples must pass for the main to be approved for service.

2) Option B:

a) Allow main to sit for a minimum of 24 hours without any water use.

b) Using sampling site procedures outlined herein, collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running.

c) Both sets of samples must pass for the main to be approved for service.

3) Allow 24 hours for the test results for each sample set.

b. Sampling Locations

1) The Owner will take one bacteriological sample from the end of the main and on each branch.

2) For long runs of main, at least one sample will be taken for every 1,200 feet of new main and as directed.

c. Sample Testing

1) The Owner will test the sample set for coliform bacteria and publish the test results within 24 hours.

d. Evaluating the Test Results

1) If one or more of the sample set tests positive for coliforms (fails), repeat chlorination and sampling processes specified herein after correcting the cause of the failure and as directed by the Engineer.

2) When two consecutive sample sets test negative (passing)for coliform bacteria, the bacterial testing is complete.

e. Completion of Bacterial Testing

1) Upon completion of bacterial testing, notify the Owner shall notify the Engineer and Contractor in writing that the testing is complete and the main is ready for tie-in.

f. Multiple Positive (Failing) Test Results

1) If sample sets continue to test positive for coliforms, the Engineer will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.

3. Results of the bacteriological testing shall be satisfactory with the ADEQ and/or other appropriate regulatory agencies, or disinfection shall be repeated by the Contractor.

B. Optional Sampling and Testing

1. If a pipeline is not promptly returned to service, the situation will be evaluated by the Owner to determine if the water quality may have been impacted and if additional testing as specified herein is warranted.

END OF SECTION

SECTION 40 05 51.24 - CHECK VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Work in this Section includes check valves for use in water and wastewater facilities. Work includes the furnish and install of all swing and silent check valves, complete, as shown on the Drawings and specified herein, including coating and lining, appurtenances, operators, and accessories.

B. Section includes:

1. Swing check valves, 1-inch through 4-inch diameter.
2. Silent check valves.

C. Related Sections:

1. Section 40 05 51 - Common Requirements Results for Process Valves

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings.

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
4. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.
5. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
6. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
7. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
8. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.

C. American Water Works Association (AWWA):

1. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.

D. NSF International (NSF):

1. NSF 61 - Drinking Water System Components - Health Effects.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
B. As required by Section 40 05 51, Common Requirements Results for Process Valves.

PART 2 PRODUCTS

2.1 SWING CHECK VALVES, 1-INCH THROUGH 4-INCH DIAMETER

A. Description:

1. Horizontal T-pattern style.

2. 200# WOG.

3. Capable of functioning in the vertical position.

4. Connections shall be standard threaded or threaded for fire hose connections where shown on plans

B. Materials:

1. Body Cap and Disc: Brass conforming to ASTM B584 C85400.

C. Manufacturer:

1. Figure 246 as manufactured by Red White Valve.

2.2 SWING CHECK VALVES, 4-INCH DIAMETER AND LARGER

A. Not Used.

2.3 TILTING DISC CHECK VALVE

A. Not Used.

2.4 SILENT CHECK VALVES

A. Description:

1. Type: Wafer and Globe-style, silent operating type that begins to close as the forward velocity diminishes and be fully closed at zero velocity, preventing flow reversal and resultant water hammer or shock.

2. Valve design shall incorporate a center-guided, spring-loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe.

3. Valve Interior: Contoured and unrestricted to achieve maximum flow capacity along with minimum pressure drop.

4. Installation: Operation of the valve shall not be affected by the position of installation. It shall be capable of operating in the horizontal or vertical position with the flow op or down.

5. Valve Disc: Concave to the flow direction providing for disc stabilization, maximum strength, and minimal flow velocity to fully open the valve.

6. All component parts shall be field replaceable without the need of special tools.

7. A replaceable guide bushing shall be provided and held in position by the valve's spring.

8. Spring: Designed to withstand 100,000 cycles without failure and exert a force which allows the valve to start opening at a differential pressure of .5 pounds per square inch (psi) (.04 kilograms per square centimeter (kg/cm2)) and to fully open at a flow velocity of 4 feet per second (1.22 meters per second).

9. The valve disc and seat shall be field replaceable and have a seating surface finish of 32 micro-inch or better to insure positive seating at all pressures.

10. Valve shall be hydrostatically tested at 1.5 times the rated working pressure.

11. Working Pressure: 150 psi.

12. End Connections: As shown on Drawings**.** End connections shall be rated to the working pressure requirements specified above.

B. Materials:

1. Body: ASTM A536, ductile iron.
2. Trim: Stainless steel.
3. Spring: Stainless steel.
4. Resilient Seat: Buna-N

C. Finishes:

1. Epoxy lining and coating conforming to AWWA C210.

2. For potable water service, epoxy lining and coating shall meet be provided with NSF 61 certification.

D. Manufacturer:

1. Val-Matic, 1800 series.
2. Cla-Val, 581 series.
3. Approved equal.

2.5 SOURCE QUALITY CONTROL

A. Testing:

1. Hydrostatically test check valves at twice rated pressure, in conformance with requirements of AWWA C508.

2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install check valves according to AWWA C508, Section 40 05 51 Common Requirements Results for Process Valve, and as recommended by Manufacturer.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVE

A. Provide the services of the Valve Manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 40 05 51.76 - ALTITUDE CONTROL VALVE

PART 1 GENERAL

1.1 DESCRIPTION

The Contractor shall furnish and install combination solenoid control, altitude shutoff, and pressure sustaining valve complete, as shown on the drawings and/or specified herein, including coating and lining, appurtenances, operators, and accessories.

1.2 CONTRACTOR SUBMITTALS

As required by Section 01 33 00.

PART 2 PRODUCTS

2.1 PILOT CONTROLLED HYDRAULICALY ACTUATED ALTITUDE VALVE

A. Construction: Valve shall be single seated, globe style, hydraulically operated and diaphragm actuated. Diaphragm assembly shall be guided top and bottom by a precision machined stem. Resilient valve disc, retained on three sides by disc retainers, shall form a drip-tight seal with a renewable seat when pressure is applied above the diaphragm. Control of valve operation shall be by means of an externally mounted, hydraulic pilot system.

Main valve body and cover shall be ASTM A48 cast iron or ASTM A536 ductile iron, with flanged ends. Main valve trim shall be bronze. Pilot control components shall be ASTM B61 bronze or ASTM B283 brass with Type 303 stainless steel trim, and pilot tubing shall be copper. Rubber parts shall be BUNA N synthetic rubber.

B. Protective Coating: Valve body and cover shall be lined and coated with an FDA approved fusion bonded epoxy coating system suitable for use with cast iron or ductile iron. The epoxy coating thickness and application shall be in accordance with AWWA C550.

C. Pressure Rating: Valve shall be suitable for a working water pressure of 150 psig.

D. Operating Conditions: Valve shall function properly with water supply to the pilot system of approximately 10 to 40 psig pressure head. Contractor shall confirm inlet pressure prior to ordering. The altitude pilot shall be 5-40 ft adjustment range. Flow through the valve shall be one-way.

E. Operating Requirements

1. Primary Control: An altitude control, located in the pilot system, shall sense the water level in the reservoir through a connection to the reservoir sensing line, and shall close the valve drip-tight when a desired high-water level in the reservoir is reached. The desired water level shall be set by adjusting the spring force in the altitude control. The altitude control shall allow the valve to re-open and return primary control to the solenoid when the water level in the reservoir drops to its normal operating range.

F. Accessories: The following accessories shall be furnished with the valve:

1. Self-cleaning strainer for pilot system.
2. Pilot system isolation valves on inlet, outlet, cover and sensing lines.
3. Opening speed control.
4. Closing speed control.
5. Valve position indicator.

G. Manufacturer: Valve shall be manufactured by Cla-Val Co., Newport Beach, CA, without exception. The valve model shall be 210-01 altitude valve for one-way flow.

PART 3 EXECUTION

3.1 GENERAL

Valve installation shall be in accordance with the manufacturer's requirements.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVES

The Contractor shall provide the services of the valve manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

SECTION 40 05 51.18 - BUTTERFLY VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes butterfly valves for use in pump stations, buried service or utility vaults. Coordinate with Section 33 12 16, Water Utility Distribution and Transmission Valves and Section 40 05 51, Common Requirements Results for Process Valves.

B. Section Includes:

1. Rubber-seated butterfly valves.

C. Related Sections:

1. Section 33 12 16, Water Utility Distribution and Transmission Valves
2. Section 33 11 10, Water Utility Distribution and Transmission Piping.
3. Section 40 05 13, Common Work Results for Process Piping.
4. Section 40 05 51, Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

4. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. American Water Works Association (AWWA):

1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).
2. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.

D. NSF International (NSF):

1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects

2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

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

B. As required by [Section 33 12 16 - Water Utility Distribution and Transmission Valves and/or Section 40 05 51, Common Requirements Results for Process Valves.]

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RUBBER-SEATED BUTTERFLY VALVES

A. Description:

1. Comply with AWWA C504, Class 150B as indicated in the Drawings .

2. Minimum Pressure Rating:

a. Twelve-inch (300-millimeter) Diameter and Smaller: 200 pounds per square inch psig.
b. Sixteen-inch (400-millimeter) Diameter and Larger: 150 psig.

3. End Connections: As shown in the Drawings.

a. Standard mechanical joint ends comply with ANSI/AWWA C111.

b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125, unless shown otherwise. Comply with AWWA C115 & ASME 16.5.

1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.

4. Gear Actuators: Conforming to AWWA C504 for manual valves.

5. Linings and Coatings:

a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.
b. All internal and external ferrous surfaces.
c. Do not coat flange faces of valves.

6. Bubble-tight at the rated pressure for bi-directional flow.

7. Style: Wafer.

8. Shaft: Self-lubricating, sleeve-type bearings. One-piece, through-shaft construction.

    a. Valve shafts shall be full size for that portion of the shaft extending through the valve bearings, valve disc, and shaft seal.

    b. Any portion of the shaft turned down for any reason shall have fillets with radii equal to the offset to minimize stress concentrations at the junction of the different shaft diameters. The turned down portion of the shaft shall be capable of transmitting the maximum operator torque without exceeding a torsional steel stress of 11,500 pounds per square inch (psi).

9. Seats: Mounted on body for valves 24 inches and smaller; field replaceable (mechanically retained in a machined groove) for valves larger than 24 inches.

10. Packing: Replaceable without dismantling valve.

B. Operation:

1. Open counterclockwise, unless otherwise indicated in the Drawings.

2. Operators shall be of the traveling nut, self-locking type and shall be designed to hold the valve in any intermediate position between full open and fully closed without creeping or fluttering.

3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.

4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel or hand lever operators, unless otherwise specified in Section 40 05 51, Common Requirements Results for Process Valves.

C. Materials:

1. Body: ASTM A126, cast iron or ASTM A536, ductile iron. Integrally cast flanged or mechanical end joints.

2. Shaft: Stainless steel.

3. Disc: ASTM A126, cast iron or ASTM A536, ductile iron.

4. Seats: Resilient, replaceable, Buna-N.

5. Seating Surfaces: Type 316 stainless steel.

6. Bearings:

    a. Sleeve: Corrosion-resistant and self-lubricating.

D. Manufacturers:

1. M&H Valve.
2. Henry Pratt Company.

3. Mueller Company.
4. Kennedy Valve Company.
5. Dezurik.
6. Val-Matic Valve & Manufacturing Corporation.

2.3 SOURCE QUALITY CONTROL

A. Testing: Test butterfly valves according to AWWA C504.

PART 3 EXECUTION

3.1 INSTALLATION

A. As required by Section 33 12 16, Water Utility Distribution and Transmission Valves and Section 40 05 51 - Common Requirements Results for Process Valves.

B. Install according to Manufacturer's instructions.

END OF SECTION

SECTION 40 05 51.15 - GATE VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes gate valves for use in buried service, pump stations and utility vaults Coordinate with Section 33 12 16, Water Utility Distribution and Transmission Valves

B. Section Includes:

1. Resilient-seated gate valves.
2. General duty gate valves smaller than 3 inches.

C. Related Sections:

1. Section 33 12 16, Water Utility Distribution and Transmission Valves
2. Section 33 11 10, Water Utility Distribution and Transmission Piping
3. Section 40 05 13, Common Work Results for Process Piping
4. Section 40 05 51, Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

4. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

3. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. American Water Works Association (AWWA):

1. [AWWA C500 - Metal-Seated Gate Valves for Water Supply Service.]
2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
3. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.

D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

1. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.
2. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

E. NSF International (NSF):

1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects
2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

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

B. As required by **Section 33 12 16 - Water Utility Distribution and Transmission Valves and Section 40 05 51, Common Requirements Results for Process Valves.**

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT-SEATED GATE VALVES

A. Description:

1. Comply with AWWA C509.

2. Minimum Pressure Rating:

a. Twelve-inch Diameter and Smaller: 200 pounds per square inch (gauge) (psig).
b. Sixteen-inch Diameter and Larger: 150 psig.

3. End Connections: As shown in the Drawings.

a. Standard mechanical joint ends comply with ANSI/AWWA C111.

b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125. Comply with AWWA C115 & ASME 16.5.

1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.

4. Gear Actuators: Conforming to AWWA C509 for manual valves.

5. Linings and Coatings:

    a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.
    b. All internal and external ferrous surfaces.
    c. Do not coat flange faces of valves.

6. Bi-directional flow.

B. Operation:

1. Non-rising stem.

2. Open counterclockwise when viewing the valve from above, unless otherwise indicated in the Drawings.

3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.

4. In-Plant Service Valves: Valves for in-plant or exposed service shall be furnished with handwheel operators, unless otherwise specified in Section 40 05 51, Common Requirements Results for Process Valves.

C. Materials:

1. Wedge:

    a. ASTM A126, cast iron or ASTM A536, ductile iron.
    b. Fully encapsulated with molded rubber.

2. Body and Bonnet:

    a. ASTM A126, cast iron or ASTM A536, ductile iron.

3. Stem, Stem Nuts, Glands, and Bushings: ASTM B584, bronze.

4. Valve Body Bolting: Stainless steel.

D. Manufacturers:

1. Clow Valve Company.
2. M&H Valve.
3. Kennedy.
4. Waterous (American Flow Control).
5. Mueller Company.

2.3 DOUBLE-DISC GATE VALVES

A. Not used.

2.4 SOLID WEDGE, METAL-SEATED GATE VALVES

A. Not used.

2.5 GENERAL-DUTY GATE VALVES – SMALLER THAN 3 INCHES

A. Two inches and Smaller:

1. MSS SP 80, Class 125.
2. Body and Trim: ASTM B584, bronze.
3. Bonnet: Union.
4. Operation: Handwheel.
5. Inside screw [with back-seating stem].
6. Wedge Disc: Solid; ASTM B584, bronze.
7. End Connections: Threaded.

B. Two and one-half inches to 3 inches:

1. MSS SP 70, Class 125.
2. Stem: Non-rising.
3. Body: ASTM A126, cast iron.
4. Trim: Bronze.
5. Bonnet: Bolted bonnet.
6. Handwheel, outside screw and yoke.
7. Wedge Disc: Solid, with bronze seat rings.
8. End Connections: ASME B16.1, ASME B16.5, ASME B16.42, flanged.

2.6 SOURCE QUALITY CONTROL

A. Testing: Test gate valves according to AWWA C509.

PART 3 EXECUTION

3.1 INSTALLATION

A. As required by [Section 33 12 16, Water Utility Distribution and Transmission Valves and/or Section 40 05 51 - Common Requirements Results for Process Valves.]

B. Install according to Manufacturer's instructions.

C. Support valves in plastic piping to prevent undue stresses on piping.

END OF SECTION

SECTION 40 05 51 – COMMON REQUIREMENTS RESULTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes basic materials and methods related to valves commonly used for process systems, including pump stations, utility vaults, and water and wastewater treatment. This Section is to be used in conjunction with related valve sections listed below.

B. Section Includes:

1. Valves.
2. Valve actuators.

C. Related Sections

1. Section 03 30 00, Cast-in-Place Concrete
2. Section 05 50 00, Metal Fabrications
3. Section 09 90 00, Painting and Coating
4. Section 33 11 10, Water Utility Distribution and Transmission Piping
5. Section 40 05 13, Common Work Results for Process Piping
6. Section 40 05 51.15, Gate Valves
7. Section 40 05 51.18, Butterfly Valves
8. Section 40 05 51.24, Check Valves
9. Section 40 05 51.76, Altitude valves
10. Section 40 05 78, Miscellaneous Valves

1.2 REFERENCE STANDARDS

A. American Water Works Association (AWWA):

1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.

2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

3. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.

4. [AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.]

5. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

B. ASTM International (ASTM):

1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):

1. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.

D. NSF International (NSF):

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

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

B. Product Data:

1. Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

2. Submit valve cavitation limits.

C. Shop Drawings:

1. Not used.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.

F. Lining and coating data.

G. Valve Labeling Schedule: Indicate valve locations and nametag text.

H. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

I. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and actuators.

B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of Manufacturer's recommended spare parts.

B. Tools:

1. Furnish special wrenches and other devices required for Owner to maintain equipment.
2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.7 QUALITY ASSURANCE

A. Cast Manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Maintain clearances as indicated on Drawings.

E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

B. Store materials according to Manufacturer instructions.

1. Store materials in areas protected from weather, moisture, or other potential damage.
2. Do not store materials directly on ground.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.

3. Provide additional protection according to Manufacturer instructions.

D. Handle products carefully to prevent damage to interior or exterior surfaces.

E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 VALVES

A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required and shown in the Drawings.

B. Operation:

1. Open by turning counterclockwise; close by turning clockwise.

2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

C. Valve Construction:

1. Bodies: Rated for maximum temperature and pressure to which valve will be subjected as specified in valve Sections.

D. Connecting Nuts and Bolts: Stainless steel.

2.3 RESILIANT-SEATED GATE VALVES

A. As specified in Section 40 05 51.15, Gate Valves.

2.4 RUBBER-SEATED BUTTERFLY VALVES

A. As specified in Section 40 05 51.18, Butterfly Valves.

2.5 VALVE ACTUATORS

A. All valves shall be furnished with manual actuators, unless otherwise indicated in the Drawings.

B. Valves in sizes up to and including 4 inches in diameter shall have direct acting lever or handwheel actuators of the Manufacturer's best standard design.

C. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.

D. Provide actuators with position indicators for shutoff valves 6 inches and larger.

E. Comply with AWWA C541 and C542, where applicable.

F. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 7 feet above floor.

G. Provide gear and power actuators with position indicators.

H. Gear-Assisted Manual Actuators:

1. Provide totally enclosed gears.
2. Maximum Operating Force: 60-pound-force (lbf).
3. Bearings: Permanently lubricated bronze.
4. Packing: Accessible for adjustment without requiring removal of actuator from valve.

I. Handwheel:

1. Furnish permanently attached handwheel for emergency manual operation.

2. Rotation: None during powered operation.

3. Permanently affix directional arrow and cast OPEN or CLOSE on handwheel to indicate appropriate direction to turn handwheel.

4. Maximum Operating Force: 60 lbf.

J. Chain Actuator:

1. Not used.

K. Valve Actuators in NEC Class I, Group D, Division 1 or 2 Hazardous Locations: UL approved.

1. Not used.

L. Pneumatic Actuators:

1. Not used.

M. Electric Motor Actuators:

1. Not used.

2.6 SOURCE QUALITY CONTROL

A. Testing: Test valves according to Manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping system is ready for valve installation.

3.2 PREPARATION

A. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.

B. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.3 INSTALLATION

A. Install valves, actuators, extensions, and accessories according to Manufacturer instructions.

B. Firmly support valves to avoid undue stresses on piping.

C. Coat studs, bolts, and nuts with anti-seizing lubricant.

D. Clean field welds of slag and splatter to provide a smooth surface.

E. Install valves with stems upright or horizontal, not inverted.

F. Install valves with clearance for installation of insulation and allowing access.

G. Provide access where valves and fittings are not accessible.

H. Comply with Division 40 - Process Interconnections for piping materials applying to various system types.

I. Valve Applications:

1. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.

2. Install shutoff and isolation valves.

3. Isolate equipment, part of systems, or vertical risers as indicated on Drawings.

4. Install valves for throttling, bypass, or manual flow control services as indicated on Drawings.

J. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.4 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.

2. If specified by valve Section, field test equipment to demonstrate operation without undue leakage, noise, vibration, or overheating.

3. Engineer will witness field testing.

3.5 ATTACHMENTS

A. Not used.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 05 13 - COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section applies to the furnishing and installation of piping inside a building, structure, enclosure piping and miscellaneous yard piping.Related Sections:

1. Section 05 50 00, Metal Fabrications
2. Section 09 90 00, Painting and Coating
3. Section 31 23 17, Trenching
4. Section 33 11 10, Water Utility Distribution and Transmission Piping
5. Section 33 05 64, Precast Concrete Valve Vaults and Meter Boxes.
6. Section 33 13 00, Testing and Disinfection of Water Utility Piping

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B1.20.1 Pipe Threads, General Purpose (inch)
2. ASME A13.1 - Scheme for the Identification of Piping Systems.
3. ASME B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
4. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
5. ASME B31.3 - Process Piping.
6. ASME B31.9 - Building Services Piping.

B. ASTM International (ASTM):

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

2. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile.

3. ASTM A325 - Specification for High-Strength Bolts for Structural Steel Joints.

4. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.

5. ASTM B88 - Standard Specification for Seamless Copper Water Tube.

6. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

7. ASTM D792 - Test Methods for Specific Gravity and Density of Plastics by Displacement.

8. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

9. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

10. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

11. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.

12. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

13. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

14. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

C. American Water Works Association (AWWA):

1. AWWA C200 - Steel Water Pipe - 6 In. (150 mm) and Larger.

2. AWWA C207 - Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.

3. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.

4. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.

5. AWWA C510 - Double Check Valve Backflow Prevention Assembly.

6. AWWA C511 - Reduced-Pressure Principal Backflow Prevention Assembly.

7. AWWA C606 - Grooved and Shouldered Joints.

8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

D. American Welding Society (AWS):

1. AWS D1.1 - Structural Welding Code.

E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry:

1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

F. NSF International (NSF):

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

1.3 COORDINATION

A. Coordinate installation of specified items with installation of valves and equipment.

1.4 SUBMITTALS

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

B. Product Data:

1. Submit Manufacturer catalog information for each product specified.

C. Shop Drawings:

1. Identification:

a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
b. Comply with ASME A13.1.

2. Provide all necessary dimensions and details on pipe joints, restraints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists.

3. Provide detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, couplings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.

D. Manufacturer's Statement: Certifying pipe fabrication and products meet or exceed specified requirements.

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS and ASME qualification within previous 12 months.

F. Manufacturer Instructions: Submit special procedures and setting dimensions.

G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

A. Drawings:

1. Piping layouts shown in the Drawings are intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

B. Inspection:

1. All pipe shall be subject to inspection at the place of manufacture.

2. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

C. Welding:

1. All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1.

2. 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.

D. Welders:

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding.

2. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency prior to commencing work on the pipeline.

3. Machines and electrodes similar to those used in the Work shall be used in qualification tests.

4. The Contractor shall furnish all material and bear the expense of qualifying welders.

E. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. Welds shall be tested as specified. The Contractor shall perform all tests at no additional cost to the Owner.

1.7 MATERIAL DELIVERY, STORAGE, AND INSPECTION

A. Inspection:

1. Accept materials on Site in Manufacturer's original packaging and inspect for damage.

2. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition.

B. Storage:

1. Store materials according to Manufacturer instructions.

2. Store materials off the ground, to provide protection against oxidation caused by ground contact

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.

3. Provide additional protection according to Manufacturer instructions.

D. All defective or damaged materials shall be replaced with new materials.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the "lead free" requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for "lead free".

2. All brass in contact with potable water shall comply with ASTM B584.

B. Unless specified otherwise or indicated differently in the Drawings, all piping systems and process piping materials shall be as listed in the table below or as shown on the Drawings:

Service	Material
Drainage/Sanitary Sewer	See Division 33.
Exposed ≥ 4"	Class 52 Ductile Iron or Heavy Wall Welded Steel
Buried ≥ 4"	Class 52 Ductile Iron
Submerged/Buried < 4"	Stainless Steel - Type 316 Schedule 40 Threaded - ASTM A 312 Fittings Welded or Threaded
Exposed < 4"	Brass - ASTM B 43, Fittings - Bronze - ASTM B 62 Threaded - ANSI/ASME B 16.15
Buried < 4"	Copper Tubing - ASTM B88 Type K Soft / Fittings - Wrought Copper - ANSI B16.22, Joints-Soldered
Miscellaneous Pipelines	As shown in the Drawings

2.2 DUCTILE IRON PIPE AND FITTINGS

A. See Article 2.1.B, Ductile Iron Pipe of Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 STEEL PIPE AND FITTINGS

A. General Service Piping:

1. ASTM A53, seamless, Grade B.
2. Schedule: 40, unless indicated otherwise on Drawings.

2.4 COPPER PIPE AND FITTINGS

A. Description:

1. Seamless; ASTM B88.

2. Type:

a. Type L, hard drawn.

b. For pipe under floor slabs, underground or cast in concrete: Type K, annealed, seamless.

B. Joints:

1. Compression.
2. Manufacturer: Mueller Model 110 or equal

C. Dissimilar Metals: See Dielectric Unions specified herein.

2.5 BRASS PIPE AND FITTINGS

A. Pipe: ASTM B43, chrome plated.

B. Fittings:

1. ASTM B584, brass.
2. ASTM B16.15.

C. Joints:

1. Mechanical compression.
2. Threaded: Tapered and smooth threads, ASME [B1.20.1] and ASTM B43.

D. Dissimilar Metals: See Dielectric Unions specified herein.

2.6 POLYVINYL CHLORIDE (PVC) WATER PIPE AND FITTINGS

A. PVC Pipe and Fittings:

1. Four-inch diameter and smaller:

a. Pipe: ASTM D1785, Schedule 40.
b. Fittings: ASTM D2466, Schedule 40.
c. Joints: Socket, solvent-welded, ASTM D2855.
d. Materials: ASTM D1784, minimum cell classification 12545-C.

2. Six-inch diameter and larger:

a. Pipe: AWWA C900, Class 235.
b. Fittings: AWWA C111, cast iron.
c. Joints: ASTM D3139, compression gasket ring.
d. Materials: ASTM D1784, minimum cell classification 12545-C.

2.7 FLEXIBLE TUBING

A. Polyethylene thermoplastic tubing:

1. Standard weight, conforming to ASTM D1248 Type 1, Class A, Category 4, Grade E5.

2.8 GALVANIZED STEEL PIPE AND FITTINGS

A. Pipe: Seamless, or electric resistance welded, ASTM A53, Schedule 40.

B. Joints: Threaded.

C. Fittings:

1. Threaded, 150-pound malleable iron, galvanized, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3.

2. Unions, 300-pound malleable iron, galvanized with dimensions conforming to ANSI B16.3, brass to iron seat.

3. Thread lubricant shall be Teflon tape or joint compound that is insoluble in water.

D. Buried Service:

1. Galvanized pipes shall be spirally wrapped with polyvinyl chloride or polyethylene pressure sensitive tape, applied with a suitable primer.

2. The wrap shall have a nominal thickness of 20 mils, consisting of either one layer of 20-mil tape or two separate layers of 10-mil tape.

3. Before the primer and wrap is applied, the piping shall be thoroughly cleaned so that all surfaces shall be dry and free of dirt, dust, rust, oil scale, oil, grease, or other foreign matter.

4. Any solvents used shall be totally volatile so as to leave no trace of oil.

5. Weld spatters, burrs, or sharp points and edges shall be removed by chiseling, ball peening or filling.

6. After thorough cleaning, the piping shall be coated with a primer applied in accordance with the Tape Manufacturer's recommendations. Spiral wrappings shall be applied with an overlap of at least 1-inch.

2.9 STAINLESS STEEL TUBING AND FITTINGS

A. Type 316 stainless steel, unless otherwise specified or shown in the Plans.

B. Meet the material standards set forth in ASTM A269.

C. Fittings: ASTM A276 and ASTM A182.

1. Threaded fittings: National pipe thread meeting the requirements of ASME B1.20.1.
2. Compression fittings: Two-ferrule, mechanical grip design.

D. Unions: Provide to facilitate installation and maintenance of tubing.

E. Manufacturer:

1. Swagelock, or equal.

2.10 STAINLESS STEEL PIPE AND FITTINGS

A. Pipe:

1. Size: 4 inches and smaller, schedule 80, type 304, unless otherwise specified.
2. Conforming to ASME B36.19 dimensions.
3. Conforming to ASTM A312 material requirements.

B. Fittings: Conform to ASME B16.11 dimensions and ASTM A182 material requirements.

C. Threads: Conform to ASME B1.20.1.

D. Socket welds: Conform to ASME B16.11.

2.11 FLEXIBLE COUPLINGS

A. Description:

1. Sleeve-type, couplings. Comply with AWWA C219.

2. Minimum design pressure rating: 150 pounds per square inch (psi).

3. Middle Ring: As required for coupling based upon connecting pipe materials, steel, or ASTM A536, ductile iron.

4. Followers: As required for coupling based upon connecting pipe materials, steel, or ASTM A536, ductile iron.

5. Gaskets:

a. Material: Buna-N.
b. Comply with ASTM D2000.

6. Bolts:

a. Buried: Steel.
b. Submerged: Stainless steel.

7. Center Pipe Stop: Required where shown on the Drawings.

B. Finishes:

1. Buried Couplings, Bolts: Factory epoxy coated.

C. Manufacturers:

1. For ductile iron and steel pipe:

a. Dresser, Style 38.
b. Romac, Model 501.
c. Smith-Blair.

2. For PVC pipe:

a. Romac, Model 501 or equal.

3. For flanged steel and ductile pipe:

a. Dresser, Style 128 or equal.

2.12 RESTRAINED FLANGE ADAPTERS FOR DUCTILE IRON PIPE

A. Description:

1. ASTM A536, ductile iron.

2. Flange bolt circles compatible with ANSI/AWWA C115/A21.15.

3. Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges.

4. Capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

5. Safety factor of 2:1 minimum.

6. Manufacturer:

a. EBAA Iron, Series 2100 Megaflange or equal.

2.13 FLANGED INSULATING JOINTS

A. Set shall include a full faced gasket, a full-length insulating sleeve for each flange bolt, and two insulating washers and two steel washers for each bolt.

1. Gaskets:

a. Full-face, comply with ASME 16.21.
b. Non-asbestos and non-phenolic compressed sheet packing with nitrile rubber binder.
c. Manufacturer: Garlock, Style 3505, or equal.

2. Insulating sleeves:

a. G-10 glass epoxy.

b. Extend the full width of both flanges, except where one flange hole is threaded where the sleeve shall extend through one flange and the gasket.

3. Insulating washers:

a. G-10 glass epoxy.
b. One-eighth-inch thickness.

4. Washers:

a. Buried: Cadmium plated steel.
b. Submerged: Stainless steel.

B. The complete assembly shall have an ANSI/AWWA pressure rating equal to or greater than that of the flanges between which is installed.

C. After assembly, the joint shall be tested for continuity. Electrical resistance between flanges and between each bolt and each flange shall be not less than 100,000 ohms.

2.14 INSULATING UNION

A. Description:

1. Material: Galvanized malleable iron with a ground joint.

2. Iron pipe threads: Conform to ANSI B2.1.

3. Insulations: Nylon, bonded, and molded onto the metal body.

4. Union: Rated for the operating and test pressures of the pipe system.

5. Joint connections to copper alloy pipe and tube shall be copper solder or threaded brass ground joints.

6. Isolation Barrier: Impervious to water.

2.15 BACKFLOW PREVENTERS

A. Manufacturers:

1. Nibco.
2. Watts.

B. Reduced-Pressure Backflow Preventers:

C. Reduced-Pressure Backflow Preventers with Detector Assembly:

1. Not used..

D. Reduced-Pressure Backflow Preventers:

1. Not used.

E. Reduced-Pressure Backflow Preventers with Detector Assembly:

1. Not used.

F. Double Check Valve Backflow Preventer Assemblies:

1. Size: 1/2-inch to 3 inches.

2. Comply with AWWA C510.

3. Materials:

a. Body: Bronze.
b. Internal Parts: Corrosion resistant.
c. Springs: Stainless steel.

4. Check Valves:

a. Quantity: Two, operating independently.
b. Intermediate atmospheric vent.

5. Ball Valves:

a. Type: Full port, resilient seated.
b. Quantity: Two.
c. Operation: Quarter turn.
d. Material: Bronze.

6. Accessories: Strainer and test cocks.

G. Double Check Valve Backflow Preventer with Detector Assembly:

1. Not used.

H. Double Check Valve Backflow Preventer Assemblies:

1. Not used.

I. Double Check Valve Backflow Preventer with Detector Assembly:

1. Not used.

J. Double Check Valve Backflow Preventer Assemblies:

1. Not used.

K. Double Check Valve Backflow Preventer with Detector Assembly:

1. Not used.

2.16 DISMANTLING JOINT

A. Description:

1. Comply with AWWA C219, where applicable.

2. Self-contained flanged restrained joint fitting, including both flanged components and sufficient harness bars to withstand the imposed thrust.

3. Design: No part of the restraint system extends outside the flange diameter. The internal bore shall match that of the pipe system.

4. Dismantling joints will allow for a minimum of 2 inches of longitudinal adjustment.

5. Furnish as a complete assembly consisting of spigot piece, flange adaptor, tie bars, and gasket.

6. The gasket seal and compression stud and nut arrangement shall be independent of the tie rod restraint system. Tie Rod diameter shall be compatible with the corresponding bolt diameter of the mating flange. The Tie Rod restraint system shall be capable of withstanding the full pressure thrust that the pipe system can develop at no more than 50 percent of the yield strength of tie rod material.

7. Pressure Rating:

   a. Determined by the flange configuration, and all commonly used flanges shall be available.

   b. Design pressure rating shall be equal to or greater than the mating flanges.

   c. Dismantling joints will be specially fabricated to accommodate pressure requirements with ANSI B16.5 or ANSI B16.47 300-pound class flanges, depending on size of dismantling joint.

8. Lining and Coating:

   a. Shop-applied fusion bonded epoxy coating applied by fluidized bed method, complying with the requirements of NSF 61 and AWWA C550 as applicable.

   b. As an alternative, a shop-coat primer suitable for field applied coatings can be supplied.

9. Flanges: Flat-faced, rated to pressure requirements as shown on the Drawings.

   a. Where design pressure is greater than 300 psi, flanges shall conform to ASME B16.5 and ASME B16.47 300-pound class.

B. Materials:

1. Spigot piece: Steel, ASTM A283 Grade C.

2. Flange adaptor:

    a. Up to 12-inch diameter: Ductile iron, ASTM A536 Grade 65-45-12.
    b. Above 12-inch diameter: Steel, ASTM A283 Grade C.

3. Tie bars: ASTM A193 Grade B7 threaded rod with rolled threads.

4. Gasket: EPDM Grade E.

5. Nuts, Bolts, and Washers: Type 304 stainless steel.

C. Manufacturer:

1. Romac or equal.

2.17 PIPE SUPPORTS

A. Floor Support for Pipe:

1. Flanged Pipe Support:

    a. Construction:

        1) Adjustable vertical pipe support, flange plate, extension pipe from base cup to top collar cup with threaded stud.

        2) Bolts directly to flange.

        3) Anchorable base plate.

    b. Material: Steel, comply with ASTM A36.

    c. Finish: Corrosion resistant, electro-galvanized, or prime coated.

    d. Manufacturers:

        1) Standon - Model S89.

2. Cradle Pipe Support:

    a. Construction:

        1) Adjustable vertical pipe support with saddle strap, extension pipe from base cup to top collar cup with threaded stud.

        2) Anchorable base plate.

    b. Material: Steel, comply with ASTM A36.

    c. Finish: Corrosion resistant, electro-galvanized, or prime coated.

    d. Manufacturers:

        1) Standon - Model S92.

2.18 PIPE PENETRATIONS

A. Sleeves for Pipes through Walls and Floors:

1. Material: Galvanized steel.

2. Thickness: Schedule 40.

3. Inside surface of all wall sleeves shall be coated with coal-tar.

4. Annular space between penetrating pipe and wall sleeve shall be filled with an approved permanently flexible sealant.

5. Diameter of wall sleeve shall be as shown in the Drawings.

B. Mechanical Sleeve Seals:

1. Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2. Manufacturer: Link-Seal or equal.

C. Pipes Cast-In Walls and Floors:

1. Not used.

D. Seep Rings:

1. Not used.

2.19 PIPE COATINGS

A. See Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.1 GENERAL

A. Furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill, and encasement, to provide a functional installation.

B. Pipe shall be installed in accordance with good trade practice. The methods employed in handling and placing of pipe, fittings, and equipment shall be such as to insure that after installation and testing they are in good condition. Should damage occur to the pipe, fitting or equipment, repairs satisfactory to the Engineer shall be made.

3.2 INSTALLATION

A. Buried Piping Systems:

1. Establish elevations of buried piping with not less than 3 feet of cover.

2. Remove scale and dirt from inside of piping before assembly, as may be required.

3. Excavate pipe trench as specified in Section 31 23 17, Trenching.

4. Install pipe to accurate lines, elevations, and grades as shown on the Drawings.

5. Where grades are not shown, pipe shall be laid to grade between control elevations shown on the Drawings.

6. Place bedding material at trench bottom to provide uniform bedding for piping.

7. Level bedding material in one continuous layer not exceeding 6 inches compacted depth.

8. Install pipe on prepared bedding.

9. Route pipe in straight line.

10. Install pipe to allow for expansion and contraction without stressing of pipe or joints.

11. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.

12. Pipe Cover and Backfilling:

    a. Backfill trench as specified in Section 31 23 17, Trenching.

13. All buried non-ferrous piping shall be installed with detectable tracer tape.

    a. Tape shall be buried 12 inches above the top of the pipe or as recommended by Manufacturer.

    b. Tape shall be continuous and labeled the same as the piping system.

B. Interior Piping Systems:

1. Install non-conducting dielectric connections wherever joining dissimilar metals.

2. Establish elevations of buried piping outside valve vault to obtain not less than 3 feet of cover.

3. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting as specified in Section 09 90 00, Painting and Coating.

4. Install water piping according to ASME B31.9.

5. Install unions downstream of valves and at equipment or apparatus connections.

6. Install brass male adapters each side of valves in copper piped system, solder adapters to pipe.

C. Backflow Preventer Assemblies:

1. Install backflow preventers of type, size, and capacity indicated.
2. Comply with applicable code and authority having jurisdiction.
3. Install airgap fitting on units with atmospheric vent connection.
4. Pipe relief outlet drain to nearest floor drain.
5. Do not install bypasses around backflow preventers.

D. Pipe Supports and Hangers

1. Install pipe supports according to MSS SP-58 and ASME B31.10.

2. All pipe shall be secured in place by use of blocking, hangers, brackets, clamps or other approved methods, and the weight thereof shall be carried independently of pump casings or equipment.

3. Special hangers and supports are shown on the Drawings.

4. The Contractor shall be responsible for determining the location of and providing all additional supports.

5. Hanger supports shall be as noted below with at least one support adjacent to the joint for each length of pipe, at each change in direction and at each branch connection. Sufficient hangers shall be provided to maintain proper slope without sagging. Support spacing shall not exceed Manufacturer's recommendations, nor as listed below.

Pipe	Maximum Support Spacing (Feet)
Steel Pipe	
Under 3 inches	6
3 inches and Over	12
Cast or Ductile Iron	
Under 4 inches	6
4 inches and Over	12
Stainless Steel and Galvanized Iron	
Under 1-1/2 inches	4
1-1/2 inches to 4 inches	6
Over 4 inches	12
Copper Pipe	6
PVC Pipe	
Under 2-1/2 inches	4
2-1/2 inches and Over	6

6. Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents unless other vertical support is shown, but in no case shall be more than 12 feet.

7. Provide adjustable hangers for all pipes, complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping. All rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine threaded. Continuous threaded rods will not be allowed.

8. Clevis or band-type hangers (B-Line FIG B3100) or equal shall be provided as required. Strap hangers not permitted.

9. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which cannot be properly supported or suspended by the walls or floors. Pipelines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.

10. Equipment shall be positioned and aligned so that no strain shall be induced within the equipment during or subsequent to the installation of pipework.

11. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.

E. Pipe Penetrations:

1. Exterior Watertight Entries: Seal with mechanical sleeve seals or grout, as shown in the Drawings.

2. Whenever a pipeline of any material terminates at or through a structural wall or floor, install piping or sleeve in advance of pouring of concrete required for the particular installation.

3. Plastic pipe shall not be cast in concrete or masonry walls.

4. Set sleeves in position in forms and provide reinforcing around sleeves.

5. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.

6. Extend sleeves through floors 1-inch above finished floor level and caulk sleeves.

7. Pipe other than concrete, to be cast in water-bearing walls or more than 4 feet below grade shall have seep rings.

8. All buried piping entering structures shall have a flexible connection installed less than 2 feet outside the structure line or as close to the wall as practical.

3.3 CLEANING, TESTING, AND DISINFECTION

A. Testing and Disinfection: Piping shall be hydrostatically tested, flushed, and disinfected as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 60 52 - PROCESS CONTROL SYSTEM, PRIMARY SENSORS AND FIELD INSTRUMENTS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust, commission and place into satisfactory operation all primary sensors and field instruments furnished under this Section.

2. Contract Documents illustrate and specify functional and general construction requirements of the sensors and field instruments and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.

3. CONTRACTOR shall be responsible for installing in-line flow elements (magmeter flow tubes, insert flow tubes, propeller flow meters) and for providing taps in the process piping systems for installation of other flow, pressure and temperature sensing instrumentation.

B. Coordination: Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

C. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.

1. Section 40 60 04, Process Control System General Requirements for Process Instrumentation.

2. Section 40 60 06, Computer Control System Factory Testing.

3. Section 40 60 07, Process Control System Start-up, Commissioning and Field Testing.

4. Section 40 60 08, Process Control System Training.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

B. Acceptable Manufacturers:

1. Furnish primary sensors and field instruments by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.

3. Obtain all sensors and field instruments of a given type from the same manufacturer.

4. The primary sensors and field devices shall be interchangeable with similar function existing primary sensors and field devices to minimize spare parts inventory.

C. Manufacturers' Responsibilities and Services:

1. Design and manufacture the primary sensors and field instruments in accordance with the applicable general design requirements specified in Section 40 60 04, Process Control System General Requirements, and the detailed Specifications herein.

2. Field supervision, inspection, start-up and training in accordance with the requirements of Section 40 60 07, Process Control System Start-up, Commissioning and Field Testing, and Section 40 60 08, Process Control System Training.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 40 60 04, Process Control System General Requirements.

B. Primary sensors and field instruments shall not be delivered to the site until all product information and Shop Drawings for the sensors and instruments have been approved by ENGINEER.

1.4 SUBMITTALS

A. Comply with the requirements specified in Section 40 60 04, Process Control System General Requirements.

1.5 MATERIALS OF CONSTRUCTION FOR WETTABLE PARTS

A. Provide the following materials of construction for primary sensors and field instrument (wetted) parts that come in contact with the following list of process fluids:

PROCESS FLUID	ELASTOMER	METAL	PLASTIC	OTHER
Air		Type 316 SS	Teflon	
Chemical Sump Drainage			Teflon Polypropylene	
Chlorine Gas		Hastelloy C, Monel, or Tantalum		
Glycerine Oil	Neoprene Viton Buna-N	Type 316 SS	Teflon Polypropylene PVC/CPVC	
Potable Water	Neoprene	Type 316 SS	Teflon	Ceramic
Silicone Oil	Viton Buna-N	Type 316 SS	Teflon Polypropylene	

1.6 IDENTIFICATION TAGS

A. All sensors and field instruments shall have an identification tag conforming to the following requirements:

1. Tag numbers for sensors and field instruments shall be as listed on the Drawings and Instrument Index.

2. Equipment tags shall be 2 inch square. The tags shall be constructed of aluminum, coated with black enamel paint. Each tag shall be engraved with the equipment identification (serialized key - 7 digit number as shown on drawings) and service description. Engraving letters shall be 1/4-inch Arial max. The tags shall be as manufactured by Brady, Model B-906, Catalog Number 87637.

3. Instrument identification tags shall be green, 1-1/2-inch round, aluminum tags. The tags shall be engraved with the instrument loop number. Engraving letters shall be 1/4-inch Arial max. The tags shall be as manufactured by Brady, Catalog Number 49903.

4. Each tag shall be attached with fasteners of nylon-coated 48 mil stainless steel wire, Brady Catalog Number 38091, and double ferrule design brass wire clamps, Brady Catalog Number 38090, to secure the stainless steel wire.

5. All sensors and field instruments mounted on or within panels shall have the aluminum identification tag installed so that the numbers are easily visible to service personnel.

PART 2 PRODUCTS

2.1 PROCESS TAPS, SENSING LINES AND ACCESSORIES

A. Pressure Sensing Lines and Accessories:

1. For Process Sensing Taps in Ductile Iron, Steel and Stainless Steel Piping Systems:

a. Material and Fittings: Type 316 stainless steel pipe (ASTM A 312) and threaded fittings and adapters (ASTM A 403) in accordance with Section 15103, Stainless Steel Pipe.

b. Sizes: 1/2-inch minimum for main sensing piping and 1/4-inch gage and switch connections or as shown on the Drawings.

c. Pressure Rating: Equal to or greater than the applicable system test.

2. Shut-off Valves:

a. Type: Full port ball.

b. Pressure Rating: 250 psi.

c. Body, Ball and Stem: Type 316 stainless steel.

d. Packing: High Density TFE.

e. Handle: Nylon with metal travel stops.

f. Support Rings: Stainless steel.

g. End Connections: Removable "Swageloks".

h. Product and Manufacturer: Provide one of the following:

1) 45 Series, as manufactured by Whitey.

3. Manifolds:

a. Type: Five valve and three valve meter manifolds.

b. Materials: Type 316 stainless steel body, bonnets and stems, delrin seats, teflon packing.

c. Product and Manufacturer: Provide one of the following:

1) Whitey.
2) Anderson-Greenwood

2.2 LEVEL TRANSMITTER – HYDROSTATIC

A. Type: Hydro Static pressure transmitter for measuring tank level. For non-pressurized tanks.

B. Required Features and Accessories:

1. Transmitter Accuracy (includes linearity, repeatability and hysteresis): ±0.2 percent of calibrated span.

2. Linearity: ±0.1 percent of calibrated span, typical.

3. Repeatability: 0.075 percent of calibrated span, typical.

4. Hysteresis: 0.075 percent of calibrated span, typical.

5. Stability over 5 Year Period: ±0.125 percent of maximum span, or better.

6. Power Supply Effect: Output change of less than .005 percent of calibrated output span per 1-volt change in supply voltage.

7. Combined Process and Ambient Temperature Effect: Less than 8-inches water change per 100°F average (combined) temperature change, plus 2.5-inches water per additional five feet of capillary when used with DC 200 silicone fill.

8. Output: 4 to 20 mA proportional to hydrostatic level.

9. Solid state electronic components.

10. Transmitter Sensor Wetted Parts:

a. Sensor Body and Bolting Materials: Type 316 stainless steel.
b. O-rings Seals: Viton.

11. Transmitter Electronics Housing: NEMA 4X rated and Buna-N O-ring sealed threaded cover constructed of die-cast, low-copper aluminum finished with an epoxy paint system.

12. Local Indicator: Provide integral 3-1/2 digit LCD output meter calibrated range value in engineering units. Calibrate in IN/FT of H2O.

13. Range: 0-16ft

14. Electrical Conduit Connection: 1/2-inch NPT.

15. Process Connections: 1/2-inch NPT.

16. Designed to operate on 4-20mA loop power.

C. Product and Manufacturer: Provide the following:

1. Endress+Hauser; Cerabar PMC71
2. No Equal

2.3 LEVEL TRANSMITTER - ULTRASONIC TYPE

A. Type: Non-contact system using transducer to convert electrical pulses from the transmitter into sonic pulses directed towards the metered surface and receive the reflected sonic pulses and convert them back into electrical pulses for reception by the transmitter. Transmitter shall generate and time the electrical pulses, and count and convert the pulse travel times into an analog output signal linearly proportional to level.

B. System Performance Requirements:

1. Accuracy: Not less than ± 1 percent of full-scale range.

2. Linearity and Repeatability: Not less than ±1 percent of full scale.

3. Minimum Operating Distance from Transducer (Deadband): 12-inches.

4. Beam Pattern: 6 degree conical, maximum.

5. Transmitter Outputs: Provide each of the following:

a. 4 to 20 mADC, direct acting and isolated, into 0 to 750 ohms.

b. Minimum of six independently adjustable alarm setpoint, relays outputs rated at five amps, 250 VAC non-inductive.

c. Loss of echo relay, which energizes when measured level falls beyond signal range or signal is interrupted for any other reason. Relay output shall be rated five amps 250 VAC non-inductive.

6. Environmental Conditions: Suitable for use under the environmental conditions specified in Section 40 60 04 Process Control System General Requirements for Process Instrumentation.

C. Required Features:

1. Transducer:

a. Encapsulated by a corrosion resistant and submergence resistant material: PVDF.

b. Process connection: 1” NPT.

c. Cable 2-wire 20 awg twisted pair with foil shield and PVC jacket. Manufacturers Cable as required 30 meter minimum.

2. Transmitter:

a. Solid state construction.

b. Integral backlit LCD indicator scaled in engineering units for the range required.

c. Potentiometers for zero and span adjustment over 0 to 100 percent of the calibrated range.

d. Distance or Height Mode of operation selectable via internal switch.

e. Lost Echo and Power On Lights.

f. Housed in weatherproof, splash proof and corrosion resistant NEMA 4X enclosure and suitable wall or pipe stand mounting. Provide with a transparent window to permit viewing indicating meter and lights.

g. Internally mounted diagnostic LED's to allow isolation of faults in terms of major components.

h. Designed for operation on 24VDC ±10 percent, 60 Hz power supply.

3. Accessories: Stainless steel tag affixed to transducer and Stainless steel tag affixed to transmitter.

D. Product and Manufacturer: Provide the following:

1. Siemens Hydro Ranger 200 Transmitter, XPS-15F Transducer
2. No Equal

2.4 MAGNETIC FLOWTUBE AND TRANSMITTER

A. Functions:

1. Flowtube: Produce low level, high impedance pulsed DC signal proportional to the rate of fluid flow using the principle of electromagnetic induction.

2. Pulsed DC Magnetic Flow Transmitter: Drive the flowtube coils with pulsed DC power and convert the flowtube output signal into a DC current output linear to the flow rate.

B. System (Flowtube and Transmitter) Performance Requirements:

1. System Accuracy (with Analog Output): ±0.5 percent of flow rate or better over range from 1 fps to 31 fps; ±.005 fps or better at flows below 1 fps flow range.

2. System Repeatability: ±0.15 percent of flow rate or ±.0015 fps, whichever is greater.

3. Drift: Complete zero stability.

4. Minimum Fluid Conductivity Limit: Five microsiemens per centimeter or less.

5. Minimum Pre-amp Input Impedance: 1012 ohms.

6. Fluid Property Effects: Accuracy unaffected by changes in fluid velocity, density, pressure, temperature or conductivity (above minimum conductivity limits).

7. Transmitter Outputs:

   a. 4 to 20 mADC, direct acting and isolated, into 0 to 1000 ohms.

   b. High accuracy, field adjustable scaled pulse output (0.1 to 10 Hz or greater) to drive local totalizer and provide scaled pulse output to Process Control System.

8. Power Consumption: Not to exceed 50 watts for flowtube and transmitter combined.

9. Operating Temperature: Suitable for operation with process fluid temperature from 0 to 140°F.

10. Pressure Rating: Greater than or equal to test pressure specified in Section 15050, Piping Systems, for appropriate piping system.

C. Construction and Required Features:

1. Flowtube:

   a. Type: Lined metal flowtubes.

   b. Interchangeability: Ratio of flow velocity to voltage reference signals generated identical for all meter sizes to permit interchangeability with transmitter without requiring circuit modifications.

   c. Tube Material:

      1) Meter tubes Type 304 stainless steel.

   d. Electrodes:

      1) Conical or elliptical shaped.
      2) Material: Type 316 stainless steel.

   e. Lining: PTFE, -4 to 194 deg F

f. Enclosure:

1) Materials and Rating: Cast low-copper aluminum alloy or fabricated sheet steel, NEMA 6 rated and capable of withstanding accidental submergence in 30 feet of water for 48 hours.

2) Finish: Finish exterior, except for flange faces, with a high build epoxy paint.

g. End Connections: ANSI Class 150 suitable for mating with pipe specified.

h. Electrical Connections: 3/4-inch NPT tapped holes for power conduit fitting and signal conduit fittings.

2. Pulsed DC Magnetic Flow Transmitter:

a. Solid state construction.

b. Pulse and analog outputs galvanically isolated from input and earth ground.

c. Low Flow Cutoff: Provide automatic low flow cutoff circuitry to stop pulse output and local totalization when flow drops below 0.5 percent ±0.2 percent of the calibrated upper range valve.

d. Enclosure:

1) Die cast, low-copper aluminum alloy, NEMA 4.
2) Finish: Epoxy coating.

e. Mounting:

1) Transmitter shall be remotely mounted from the flow tubes at locations shown on the Drawings.

2) Provide complete Type 316 stainless steel mounting hardware.

3) Type of mounting (wall, support frame or pipe stand), as required.

f. Local Indication:

1) LCD meter with field selectable engineering units: The engineering units shall be as specified indicated on the drawings.

2) 7-digit electromechanical totalizer or 8 digit electronic LCD totalizer with reset and lithium battery backup. Totalizer shall be integral with transmitter and visible through viewing window, or shall be externally mounted in a separate NEMA 4X enclosure or condulet with viewing window and installed adjacent to the transmitter.

g. Power Requirements: Designed for operation on 24VDC

h. Communications: Ethernet/IP

3. Accessories:

    a. Shielded cable assemblies of sufficient length for connection between flowtube and transmitter electronics.

    b. Type 316 stainless steel grounding rings for flowtubes.

    c. Type 316 stainless steel grounding straps.

    d. Provide spool piece for replacement of each different size flow tube where no bypass piping is provided.

    e. Provide one calibrator suitable to calibrate all flow tubes provided.

D. Product and Manufacturer: Provide one of the following:

1. Endress+Hauser; Promag W 400
2. No Equal

2.5 PRESSURE TRANSMITTER

A. Type: Two-wire, differential capacitance or resonant type transmitter.

B. Required Features and Accessories:

1. Accuracy (includes combined effects of linearity, hysteresis and repeatability): ±0.075 percent of calibrated span..

2. Stability (drift over a six month period): Not more than ±0.25 percent of transmitter upper range limit.

3. Ambient Temperature Effect: Total Error per 100°F change between the limits of -20°F and +180°F: Not more than ±1.0 percent of the transmitter upper range limit (maximum span).

4. Supply Voltage Effect: Output change not greater than 0.005 percent of span for each one-volt change in supply voltage.

5. Output:

    a. Isolated direct acting 4 to 20 mADC.

6. Solid state electronic components.

7. Positive overrange protection of at least 1.25 times the maximum span limit.

8. Calibration Adjustments:

    a. Zero: Adjustable in electronics compartment.
    b. Span: Coarse and fine span adjustments in electronics compartment.

9. Zero elevation and suppression capability to the extent that the amount of suppression plus calibrated span does not exceed the upper range limits of the sensor.

10. Adjustable internal damping.

11. Measuring elements protected by sealing diaphragm.

12. Built-in electrical surge and RFI protection.

13. Electric Conduit Connection: 1/2-inch NPT.

14. Process Connections: 1/2-inch NPT.

15. Designated to operate on power from receiver or remote power supply, nominal 24 VDC.

16. Type 316 stainless steel mounting bracket and hardware suitable for mounting transmitter on flat vertical surface or 2-inch diameter pipe.

17. Process Wetted Parts: Type 316 stainless steel.

18. Non-Wetted Parts:

    a. Body and Process Connection Bolting: Type 316 stainless steel.

    b. Housing and Cover: Die cast low copper aluminum alloy finished with epoxy paint system; covers shall be threaded and seated on Buna-N O-rings; NEMA 4 rating.

    c. Capsule Fill Liquid: Silicone oil.

19. Indicator: Provide integral indicator in engineering units.

C. Product and Manufacturers: Provide one of the following:

1. Endress+Hauser; Cerabar PMP71
2. No Equal

2.6 PRESSURE SWITCH

A. Type: Switch assembly with diaphragm piston actuator for sensing gage.

B. Performance Specifications:

1. Adjustable Operating Range: 0-100psig.

2. Setpoint Accuracy: ± One percent of span.

3. Actuating Setpoint: 78psi.

4. Adjustable Deadband Range and Setting:

    a. Maximum full scale, minimum seven percent of full scale.
    b. Required Deadband Setting: 2psi.

5. Switch: Snap action, SPDT rated not less than five amp resistive at 120 VAC and 1/2 amp resistive at 125 VDC. Provide DPDT contacts and other optional switch configurations when so required.

6. Switch and Reset (Deadband) Action: Adjustable, Fixed, Manual Reset or Two Stage type.

C. Construction Features:

1. Set and Reset Point Adjustments: Adjustable external adjusting nuts and pressure setting scales.

2. Process Connection: 1/4-inch NPT.

3. Housing: Copper-free die cast aluminum, NEMA 4; NEMA 7 construction required for hazardous areas.

4. External Mounting Lugs.

5. Adjusting Nuts Metal Cover with Gasket on NEMA 4 and NEMA 7 rated units.

6. Electrical Connection: 3/4-inch NPT.

7. Provide diaphragm seal.

D. Product Manufacturer: Provide pressure switch of one of the following:

1. Ashcroft; B-Series Type 400
2. Approved Equal

2.7 LEVEL SWITCH - FLOAT TYPE

A. General: The device shall be capable of detecting fluid level and initiating a signal.

B. Type: Direct acting float.

C. Required Features:

1. Sealed SPDT control switch (non-mercury).

2. Actuation by steel ball.

3. High impact, corrosion resistant, polypropylene float material.

4. Heavy duty, flexible 18 gauge, three connector, neoprene-jacketed cable with waterproof connection. Cable length, as required.

5. Not sensitive to rotation.

6. Operating Temperature: Up to 140°F.

7. Provide cable weight or mounting bracket to suit installation.

D. Product and Manufacturer: Provide the following:

1. Flygt, Model ENM-10.

2.8 SPARE PARTS AND TEST EQUIPMENT

A. CONTRACTOR shall furnish and deliver the spare parts and test equipment as outlined below, all of which shall be identical and interchangeable with similar parts furnished under this Section.

B. Spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. The following shall constitute the minimum spare parts: Ten (10) spare fuse of every type and trip rating used.

D. All spare parts shall have been operated and tested in the factory as part of factory testing prior to shipment of the control system.

E. For process sensors and all other analog instruments, the supplier shall submit a separate quotation for a recommended list of spare parts and test equipment. Each item recommended shall be listed and priced separately. The spare parts quotation shall contain a statement that the prices quoted are firm for a period of one year from the installation date of the equipment, and that the supplier understand that the OWNER reserves the right to purchase none, any, or all of the parts quoted. The supplier is required to show that a stock of spare parts and test equipment is obtainable within a 48-hour period.

PART 3 EXECUTION

3.1 INSTALLATION

A. CONTRACTOR shall require the integrator to furnish the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.

B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Transmitters and instruments that require access for periodic calibration or maintenance shall be mounted so they are accessible while standing on the floor.

C. All items shall be mounted and anchored using Type 316 stainless steel hardware, unless otherwise noted.

D. All field instruments shall be rigidly secured to walls, stands or brackets, as required, by the manufacturer and as shown on the Drawings. Mounting instruments on handrails will not be allowed.

E. Conform to all applicable provisions of the NEMA standards, NEC and local, state and federal codes when installing the equipment and interconnecting wiring.

3.2 START-UP, CALIBRATION, AND TESTING AND TRAINING

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

END OF SECTION

SECTION 40 60 08 - PROCESS CONTROL SYSTEM TRAINING

PART 1 GENERAL

1.1 REQUIREMENTS AND RESPONSIBILITIES

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform and coordinate all required training at times acceptable to OWNER and ENGINEER.

B. CONTRACTOR shall retain the services of the Instrumentation Supplier to provide operation and maintenance training for all Process Control System equipment as specified herein.

C. For equipment items not manufactured by the Instrumentation Supplier, the Instrumentation Supplier shall provide for on-site training by an authorized representative of the equipment manufacturer as part of the Instrumentation Supplier's services. The manufacturer's representative shall be fully knowledgeable in the operation and maintenance of the equipment.

D. CONTRACTOR shall be responsible for all costs associated with training both on-site and at the supplier's facilities and shall provide all required materials, texts and required supplies.

E. All training shall be conducted in the normal eight hour working days until conclusion of the training course. For training at the supplier's facility, the course instructor shall be assigned full time and shall not perform other duties throughout the period of the course.

1.2 SUBMITTALS

A. CONTRACTOR shall submit his plan for training. Included in the plan shall be course outlines and schedules for training to be provided at the supplier's facilities.

1.3 TRAINING AT THE SUPPLIER'S FACILITY

A. General:

1. CONTRACTOR shall provide an Instrumentation Supplier who shall perform standardized, structured training courses at an established training facility staffed with regular full time training instructors covering both operation and maintenance of the system equipment furnished by the Instrumentation Supplier.

2. All training shall be scheduled so that it has been completed prior to the start of the factory testing of the system.

3. OWNER will send the following personnel to attend training courses at the Instrumentation Supplier's facilities.

    a. Operations Training: 1 person.
    b. Maintenance Training: 1 person.

B. Operator Training Course:

1. Provide 1 day, eight hours per day, course covering the structure and the functions of the PLC and OIT and other system components and devices. The course shall familiarize the student with the procedures for applying the system to process control problems and develop student-programming capability.

2. As a minimum, the course shall cover the following topics:

a. Overview of systems functional capabilities.

b. Equipment overview including system component functions, operating principals and proper use.

c. Loading and start-up of the digital system hardware components.

d. Use of system commands.

e. Development of programs and control schemes.

f. Development and use of system displays.

g. Programming concepts and techniques.

h. Use of bulk storage device for system backup.

C. Maintenance Training Course:

1. Provide a 1 day, eight hours per day, course covering preventive and troubleshooting maintenance for the system components. The course shall familiarize the student with diagnostic capabilities of the system, both software and hardware, and also the routine maintenance procedures on the system and the common peripheral devices.

2. As a minimum the course shall cover the following topics:

a. System overview description including the power subsystems and logic components of the processor bus.

b. Description of the maintenance and troubleshooting aids of the system including software diagnostic programs.

c. Description of all bus operations.

d. Description of peripheral and process interface devices.

1.4 ON-SITE TRAINING

A. Primary Sensors/Transducers and Field Instruments:

1. Provide on-site operation and maintenance training by Instrumentation Supplier and the equipment manufacturer representatives prior to placing the equipment in continuous operation. The services of equipment manufacturer's representatives shall be provided for a minimum of eight hours for each type of instrument provided.

2. Training shall accomplish the following:

    a. Provide instruction covering use and operation of the equipment to perform the intended functions.

    b. Provide instruction covering procedures for routine, preventive and troubleshooting maintenance, including equipment calibration.

    c. Explain procedures for placing the equipment in and out of operation and explain necessary actions and precautions to be taken regarding the overall Process Control System.

B. Training covering the control equipment:

1. The Instrumentation Supplier shall provide 1 days of operations training covering all system components.

2. Training course shall accomplish the following:

    a. Provide all instructions required to operate and utilize all system components.

    b. Provide all instruction required to monitor and control the system processes from the designated control panel.

    c. Explain procedures for control of the system during scheduled or rescheduled shutdown and the subsequent start-up.

    d. Provide instructions for routine preventative and troubleshooting maintenance.

C. PLC Training:

1. The CCS Supplier shall provide training that covers PLC as follows:

    a. Provide an overview of system hardware and software.

    b. It shall train people in configuration, operation and programming PLC's.

    c. The emphasis shall be placed on how to perform set point changes, minor programming changes, range changes, diagnostics and upkeep of documentation.

    d. Instruction for hardware and software maintenance, troubleshooting and maintenance planning.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 60 51 - PROCESS CONTROL SYSTEM, PROCESS CONTROL DESCRIPTIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Instrumentation control loops.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.
2. Section 40 60 04 – Process Control System General Requirements

1.2 QUALITY ASSURANCE

A. PLC Program and SCADA Screen development shall comply with NTUA SCADA Standards.

1.3 SYSTEM DESCRIPTION

A. The control loop descriptions provide the functional requirements of the control loops represented in the Contract Documents.

1. Descriptions are provided as follows:

a. Control system overview and general description.
b. Major equipment to be controlled.
c. Major field mounted instruments (does not include local gages).
d. Manual control functions.
e. Automatic control functions/interlocks.
f. Major indications provided at local control panels and motor starters/VFD's.
g. Remote indications and alarms.

B. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions but are rather intended to supplement and complement the Drawings and other Specification Sections.

1. The control loop descriptions shall not be considered equal to a bill of materials.

C. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on Drawings.

1.4 SUBMITTALS

A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Contract Closeout Information:

1. Operation and Maintenance Data:

a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Control Strategy for Record Documents:

1. Obtain this Specification Section in electronic format (Microsoft Word) from Engineer at beginning of Project.

2. Revise and update the file monthly during construction and start-up to reflect all changes that occur due to specific equipment and systems supplied on the Project.

a. Show all revisions in 'track change' mode.

b. Change Specification Section Title to read "Control Loop Descriptions - Contractor Record Document."

c. Reference all changes by Request for Information (RFI) number or Change Proposal Request (CPR) number.

d. Submit revised file monthly to Engineer for review.

3. Deliver the revised and updated file as a final control loop description Record Document in the Operation and Maintenance Manual described in Specification Section 01 78 23.

4. Provide both paper copy and electronic copy of the Record Document control loop descriptions in the Operation and Maintenance Manual described in Specification Section 01 78 23.

PART 2 PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 EXECUTION (CONTROL LOOPS)

3.1 GENERAL OVERVIEW

A. The Cottonwood BPS flow path includes one storage reservoir, one discharge reservoir, two VFDs, and a vendor provided pump skid.

1. Cottonwood BPS shall pump water from the storage reservoir to the discharge reservoir. BPS shall run based on both reservoir levels.

2. The storage reservoir level shall be continuously monitored by a single level transmitter.

3. The discharge reservoir level shall be continuously monitored by a single level transmitter. Discharge reservoir is off site, tank level shall be relayed through owners existing radio network.

B. The Nazlini BPS flow path includes one storage reservoir, one discharge reservoir, two VFDs, and a vendor provided pump skid.

1. Nazlini BPS shall pump water from the storage reservoir to the discharge reservoir. BPS shall run based on both reservoir levels.

2. The storage reservoir level shall be continuously monitored by a single level transmitter. Storage reservoir is off site, tank level shall be relayed through owners existing radio network.

3. The discharge reservoir level shall be continuously monitored by a single level transmitter. Discharge reservoir is off site, tank level shall be relayed through owners existing radio network.

C. The Tolani Lakes BPS flow path includes two storage reservoirs, one discharge reservoir, three VFDs, and a vendor provided pump skid.

1. Tolani Lakes BPS shall pump water from the two storage reservoirs to the discharge reservoir. BPS shall run based on all three reservoir levels.

2. The storage reservoir level shall be continuously monitored by a single level transmitter.

3. The discharge reservoir level shall be continuously monitored by a single level transmitter. Discharge reservoir is off site, tank level shall be relayed through owners existing radio network.

D. The Yellowhair BPS flow path includes one storage reservoir, one discharge reservoir, two VFDs, and a vendor provided pump skid.

1. Yellowhair BPS shall pump water from the storage reservoir to the discharge reservoir. BPS shall run based on both reservoir levels.

2. The storage reservoir level shall be continuously monitored by a single level transmitter.

3. The discharge reservoir level shall be continuously monitored by a single level transmitter. Discharge reservoir is off site, tank level shall be relayed through owners existing radio network.

3.2 BOOSTER PUMP (TYPICAL FOR EACH SITE UNLESS NOTED OTHERWISE)

A. Each Booster Pump shall be equipped With a Hand-Off-Auto selector switch at the starter and an Auto/Manual selector switch at the SCADA HMI and OIT. These two selectors shall determine the pump mode of operation.

B. Local Manual Control Mode: when the Hand-Off-Auto selector switch is in the hand position the motor shall start and run continuously or shall run via local start and stop pushbuttons where equipped. The PLC shall not be able to control the motor.

C. Remote Manual Control Mode: when the Hand-Off-Auto selector switch is in the auto position an operator may place the motor into remote manual mode from the SCADA HMI or OIT. When in remote manual mode the operator may start and stop the motor from the SCADA HMI or OIT.

D. Remote Automatic Control Mode: when the Hand-Off-Auto selector switch is in the auto position an operator may place the motor into remote automatic mode from SCADA HMI or OIT. When in remote automatic mode the motor shall run via the booster station loop description.

E. PLC program shall allow for bump-less transfer from remote manual to remote auto modes and vice versa.

F. Where the motor is in remote mode and called to run either manually or automatically but does not report a running status back to the PLC. A fail to run alarm shall be generated.

G. The PLC shall automatically log pump running hours.

H. Status Display:

1. Booster Pump Running Status
2. Booster Pump Local Status
3. Booster Pump Auto Status (In Remote)
4. Booster Pump Remote Manual Status
5. Booster Pump Remote Automatic Status
6. Booster Pump Speed
7. Run Time Hours

I. Alarms:

1. Booster Pump VFD Fault Alarm
2. Booster Pump High Discharge Pressure Alarm

J. OIT/SCADA Controls:

1. Booster Pump Remote Manual/Automatic Select
2. Booster Pump Remote Manual Start
3. Booster Pump Remote Manual Stop
4. Booster Pump Remote Manual Speed Command (30-100%)
5. Alarm Reset

K. Equipment Ranges

Setpoint	Range	Starting Value
Booster Stop Level (Storage Reservoir(s))	0-XXft	xxft
Note 1: Contractor shall field coordinate tank ranges based on existing tank heights. Coordinate starting setpoints with owner. Note 2: The Booster Stop level activated from the storage reservoir shall be clamped to a level higher than the storage reservoir low level setpoint.		

L. Interlocks:

Interlock	Loop #	Response	Local / PLC
VFD Fault	YA-110 YA-120 YA-130 (Tolani Lakes Only)	Shut Down Booster Pumps	Local

Interlock	Loop #	Response	Local / PLC
Communication Fault	-	Shut Down Booster Pumps after 300 sec	Local
Discharge High Pressure Alarm	PAH-110 PAH-120 PAH-130(Tolani Lakes Only)	Shut Down Booster Pumps	Local
Discharge Reservoir Level High Alarm	Remote Transmitter via radio network. Coordinate Loop number with Owner	Shut Down Booster Pumps	PLC
Storage Reservoir Level Low Alarm	LIT -100 LIT-200(Tolani Lakes Only)	Shut Down Booster Pumps	PLC
Low Suction Pressure Cutoff	PIT-125	Shut Down Booster Pumps	PLC

3.3 RESERVOIR LEVEL – (TYPICAL FOR EACH SITE UNLESS NOTED OTHERWISE)

A. The reservoir level transmitter tracks and reports the water level in the reservoir.

B. Status Display:

1. Storage Reservoir Level (LIT-100)
2. Storage Reservoir Level (LIT-200) (Tolani Only)
3. Discharge Reservoir Level (Remote Off Site)

C. Alarms:

1. Reservoir High Level Alarm
2. Reservoir Low Level Alarm

D. OIT/SCADA Controls: N/A

E. Equipment Set Points / Ranges

Setpoint	Range	Starting Value
Storage Reservoir High-Level Warning	0-xxft	xxft
Storage Reservoir Low-Level Warning	0-xxft	xxft
Note: Contractor shall field coordinate tank ranges based on existing tank heights. Coordinate starting setpoints with owner.		

F. Interlocks: N/A

3.4 FLOW METER (TYPICAL FOR EACH SITE UNLESS NOTED OTHERWISE)

A. Flow rate shall be continuously monitored. The flow total shall be displayed on the SCADA HMI and OIT. The flow total can be reset from the SCADA HMI and OIT.

B. Display Status:

1. Flow Rate (FIT-130)

2. Flow Total

C. Alarm: N/A

D. OIT/SCADA HMI Controls:

1. Flow Total Reset

E. Equipment Set Points / Ranges: 0-XXXXgpm (Coordinate Range with packaged pump supplier)

F. Interlocks: N/A

3.5 BOOSTER STATION (TYPICAL FOR EACH SITE UNLESS NOTED OTHERWISE)

A. Overview:

1. Each booster station is equipped with up to three (3) pumps which are each equipped with VFD's and shall pump water from the storage reservoir into the discharge reservoir. The pumps shall operate in a lead, lag-1, and lag-2 configuration (Only Tolani Lakes shall utilize lag pump 2). The booster pumps shall be automatically controlled by the PLC based on discharge reservoir level.

2. Booster pumps BP-110, BP-120, and BP-130 (Tolani Lakes Only) shall each be assigned a starting order referred to as Lead, Lag-1, or Lag-2. The pump starting order can be assigned by the operator from SCADA or from the OIT. Additionally, at the end of each running cycle where all available pumps are off and ready, the pump shall rotate status to allow for even run time. Only one pump will be permitted to be assigned to any given start order.

3. Booster Pumps shall only be assigned a starting order when the Hand-Off-Auto selector switch is in auto and when the automatic/manual selection utility is set to automatic in SCADA.

4. The pump station shall automatically start and stop pumps to meet water demand by maintaining discharge reservoir level. If discharge reservoir level falls below the user designated setpoint pumps shall be added (started) and as discharge reservoir water level increases pumps shall be removed (shutdown). The pump start order shall be lead, lag-1, and lag-2. Pumps shall stop in the reverse order from which they start.

B. Lead Pump Start:

1. When the station discharge reservoir water level falls below the user designated setpoint +deadband and the start delay timer expires, the lead pump shall be called to start.

2. Upon starting the lead pump speed shall be varied to maintain the discharge reservoir level using a PID feedback loop.

C. Adding Lag Pump(s):

1. Where the running pump(s) are at full speed and discharge level +deadband cannot be maintained and the start delay timer has expired. Start the next lag pump.

2. Adjust the pump speeds in unison to maintain the discharge reservoir level using a PID feedback loop.

3. Repeat these steps to add additional lag pumps as needed.

D. Removing Lag Pump(s):

1. Where the running pump(s) are at minimum speed and discharge reservoir level is being maintained +deadband and the stop delay timer has expired. Stop the last lag pump to start.

2. Adjust the pump speeds in unison to maintain discharge reservoir level using a PID feedback loop.

3. Repeat these steps to remove additional lag pumps as needed.

E. Stopping Lead Pump:

1. With all lag pumps stopped and the lead pump is at minimum speed and discharge reservoir level is being maintained +deadband and the stop delay timer has expired. Stop the lead pump.

F. Status Display:

1. Discharge Pressure
2. Lead Booster Pump Assignment
3. Lag-1 Booster Pump Assignment
4. Lag-2 Booster Pump Assignment

G. Alarms:

1. High Discharge Pressure Alarm

H. OIT/SCADA Controls:

1. Lead Booster Pump Assignment
2. Lag-1 Booster Pump Assignment
3. Lag-2 Booster Pump Assignment

I. Equipment Set Points / Ranges

Setpoint	Range	Starting Value
Discharge Reservoir level Setpoint	0-XX ft	XX ft
Station Pressure Deadband Setpoint	0-XX ft	XX ft
Add Pump Delay Timer Setpoint	0-600 sec	60 sec
Remove Pump Delay Timer Setpoint	0-600 sec	60 sec
High Discharge Pressure Alarm	0-600 sec	15 sec
Note: Contractor shall field coordinate tank ranges based on existing tank heights. Coordinate starting setpoints with owner.		

J. Interlocks: N/A

END OF SECTION

SECTION 40 60 65 - PROCESS CONTROL SYSTEM, PANELS AND ENCLOSURES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish, install, calibrate, test, start-up, commission and place into satisfactory operation all control panels, intermediate termination panels and/or enclosures.

B. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.

1. Division 26, Electrical
2. Section 40 60 04 Process Control System General Requirements.
3. Section 40 60 06, Computer Control System Factory Testing.
4. Section 40 60 66, Process Control System Panel Instruments and Devices.

1.2 QUALITY ASSURANCE

A. Reference Standards: Construction of panels and the installation and interconnection of all equipment and devices mounted within shall comply with applicable provisions of the following, except where otherwise shown or specified.

1. National Fire Protection Association 79, Annex "D" Standards.
2. National Electrical Code (NEC).
3. National Electrical Manufacturer's Association Standards (NEMA).
4. American Society for Testing and Materials (ASTM).
5. Operational Safety and Health Administration (OSHA) Regulations.
6. State and local code requirements.
7. Where any conflict arises between codes or standards, the more stringent requirement shall apply.
8. All electrical materials and equipment shall be new and shall bear the label of the Underwriters' Laboratory (UL), Inc., Factory Mutual (FM) or equivalent where standards have been established and label service regularly applies.

B. General Design Requirements:

1. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

2. Comply with the control descriptions of Section 40 60 51, Computer Control System Process Control Descriptions.

C. Factory Assembly and Testing:

1. Comply with the requirements of Section 40 60 06, Computer Control System Factory Testing.

1.3 SUBMITTALS

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements.

PART 2 PRODUCTS

2.1 GENERAL CONSTRUCTION REQUIREMENTS

A. Provide all electrical and/or pneumatic components and devices, support hardware, fasteners, interconnecting wiring and/or piping required to make the control panels and/or enclosures complete and operational.

B. Locate and install all devices and components so that connections can be easily made and that there is ample room for servicing each item.

C. Components for installation on panel exterior shall be located generally as shown on the Drawings. Layouts shall be submitted for approval in accordance with the requirements of Section 40 60 04, Process Control System General Requirements.

D. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.

E. Provide sub-panels for installation of all relays and other internally mounted components.

F. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master numbered terminal strips, unless otherwise specified.

G. Provide copper grounding studs for all panel equipment and panel doors.

H. Provide the following convenience accessories inside of each control panel:

1. One 120 VAC, 20A GFCI type receptacle.

2. One or more 120 VAC fluorescent light fixtures with 40-watt lamp and protective plastic shield to span across the width of the panel (but not less than two-thirds).

3. One 120 VAC, 20A, snap switch, to turn on the light, mounted in an outlet box with a cover and located so that it is easily accessible from access door.

4. Service light and receptacle shall have an internal circuit breaker and a separate power feed.

I. The bottom 12-inches of free-standing panels shall be free of all devices, including terminal strips, to provide ease of installation and testing.

J. No device on the front shall be mounted less than 36-inches above the operating floor level, unless otherwise specified.

2.2 IDENTIFICATION

A. Provide laminated plastic nameplates for identification of panels and components mounted thereon.

B. Tag all internally mounted instruments in accordance with the following requirements:

1. Tag numbers shall be as listed in the Instrument Index or as shown on the Drawings.

2. The Identification Tag number and services description shall be provided on a permanent sticker which shall be placed on the panel interior above the devices.

3. The Identification Tag shall be installed so that the numbers are easily visible to services personnel.

C. Tagging of the following items shall be accomplished with the use of adhesive plastic Brady USA, Inc. labels, or equal.

1. Tag all electrical devices (e.g., relays, timers, power supplies) mounted within control panels and enclosures.

2. Tag all pneumatic lines.

3. Numerically tag all terminal blocks.

4. Color code and numerically tag wiring at each end.

D. Numerically code terminals on terminal strips using a Brady LS2000 Labeling System, or equal.

E. Color code and/or numerically code wiring as required by applicable standards. Wires shall be identified at each end with permanent number codes using a Brady LS2000 Labeling System, or equal.

2.3 PANELS AND ENCLOSURES

A. General:

1. Panels and enclosures shall meet the NEMA requirements for the type specified.

2. Sizes shown are estimates. CONTRACTOR shall furnish panels and enclosures amply sized to house all equipment, instruments, front panel mounted devices, power supplies, power distribution panels, wiring, tubing and other components installed within.

B. Construction Features:

1. Control panels located inside control or electrical room areas shall be NEMA type 12 rated. Control panels located outdoors shall be NEMA type 4 rated.

    a. Fabricate enclosures using minimum 14 gage steel for wall or frame mounted enclosures and minimum 12 gage for free standing enclosures. Steel shall be free of pitting and surface blemishes.

    b. Continuously weld all exterior seams and grind smooth. Also, surface grind complete removal of corrosion, burrs, sharp edges and mill scale.

    c. Reinforce sheet steel with steel angles where necessary to adequately support equipment and ensure rigidity and to preclude resonant vibrations.

    d. Panel shall be flat within 1/16-inch over a 24-inch by 24-inch area, or flat within 1/8-inch for a larger surface. Flatness shall be checked by using a 72-inch-long straight edge. Out-of-flatness shall be gradual, in one direction only, and shall not consist of obvious depressions or a series of wavy sections.

    e. Use pan type construction for doors. Door widths shall not exceed 36-inches.

    f. Mount doors with full length heavy duty piano hinge with stainless steel hinge pins.

    g. Provide oil resistant gasket completely around each door or opening.

    h. Provide handle-operated, oil-tight, key-lockable three-point stainless steel latching system with rollers on latch-rods for easy door closing.

    i. Use stainless steel fasteners throughout.

    j. Provide interior mounting panels and shelves constructed of minimum 12 gage steel.

    k. Provide steel print pocket with white enamel finish.

    l. Provide enclosure mounting supports as required for floor, frame, or wall mounting.

    m. Provide all holes and cutouts for installation of conduit and equipment, prior to installation. Cable and piping to enter the enclosure through the bottom, unless otherwise noted. All conduit and piping openings and all conduits shall be sealed watertight.

    n. Completely clean all interior and exterior surfaces so they are free of corrosive residue, oil, grease and dirt. Zinc phosphatize for corrosion protection.

    o. One coat of primer shall be applied to all interior and exterior surfaces immediately after corrosion protection has been applied. Exterior surfaces shall then be given sufficient coats of primer surfacer, applied with sanding and cleaning between coats, until a Grade 1 finish can be produced on the finish coat.

    p. All interior surfaces shall be painted with two coats of semi-gloss gray polyurethane enamel.

q. All exterior surfaces shall be painted with a minimum of three finish coats of polyurethane enamel to ultimately produce a Grade 1 finish (super smooth; completely free of imperfections). Color to be selected by ENGINEER from complete selection of standard and custom color charts furnished by the manufacturer. Provide one extra quart of touch-up paint for each exterior finish color.

r. Primer and finish paint shall be compatible and shall be a low VOC, high solids polyurethane enamel, Hi-Solids Polyurethane B65 W300 Series as manufactured by Sherwin-Williams, Inc. or equal.

2. Non-metallic Panels:

a. Panels shall be constructed of polycarbonate or ABS, with a minimum thickness of 3/16-inch for all surfaces, except those areas requiring reinforcement.

b. Panels shall be precision molded to form a one-pieced unit with all corners rounded.

c. Exterior surfaces shall be gel-coated to provide a corrosion-resistant, maintenance-free satin finish that shall never require painting.

d. Color pigments shall be molded into the resin.

e. Color to be selected from color charts furnished by CONTRACTOR.

f. Provide a clear plastic, gasketed, hinged door to encompass all non-NEMA 4 front of panel instruments.

g. All hardware, including hinge and means of locking shall be corrosion resistant.

3. Metallic Panels:

a. Panels shall be Type 316 stainless steel construction with a minimum thickness of 12 gage for all surfaces (except those areas requiring reinforcement) having a smooth brushed finish.

b. Stainless steel fast-operating clamp assemblies on three sides of each door.

c. Rolled lip around three sides of door and along top of enclosure opening.

d. Hasp and staple for padlocking.

e. Provide a clear plastic, gasketed lockable hinged door to encompass all non-NEMA 4 front of panel instruments.

f. Provide 3-inch-high channel base assembly, with solid bottom, drilled to mate the panel to its floor pad for free-standing panel.

g. Provide 5/16-inch diameter copper ground studs that shall be the ground connection points for all panel equipment and panel doors.

h. Floor Pad: Refer to Part 3 of this Section.

C. Electrical Systems:

1. Control of Environment:

2. Outdoor Panels:

   a. Provide adequately sized automatically controlled 120 VAC heaters, as manufactured by Hoffman, or equal, to maintain temperature inside each enclosure above 40°F to a maximum of 80°F when the outside temperature is 0°F through 40°F.

   b. Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louvers, if required, to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure, as shown on the Drawings. Housing shall be constructed of corrosion resistant materials. Air conditioners shall be provided with a separate circuit and drain line.

   c. Provide calculations for cooling and heating load requirements.

   d. Provide thermostats to automatically control heating and cooling requirements without need of manual operation of a heating/cooling transfer switch.

   e. Heating and coiling elements including external housing that are in contact with Plant's ambient environment shall be Heresite coated, or equal, for protection from hydrogen sulfide corrosion with hydrogen sulfide levels up to seven ppm.

3. Indoor Panels:

   a. Provide automatically controlled closed loop ventilation fans or closed loop air conditioners with filtered air louver, if required, to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the enclosure, as shown on the Drawings. Air conditioners shall be provided with a separate circuit and drain line.

   b. Provide calculations for cooling and heating load requirements.

   c. Provide thermostats to automatically control heating and cooling requirements without need of manual operation of a heating/cooling transfer switch.

   d. Heating and coiling elements including external housing that are in contact with Plant's ambient environment shall be Heresite coated, or equal, for protection from hydrogen sulfide corrosion with hydrogen sulfide levels up to seven ppm.

4. Power Source and Internal Power Distribution:

   a. General: Control panel power supply source, type, voltage, number of circuits and circuit ratings shall be as shown on the Drawings.

   b. Panels shall be provided with an internal 120 VAC with number of circuits and separate circuit breakers sized as required to distribute power to the panel components.

c. Circuit breakers shall be 120volt and 240 Volt AC, DIN rail mounted, UL listed and provided with end caps, marking strips, insulated side jumpers and other accessories. Manufacturer shall be Phoenix Contact or Allen-Bradley.

d. Provide an auxiliary contact to provide a “Power Fail” status to the CCS whenever any one of the circuit breakers are open as shown on the Drawings.

5. Wiring:

a. Internal wiring shall be Type MTW stranded copper wire with thermo-plastic insulation rated for 600 V at 90°C for single conductors, color coded, conforming to the requirements of NFPA 79and Specification 01420, and labeled with wire identification.

b. For DC panel signal wiring, use No. 16 minimum AWG shielded.

c. For AC power wiring, use No. 14 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by NEC and NFPA "79" Standards.

d. Separate and shield low voltage signal wiring from power and control wiring by a minimum of 6-inches. 480-volt equipment shall be located in a separate enclosure or place a non-metallic barrier between the 480 power and other power sources.

e. Group or bundle parallel runs of wire using covered wireways. Troughs shall have 50 percent spare capacity. When power and control wireways and low voltage analog wireways are running parallel and within 6 inches of each other, an aluminum barrier shall be installed to extend 3 – inches higher and along the entire length of the wireway.

f. Install wire troughs along horizontal or vertical routes to present a neat appearance. Angled runs are not acceptable.

g. Adequately support and restrain all wiring runs to prevent sagging or other movement.

h. Terminate all field wiring using forked, insulated, crimp-on connectors (soldered type not acceptable) at 600 V rated barrier type terminal strips with screwed connections and permanently affixed numeric identifiers beside each connection. Identifiers to be heat-shrink labels, as manufactured by Brady, permanent type, machine printed numbers.

i. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device. Install loops on the hot and neutral service.

j. For internal component to component wiring only, compression type barreled, or soldered connectors are acceptable.

k. Provide spare terminals equal in number to 20 percent of the terminals used for each type of wiring (e.g., DC signal and AC power).

l. Provide grounding terminals, studs and wirings for shielded cable as per Division 01 – General requirements.

m. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation.

n. When DC power and/or low voltage AC power is required, provide and install the necessary power supplies and transformers in the panel.

o. All field 4-wire instruments shall be powered from an instrument lighting panel as shown on the Drawings. Provide circuit breakers to protect each circuit.

p. Provide complete wiring diagram showing "as built" circuitry. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.

6. Surge Protection:

7. General: Surge protection shall be provided to protect the electronic instrumentation system from surges propagating along the signal and power supply lines. The protection systems shall be such that the protection level shall not interfere with normal operation but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. These protectors shall be mounted within the instrument enclosure.

8. Product and Manufacturer: Provide one of the following:

a. Phoenix Contact.
b. Advanced Protection Technologies.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment in conformance with NEC.

B. Unless otherwise noted, install indoor NEMA 4 panels on 4-inch concrete pad. Extend pad 4-inches beyond outside dimensions of base, all sides. Lay grout after panel sills have been securely fastened down.

C. Unless otherwise noted, install outdoor free standing NEMA 4 panels on a reinforced concrete pedestal:

1. Minimum Size: 4-inches larger than outer dimensions of base, all sides.

D. Seal the contact surface between the panel base along the outside perimeter of the panel using RTV sealant.

1. Minimum Thickness: 8-inches with No. 4 steel reinforcing bars at 12-inches on centers, each way.

E. Install and interconnect all equipment, devices, electrical hardware, instrumentation and controls and process controller components into and out of and among the enclosures as shown on the Drawings.

3.2 TESTING AND ADJUSTMENTS

A. Perform system testing and make any adjustments necessary in accordance with this Section and Section 40 60 04, Process Control System General Requirements; Section 40 60 06, Computer Control System Factory Testing; and Section 40 60 07, Process Control System Start-up, Commissioning and Field Testing.

B. Perform power supply, voltage adjustments to tolerances required by the appurtenant equipment.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 60 66 - PROCESS CONTROL SYSTEM, PANEL INSTRUMENTS AND DEVICES

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish, install, calibrate, test, adjust, commission and place into satisfactory operation panel instruments and devices.

2. Contract Documents illustrate and specify functional and general construction requirements of the panel components and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. CONTRACTOR shall provide all piping, wiring, accessories and labor required for a complete, workable and integrated system.

B. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.

C. Reference Standard:

1. Division 26, Electrical.
2. Section 40 60 04, Process Control System General Requirements.
3. Section 40 60 06, Computer Control System Factory Testing.
4. Section 40 60 65, Process Control System Panel and Enclosures.

D. Coordination: Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

1.2 QUALITY ASSURANCE

A. Comply with the requirements of Section 40 60 04, Process Control System General Requirements for Process Instrumentation.

B. Acceptable Manufacturers:

1. Furnish instruments and devices by the named manufacturers.

2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied. Model number or specification requirements may vary based on manufactures availability.

3. Obtain all instruments or devices of a given type from the same manufacturer.

C. Manufacturers' Responsibilities and Services:

1. Design and manufacture the instruments and devices in accordance with the applicable general design requirements specified in Section 40 60 04, Process Control System General Requirements, and the detailed Specifications herein.

D. Field supervision, inspection, start-up, commissioning, and training in accordance with the requirements of Section 40 60 07, Process Control System Start-Up, Commissioning and Field Testing, and Section 40 60 08, Process Control System Training.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the requirements specified in Section 40 60 04 Process Control System General Requirements.

B. Instruments and devices shall not be assembled in the panels until all product information and system Shop Drawings for respective components have been approved.

1.4 IDENTIFICATION TAGS

A. All panel instruments and devices shall have an identification tag meeting the following requirements:

1. Tag numbers shall be derived from the P&ID, ISA number.

2. Identifying tag number shall be permanently etched or embossed onto a stainless-steel tag which shall be fastened to the device housing with stainless steel rivets or self-tapping screws of appropriate size.

3. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circlet of 1/16-inch diameter nylon-coated stainless steel wire rope.

4. All instruments and devices mounted within panels shall have the stainless-steel identification tag installed so that the numbers are easily visible to service personnel. Front of panel mounted components shall have the tag attached to the rear of the device.

5. Front of panel mounted components shall have nameplates which comply with the requirements specified in both, Section 40 60 65, Process Control System Panels and Enclosures.

PART 2 PRODUCTS

2.1 POWER SUPPLIES

A. General:

1. Single unit and multiple unit power supplies, located in control room panels, intermediate termination panels and field panels, as required.

B. Single Unit Required Features:

C. Solid state circuitry.

1. Surface mounting.
2. Input Power: 120 VAC, ± 10 percent, 60 Hz.
3. Output Power: 24 VDC or as required.
4. Line/Load Regulation: 0.005 percent.
5. Ripple: 0.25 mv RMS.

6. Overload Protection: Internal preset.
7. Include mounting brackets, fuse, and mating connector for AC power plug.

D. Product and Manufacturer: Provide one of the following:

1. Sola, SDN-C Series
2. Phoenix Contact, Quint Series
3. Approved Equal

2.2 CURRENT ISOLATOR

A. General:

1. The isolating unit shall be a two wire, loop powered device. It shall accept a 4 to 20mA DC input signal and deliver a 4 to 20mA DC output.

B. Required Features:

1. Repeatability: One percent of span.
2. Rated for Ambient Temperature Range: -25°F to +185°F.
3. Linearity: 0.1 percent of full scale.
4. Provide one spare isolator.

C. Product and Manufacturer: Provide one of the following:

1. Wilkerson.
2. A.G.M.
3. Action Pak.

2.3 CONTROL RELAYS

A. Type: General purpose, plug-in type rated for continuous duty.

B. Construction Features:

1. Coil Voltages: 24 VDC and 120 VAC, as required.

2. Contacts:

a. Silver cadmium oxide rated not less than five amperes resistive at 120 VAC or 28 VDC continuous.

b. For switching low energy circuits (less than 200 ma) fine silver, gold flashed contacts rated not less than three amperes resistive at 120 VAC or 28 VDC continuous shall be provided.

3. Relays to have clear plastic dust cover.

4. Relays to be UL recognized.

C. Product and Manufacturer: Provide one of the following:

1. IDEC, RH Series.
2. Type R and/or Type K, as manufactured by Square D Company.

3. Or Equal.

2.4 TIME DELAY RELAY

A. Type: Dial adjustable, plug-in type time delay relay providing delay-on-make, delay-on-break or interval operation.

B. Construction Features:

1. MOS digital circuit with transformer coupled power.

2. Switch selectable ranges as follows:

a. One second.
b. Ten seconds.
c. One minute.
d. Ten minutes.
e. One hour.
f. Ten hours.

3. Minimum Setting: Three percent of range, except 50 ms for one second range.

4. Contacts:

a. Type: DPDT.
b. Rating: Seven amps resistive at 120 VAC, seven amps at 24 VDC.

5. Housing: Plug-in design with dust and moisture resistant molded plastic case.

6. Power Input: 120 VAC and 24 VDC, as required.

7. Relays to be UL recognized.

C. Product and Manufacturer: Provide one of the following:

1. IDEC, Type GT3.
2. Or Equal

2.5 SELECTOR SWITCHES, PUSHBUTTONS AND INDICATING LIGHTS

A. General:

1. Selector switches, pushbuttons and indicating lights shall be supplied by one manufacturer and be of the same series or model type.

2. Type:

a. Heavy duty, oiltight.

3. Provide legend plate for indication of switch, pushbutton or light function (e.g., Open-Closed, Hand-Off-Auto).

4. Mounting: Flush mounted on control panel front, unless otherwise noted.

5. NEMA rated to match panel in which mounted.

B. Selector Switches:

C. Type: Provide selector switches with number of positions as required to perform intended functions as shown on the Drawings and specified.

1. Contacts:

a. Provide number and arrangement of contacts as required to perform intended functions specified, but not less than one single pole, double throw contact.

b. Type: Double break, silver contacts with movable contact blade providing scrubbing action.

c. Rating: Compatible with AC or DC current with devices simultaneously operated by the switch contacts, but not less than ten amperes resistive at 120 volts AC or DC continuous.

2. Switch Operator: Standard black knob.

D. Pushbuttons (Standard or Illuminated):

1. Type: Provide momentary, booted type pushbuttons as required to perform intended functions specified and shown on the Drawings. Boot color to be red for stop buttons and black for other functions.

2. Contacts: Comply with the requirements specified for selector switches.

E. Indicating Lights:

F. Type: Compact, integral non-transformer type.

1. Lamps: 120 VAC, LED, long life (20,000 hours minimum).

2. Common, push-to-test circuitry shall be provided for each panel to simultaneously test all indicating lights on the panel using a single pushbutton.

G. Button and Lens Colors:

1. Red for indication of open, on, running.

2. Green for indication of closed, off (ready), stopped.

3. Amber for indication of equipment malfunction, process trouble and alarms (e.g., high level, low level, etc.).

4. White for indication of electrical control power on.

2.6 SURGE PROTECTION DEVICE

A. General: Lightning and surge protection shall be provided for instrument and main power protection.

B. Required Features:

1. Amp Rating: Ten kA for instruments; 20 kA for main power.

2. Voltage Rating: Compatible with working voltage of protected device.
3. Reaction Time: nanosecond range.
4. Mounting: DIN rail.
5. Enclosure Rating: Intrinsically safe, unless otherwise noted.

C. Product and Manufacturer: Provide one of the following:

1. Phoenix Contact
2. Advanced Protection Technologies.
3. Approved Equal

2.7 UNINTERRUPTIBLE POWER SYSTEM

A. Uninterruptible Power System (UPS) shall be furnished to provide a reliable source of uninterruptible power with no break in DC output power during a complete or partial interruption of incoming line power. UPS shall be UL listed.

B. UPS shall be comprised of a precision hysteresis loop battery charger, sealed maintenance free batteries, a relay.

C. When DC line power fails, the UPS shall supply DC power to the transformer from the battery source. There shall be no break in the output of the system during transfer from normal DC line supply to battery supply or back to line.

D. Output capacity shall be provided to meet the load of equipment furnished.

E. Backup Run Time: 10 minutes.

1. Output Voltage: 24VDC.
2. Voltage Regulation: ± Three percent nominal regulation.
3. Operating Temperature: 32°F to +104°F.

F. Product and Manufacturer: Provide one of the following:

1. Phoenix Contact
2. Sola, SDU
3. Or equal.

2.8 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. General: The PLC shall provide all operational, protective, status, and alarm functions as described for the equipment control functions and as shown on the Drawings. The PLC shall be Modicon, M340 Series. The following shall outline the minimum basic PLC system requirements:

1. PLC Processor: The processor shall be sized to support required I/O, communication, process functions, data storage, and spare I/O.

2. Memory Type: Lithium battery backed RAM with EEPROM backup.

3. Communications:

a. Modbus TCP

4. I/O Modules: Each PLC shall be equipped for input/output signal interface with field devices for control and monitoring. The discrete inputs shall be 24VDC. The discrete outputs shall be 24VDC. The analog inputs shall be 4 to 20 mADC. The analog outputs shall be isolated 4 to 20 mADC. Any other type of I/O signal interface module shall be provided as required to meet the needs of the equipment process control. A minimum of 25 percent spare I/O capacity shall be provided for each I/O type.

5. Power Supplies: Each PLC shall be provided with a power supply(s) suitable for operation on 24VDC. Power supply(s) shall be provided for each PLC system and shall be sized to include the spare I/O capacity.

6. I/O Chassis: Each PLC shall be provided with an I/O chassis to house I/O modules, CPU, power supplies, communication modules, and interface modules. Unused slots in the chassis shall have cover plates.

7. Interconnection: All interconnecting cables and wires between power supplies, I/O chassis, and control system components shall be provided.

B. The application program for the PLC shall be fully documented with I/O descriptors and function annotation to be able to follow the program's control logic. A copy of the application program shall be provided to the OWNER upon project completion. The OWNER shall be provided with READ/WRITE access to the application program.

2.9 ANTENNA - YAGI

A. General: The device shall be capable of communicating on the 890-960 MHZ band.

B. Type: Broadband yagi antenna.

C. Required Features:

1. Can communicate on the 890-960 MHZ band.
2. High impact, stainless steel material.
3. Not sensitive to wind.
4. Operating Temperature: Up to 140°F.
5. Provide cable weight or mounting bracket to suit installation.

D. Product and Manufacturer: Provide the following:

1. SCALA, Model TY-900.

2.10 RADIO – 900MHZ

A. General: The device shall be capable of communicating on the 900 MHZ band.

B. Type: Long range.

C. Required Features:

1. Capable of connecting to yagi antenna.
2. Serial connections for RTU/PLC.
3. Rugged industrial housing.

4. Not sensitive to rotation.
5. Operating Temperature: Up to 140°F.
6. Provide cable weight or mounting bracket to suit installation.

D. Product and Manufacturer: Provide the following:

1. GE Vernova, Model SD9.

2.11 SPARE PARTS AND TEST EQUIPMENT

A. CONTRACTOR shall furnish and deliver the spare parts and test equipment as outlined below, all of which shall be identical and interchangeable with similar parts furnished under this Specification.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. The following shall constitute the minimum spare parts:

1. Five of each type of input-output relay for each 40 or less furnished for this Contract.

2. One replacement power supply for each type and size furnished for this Contract.

3. A one year supply of all expendable materials.

4. One per ten (two, if fewer than twenty) of each type of panel mounted instrument including lights and pushbuttons.

5. One dozen of each type and size of fuse used in panels and instruments.

D. The following shall constitute the minimum test and calibration equipment:

1. All tooling required to insert, extract and connect any internal or external connector, including edge connectors.

2. All special calibration equipment required for system calibration.

E. All spare parts shall have been operated and tested in the factory as part of factory testing prior to shipment of the control system.

F. For process sensors and all other analog instruments, the supplier shall submit a separate quotation for a recommended list of spare-parts and test equipment. Each item recommended shall be listed and priced separately. The spare parts quotation shall contain a statement that the prices quoted are firm for a period of one year (with escalators for the next two years) subsequent to the OWNER'S acceptance of the equipment, and that the supplier understands that the OWNER reserves the right to purchase none, any, or all of the parts quoted. The supplier is required to show that a stock of spare-parts and test equipment is obtainable within a 48 hour period.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install each item in accordance with manufacturers recommendations and in accordance with the Contract Documents.

B. All items shall be mounted and anchored in compliance with Section 40 60 65, Process Control System Panels and Enclosures.

3.2 START-UP, CALIBRATION, TESTING AND TRAINING

A. Comply with the requirements of Section 40 60 04 Process Control System General Requirements.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 60 07 - PROCESS CONTROL SYSTEM START-UP, COMMISSIONING AND FIELD TESTING

PART 1 GENERAL

1.1 SYSTEM START-UP, COMMISSIONING AND FIELD TESTING RESPONSIBILITIES

A. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install all equipment and coordinate all activities required to perform start-up, commissioning and field testing of the Process Control System. Field testing shall include an integrated system field test and operational availability demonstration.

B. CONTRACTOR shall retain the services of the Instrumentation Supplier and Computer Control System vendor to supervise and/or perform start-up, commissioning and field testing of all system components. As part of these services, the Instrumentation Supplier shall include for the equipment items not manufactured by the Instrumentation Supplier, the services of an authorized manufacturer's representative to check the equipment installation and place the equipment in operation. The manufacturer's representative shall be thoroughly knowledgeable about the installation, operation and maintenance of the equipment.

C. CONTRACTOR shall submit to the ENGINEER a schedule with proposed start dates and test procedure guidelines for start-up, commissioning, and field testing at least four weeks in advance. Prior to testing each process area, CONTRACTOR shall install Computer Control System (CCS) software, including any modifications, and perform independent software configuration testing. Complete testing of each process area through the CCS shall be documented by CONTRACTOR and submitted to the ENGINEER upon successful completion.

1.2 SYSTEM CHECK-OUT AND START-UP

A. CONTRACTOR under the supervision of the Instrumentation Supplier, and other equipment suppliers as applicable, shall perform the following:

1. Check and approve the installation of all computer control system components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation. Check-out shall include the following items as a minimum:

    a. All wiring shall be checked at each termination point for correct wire size, type, color, termination and wire number.

    b. Analog wiring shall be checked for correct polarity and ground continuity at each termination point in the loop.

    c. All control and monitoring loops shall be checked for signal continuity from source (such as field instrument/equipment, control panel, etc.) to end destination (Intermediate Termination Panels, ITP).

2. Conduct a complete system checkout and adjustment, including calibration of all instruments, tuning of control loops, checking operation functions, and testing of final control actions. When there are future operational functions included in this Work, they

should be included in the system checkout. All problems encountered shall be promptly corrected to prevent any delays in start-up of the various unit processes.

3. All instruments and devices shall be checked to verify compliance with the Specifications and approved Shop Drawings.

B. CONTRACTOR shall provide all test equipment required to perform the testing during system checkout and start-up.

C. CONTRACTOR shall furnish to the ENGINEER certified calibration reports for field instruments and devices specified in Section 40 60 52, Process Control System Primary Sensors and Field Instruments, and panel mounted devices specified in Section 40 60 66, Process Control System Panel Instruments and Devices, as soon as calibration is completed.

1. Receipt of any calibration certificate shall in no way imply acceptance of the work or instrument.

2. The calibration certificate forms shall be prepared and furnished by CONTRACTOR.

3. Each calibration certificate shall be signed and dated by an authorized representative of CONTRACTOR. Three copies of each completed certificate shall be submitted to ENGINEER.

D. CONTRACTOR shall furnish ENGINEER two copies of an installation inspection report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by authorized representatives of both CONTRACTOR and the Instrumentation Supplier.

E. Approved Operation and Maintenance manuals as specified in Section 40 60 04, Process Control System General Requirements, and a schedule for training must be approved prior to commencing integrated system field tests.

F. All spare parts must be on site and accepted prior to commencing integrated system field tests.

1.3 COMMISSIONING

A. Following the Process Control System checkout and initial operation, CONTRACTOR, under the supervision of the Instrumentation Supplier, shall perform a complete system test in the presence of the ENGINEER to verify that all equipment is operating properly as a fully integrated system, and that the intended monitoring and control functions are fully implemented and operational.

1. Commissioning can only begin when all instruments and control panels are installed and wired. Operation and Maintenance manuals as specified in Section 40 60 04, Process Control System General Requirements and a schedule for training must be approved prior to Commissioning.

2. All spare parts must be on site and accepted prior to Commissioning.

3. CONTRACTOR shall submit to the ENGINEER a schedule for Commissioning, including a proposed start date and Commissioning test sheet examples at least three weeks in advance.

B. Commissioning shall be divided into two parts. Part I will exercise field signals between field equipment or instrumentation and each Intermediate Termination Panel (ITP). Part II shall exercise input/output signals from each ITP though the Computer Control Systems' workstation graphic display. CONTRACTOR shall make the necessary arrangements in each ITP to isolate field wiring from the CCS and allow concurrent Part 1 and Part II testing. CONTRACTOR shall, as a minimum, perform the following checks for each test:

1. All wiring shall be checked at each termination point for correct wire size, type, color, termination and wire number.

2. All instruments and devices shall be checked to verify compliance with the Specifications and approved Shop Drawings. The calibration of analog devices shall be verified including the zero and span.

3. Analog wiring shall be checked for correct polarity and ground continuity at each termination point in the loop.

4. All analog loops shall be verified at each termination point at 0%, 10%, 25%, 50%, 75%, 90% and 100% signal levels.

C. CONTRACTOR shall provide the following documentation for use during the Commissioning effort. This documentation is in addition to that included in Section 40 60 04, Process Control System General Requirements.

1. Complete panel schematic and internal point-to-point wiring interconnect drawings as detailed in Section 40 60 04, Process Control System General Requirements.

2. Complete electrical control schematics in accordance with NFPA 79 Standards.

3. Complete panel layout drawings as detailed in Section 40 60 04, Process Control System General Requirements.

4. Complete field wiring diagrams as detailed in Section 40 60 04, Process Control System General Requirements.

5. Complete instrument loop diagrams as detailed in Section 40 60 04, Process Control System General Requirements.

6. Completed Calibration Certificates for all field and panel devices which require adjustment or calibration.

7. CONTRACTOR shall provide one set of Commissioning documentation for the OWNER'S personnel, one set for the ENGINEER'S use, one set for field use, and the required number of sets for CONTRACTOR'S use.

8. The Drawings corrected and modified during Commissioning shall form the basis for the "As-Built" Record Drawing requirement as specified in Section 40 60 04, Process Control System General Requirements.

D. Any defects or problems found during the Commissioning effort shall be corrected by CONTRACTOR and then retested to demonstrate proper operation.

1.4 INTEGRATED SYSTEM FIELD TEST

A. Following the completion of Process Control System checkout and initial operation, the CONTRACTOR shall begin CCS software testing. CONTRACTOR, under the supervision of the Instrumentation Supplier and CCS vendor, shall remain on-site and be available during this period to correct instrumentation and control system hardware problems, if necessary. The integrated field test shall be performed to verify all equipment/instrumentation is operating properly as a fully integrated system with the CCS, and that the intended monitoring and control functions are fully implemented and operational.

B. Following software testing and demonstration of all system functions, the Process Control System including field sensors/transducers and instruments shall be running and fully operational for a continuous 48 hour period. The Operational Availability Demonstration specified below shall not begin until the continuous 48 hour integrated system test has been successfully completed and OWNER and ENGINEER agree that the Operation Availability Demonstration can begin.

C. CONTRACTOR shall provide the following documentation for use during the integrated field test effort.

1. Complete panel schematic and internal point-to-point wiring interconnect drawings as detailed in Section 40 60 04, Process Control System General Requirements.

2. Complete panel layout and electrical control schematics drawings as detailed in Section 40 60 04 Process Control System General Requirements.

3. Complete field wiring diagrams as detailed in Section 40 60 04, Process Control System General Requirements.

4. Complete instrument loop diagrams as detailed in Section 40 60 04, Process Control System General Requirements.

5. Completed Calibration Certificates for all field and panel devices which require adjustment or calibration.

6. CONTRACTOR shall provide one set of the documentation required for the integrated field test effort for the OWNER'S personnel, one set for the ENGINEER'S use, one set for field use, and the required number of sets for the CONTRACTOR'S use.

7. The drawings corrected and modified during Shop Drawing review and integrated field tests shall form the basis for the "As-Built" Record Drawing requirement as specified Section 40 60 04, Process Control System General Requirements.

D. Any defects or problems found with the instrumentation, control system hardware, control panel components/wiring and field devices during the integrated field testing effort shall be corrected by CONTRACTOR and then retested to demonstrate proper operation.

1.5 OPERATIONAL AVAILABILITY DEMONSTRATION

A. Operational Availability Demonstration (OAD) shall begin following completion of the integrated system field test as specified above and shall continue until a time frame has been

achieved wherein the instrumentation and control system hardware availability meets or exceeds 99.7 percent for seven consecutive days and no system failures have occurred which result in starting the OAD over again. During the OAD the system shall be available to plant operating personnel for use in normal operation of the Plant.

B. For the purpose of the Operational Availability Demonstration, the system shall be defined as consisting of the following systems and components:

1. PLC, OIT, and Physical Controls.

C. The conditions listed below shall constitute system failures which are considered critical to the operability and maintainability of the system. The Operational Availability Demonstration shall be terminated if one or more of these conditions occur. Following correction of the problem, a new seven consecutive day OAD shall begin.

1. Failure to repair a hardware or software problem within 120 consecutive hours from the time of notification of a system failure.

2. Recurrent hardware problems: If the same type of problem occurs three times or more.

D. The following conditions shall constitute a system failure in determining the system availability based on the equation specified in Paragraph 1.5.E., below

1. Failure of PLC, OIT, or equipment fault/failed conditions.

2. Loss of communications between devices on the communications network.

3. Failure of one or more input/output components.

4. Failures of any type affecting ten or more input/output points simultaneously.

5. Failure of any type affecting one or more regulatory control loops or sequential control strategies thereby causing a loss of the automatic control of the process variable or process sequence operation.

6. Failure of power supply. Where redundant power supplies are provided, failure of one power supply shall not constitute a system failure provided the backup power supply operates properly and maintains supply power. Failure of the backup supply to operate properly and maintain supply power shall constitute a system failure.

7. Failure of three or more primary sensors/transducers or field instruments simultaneously.

E. The system availability shall be calculated based on the following equation:

$$A = \frac{MTBF}{MTBF + MTTR} \times 100\%$$

where, A = system availability in percent

MTBF = average time interval between consecutive system failures
MTTR = mean time required to repair system failures

F. Time between failures shall be the period between the time that a reported system failure has been corrected and the time of subsequent notification of CONTRACTOR that another system failure has occurred in terms of operating hours.

G. Time to repair shall be the period between the time that CONTRACTOR is notified of a system failure and the time that the system has been restored to proper operation in terms of hours with an allowance for the following dead times which shall not be counted as part of the time to repair period.

1. Actual travel time for service personnel to get to the plant site up to a maximum of six hours from the time CONTRACTOR is notified of a system failure.

2. Time for receipt of spare parts to the plant site once requested up to a maximum of 24 hours. No work shall be done on the system while waiting for delivery of spare parts.

3. Dead time shall not be counted as part of the system available period. The dead time shall be logged and the duration of the OAD extended for an amount of time equal to the total dead time.

H. Completion of a 15 consecutive day period without any restarts of the OAD and with a system availability in excess of 99.7 percent will constitute acceptance of the Process Control System by OWNER. CONTRACTOR shall submit a request of acceptance after 30 consecutive day period without any restarts to the ENGINEER for approval.

I. All parts and maintenance materials required to repair the system prior to completion of the OAD shall be supplied by CONTRACTOR, at no additional cost to OWNER. If parts are obtained from the contractual spare parts inventory, they shall be replaced to provide a full complement of parts as specified.

J. A Process Control System Malfunction/Repair Reporting Form shall be completed by the OWNER and ENGINEER to document system failures, to record CONTRACTOR notification, arrival and repair times and CONTRACTOR repair actions. Format of the form shall be developed and agreed upon prior to the start of the OAD.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 40 60 06 - COMPUTER CONTROL SYSTEM FACTORY TESTING

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope

1. CONTRACTOR shall provide all labor, materials, equipment and incidentals as shown on the Drawings, specified and required to perform factory testing, before shipment, at the manufacturer's facility to verify that system components are functioning properly and that they meet the functional and performance requirements of the Contract Documents.

2. CONTRACTOR shall submit information on factory testing procedures to verify that testing shall fulfill the requirements as specified herein. Submittal shall be made at least two months in advance of any scheduled testing and shall include dates of scheduled tests.

3. CONTRACTOR shall notify ENGINEER, in writing, at least four weeks before expected initiation of tests. OWNER and ENGINEER may elect to be present at CONTRACTOR'S facilities during operational test of system equipment, either for individual units or as an integrated system. Presence of OWNER and ENGINEER during testing does not relieve CONTRACTOR from conforming to the requirements of the Contract Documents and shall in no way imply acceptance of the equipment.

1.2 INSPECTION

A. All panels, consoles and cabinets shall be inspected. Inspection shall include, but not be limited to, the following:

1. Nameplates and tags.
2. Wire sizes and color-coding.
3. Terminal block contact ratings and numbers.
4. Annunciator and terminal block spares.
5. Proper wiring practices and grounding.
6. Enclosure flatness, finish, and color.

1.3 SYSTEM HARDWARE OPERATIONAL TESTING

A. All input/output devices and components shall be tested to verify operability and basic calibration.

B. All system hardware components equipment shall be tested to verify proper operation of the equipment as standalone units. Test shall include, but not be limited to, the following:

1. AC/DC power checks.

2. Power fail/restart tests.

3. Diagnostics checks.

4. Test demonstrating that all specified equipment functional capabilities are working properly.

C. All system components shall be tested to verify that communication between units is working properly.

D. An integrated system test with all system equipment connected (excluding field sensors and instruments) shall be performed to verify that all equipment is performing properly as an integrated system.

1.4 SYSTEM SOFTWARE DEMONSTRATION

A. CONTRACTOR shall demonstrate all system software utility and security programs incorporated into the system to illustrate the various specified functions and capabilities.

B. CONTRACTOR shall demonstrate the operation and display of all software based on a simulation of ten percent of total input/output count, both analog and discrete, as selected by the manufacturer. In addition, OWNER shall randomly select, at the time of the test, additional inputs and outputs to be simulated in an amount approximately equal to ten percent of total input/output count. Demonstration shall show that the monitoring and control application software associated with the input/output points performs the functions intended.

C. System performance shall be tested using a fully integrated system, including all software and hardware, if applicable. To achieve this, the entire control system, including all the peripheral devices and all interconnecting cables, shall be assembled on the factory test floor and simulated inputs applied. CONTRACTOR shall carry out a full system test, during which the entire system shall operate continuously without failure in accordance with the requirements of the Contract Documents. CONTRACTOR shall provide process input/output simulation panel prior to the test:

1. Toggle switches to simulate field or other input contacts.

2. Indicating lights to simulate outputs from tested panels.

3. Control relays to simulate Motor Control Center coil inputs.

4. Time relays to simulate position switches.

5. Signals to indicate every 4 to 20mA DC output from tested panel.

6. Potentiometers to simulate 4 to 20mA DC inputs to tested panel.

7. Every device shall have nameplate with description and device's P&ID tag number. Nameplates shall be removable and interchangeable for multiple use of panel during the test.

D. Demonstration of communication between controller to remote I/O shall be included in the Test Procedure, where applicable.

E. Operator Interfaces: Prior to the staging and testing of the system, the display environments shall have been configured in accordance with the agreed upon display structure, loaded and data base parameters linked to the specified fields. During this phase of the factory acceptance

test, the overall display structure shall be demonstrated, including environment configurations, passwords, security, etc. The memo display contents shall be reviewed to demonstrate how an operator navigates within the overall display structure. Each graphic display shall be reviewed for correctness in terms of the layout, symbols, color scheme, etc. The operation of standard alarm management displays (Current Alarm Display, Alarm History, etc.) shall also be demonstrated.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 60 04 – PROCESS CONTROL SYSTEM GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown on the Drawings, specified and required to furnish, install, calibrate, test, start-up, commission and place in satisfactory operation a complete Computer Control System (CCS). CCS shall be as specified in Division 40 and as shown on the Drawings. The system includes, but is not limited to the following major equipment:

1. Computer Control System.
2. Instrumentation
3. Process and Local Control Panels.
4. Intermediate Termination Panels.

B. The CCS shall be designed to monitor, store, display, and log process, equipment operating information, alarms, and to perform various process control functions and generate various reports. The unit processes, which the CCS shall monitor, and control are shown on the Drawings and described herein.

C. Process and Instrumentation Diagrams (P&ID's), of this Section and the other Division 40 Sections, illustrate and describe the overall CCS functional and operational requirements.

D. SUPPLIER shall configure all computer control system software for the supplied CCS. However, CONTRACTOR shall be responsible for hardware configuration, loop testing of signals, and communications testing for new and modified existing control equipment through the Computer Control System under ENGINEER supervision.

E. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.

1. Section 01 78 23, Operation and Maintenance Data.
2. Section 40 60 06, Computer Control System Factory Testing.
3. Section 40 60 07, Process Control System Start-Up, Commissioning and Field Testing.
4. Section 40 60 08, Process Control System Training.
5. Section 40 60 52, Process Control System Primary Sensors and Field Instruments.
6. Section 40 60 65, Process Control System Panels and Enclosures.
7. Section 40 60 66, Process Control System Panel Instruments and Devices.

1.2 QUALITY ASSURANCE

A. General:

1. The CCS shall be furnished by a single Supplier who shall assume responsibility for providing a complete and integrated system.

2. All equipment, components and materials required shall be furnished by the single Supplier who shall assume the responsibility for adequacy and performance of all items.

3. The Supplier shall identify those system components, which are not of its manufacture.

4. The Supplier shall supply its company's Quality Assurance Plan, and for components which are not of its manufacture, the component manufacturer's Quality Assurance Plan. The plans shall include, but not necessarily be limited to: method of testing, raw material criteria, methods of documentation, station control, "Burn-In", final tests and serialization coding and packaging. Said plans shall be in accordance with M.I.L.-105D.

B. Supplier's Qualifications:

1. Be a financially sound firm having at least five years continuous experience in designing, implementing, supplying and supporting instrumentation and control systems, which are comparable to the CCS in terms of hardware, software, cost and complexity.

2. Have manufactured and supported standard lines of digital processing and control equipment and application software continuously for the last five years.

3. Have in existence at the time of bid advertisement, an experienced engineering and technical staff capable of designing, implementing, supplying and supporting the CCS and handling the CCS submittals and training requirements.

4. Provide system hardware components and software packages of fully developed, field proven standardized designs and therefore shall furnish a system, which is not a highly unique, custom one-of-a-kind system.

5. Have a minimum of two years experience in hardware application and programming of computer control systems and data highway systems.

6. Provide standard course offerings in general process control applications and in operation, programming and maintenance of the control system and equipment at a facility specifically utilized for training purposes. The facility shall have been in operation continuously for the last two years.

7. Have a thorough working knowledge of water treatment processes and control philosophy in accordance with standard practices of the water treatment industry.

8. Have a system of traceability of the manufactured units and purchased components through production, assembly and testing.

9. Have a system of "Burn-In" for all components and available supportive documentation.

10. Have a demonstrated record of prompt response to field failures.

11. Have a documented program of failure analysis.

12. Have a record of prompt shipments in accordance with contract obligations required for previous projects.

13. Shall have a warranty covering parts, spare parts and labor and in the case of microprocessor-based equipment and its appurtenances, a guaranteed availability clause.

14. Shall have proof of compliance with relevant NEC, OSHA, MIL, NRC, ISA, SAMA, NFPA, UL and API standards and all relevant state and local codes.

C. Technical Proposal Requirements: The apparent low, responsive, responsible Bidder shall submit to OWNER a copy of a Technical Proposal from the Supplier that has selected to provide the CCS. The Technical Proposal shall be submitted 30 days after the Notice to Proceed. The Technical Proposal shall be complete and contain all information as specified below:

1. Financial Statement: Include the value of computer control systems delivered during the last two fiscal years. Also, include the value of other process instrumentation and controls shipped during the period.

2. Experience:

   a. Provide evidence of compliance with the specific experience requirements listed in Paragraph 1.2.B., above, in the form of an experience certification signed by an officer of the company.

   b. Describe at least three completed municipal projects utilizing instrumentation and control equipment identical to or similar to (indicate which) that specified. Indicate owner, value, completion date, names and phone numbers of owner's representatives familiar with each project. Letters of recommendation may be submitted.

   c. Furnish list of last ten projects completed.

3. Personnel: Provide a listing of those personnel committed to be assigned to the Project. List shall include Project Manager, Project Engineer, field representative, local service representative, and sales representative. Indicate addresses of personnel not based at supplier's main office. Provide documentation including resumes of personnel demonstrating experience in water treatment applications.

4. Exceptions: List all exceptions and deviations from the requirements of the Specifications. Reference Section Number, Article, and Paragraph of proposed variance and provide an explanation of why the proposed substitution meets (or exceeds) the functional or equipment requirements specified.

5. Shipment Records: Provide evidence of timely delivery of equipment on past projects.

6. Computer Control System Hardware and Software:

   a. Provide a general system configuration drawing and include designations for model numbers and types of the proposed CCS and all other proposed system components.

   b. Provide descriptive literature and manufacturer's catalog information covering all aspects of the hardware design and software functions and capabilities of the specific CCS and data highway system proposed for the CCS.

7. Hardware and Software:

    a. Provide descriptive literature and catalog information covering the features and capabilities of all proposed hardware components.

    b. Describe standard software packages proposed, including any customized software required to meet the functional intent of the system Specifications. Descriptions shall address the following:

        1) Overview of system software including the functions, organization and interrelationship of the major software modules provided.

        2) Estimated UPS memory requirements to accomplish the specified graphic display, logging, reporting and alarming functional requirements.

            a) Examples of graphic displays, methods of display access and procedures for display definition and generation, including use of the standard symbols library and capabilities for generating and storing user defined symbols in the symbol library.

            b) Real-time data logging and reporting software features and capabilities including examples of logs and reports, procedures for automatic reporting and logging file setups, limitations on sampling and computing frequency for data acquisition and logging, and utilities for log file and report modifications and file maintenance.

            c) Alarm handling software features and capabilities including an alarm display example, methods of defining alarms and alarm files, automatic printing of alarms, acknowledgements and return to normal conditions, chronological sorting and time-tagging of alarms, and alarm file maintenance utilities.

            d) Use of system level diagnostics for monitoring the performance of and detecting and reporting faults associated with the communications data highway.

8. Instrumentation and Panel Mounted Devices: Provide descriptive literature and catalog cuts for each type of sensor, transmitter, indicator, and other such devices required by the Project.

9. Training: Provide information and literature as to the organization proposed and the factory facilities to be utilized for the training specified. Indicate the qualifications of the factory training staff.

10. Start-Up and Field Testing: Indicate how the Availability Demonstration will be accomplished.

11. Maintenance: Provide the following information:

    a. Location of service facility along with minimum and maximum response time.
    b. Location of parts facility with delivery time and method.

D. Operating Experience or Bonding Alternative:

1. The treatment facilities outlined in the Contract Documents, included herein, have been designed to meet stringent quality standards. OWNER and ENGINEER have selected and designed a CCS to provide effective monitoring and control for the treatment facilities required to meet these stringent quality criteria limitations. The criteria for selection of this system includes, but is not limited to, the following:

    a. The use of standard, "non-custom" equipment and application software.

    b. The ability of OWNER'S personnel to make modifications and adjustments in the field to react to actual field conditions.

    c. The ability of OWNER to obtain training of OWNER'S personnel in well established equipment manufacturer training programs.

    d. The availability of factory service and a well stocked spare parts inventory, which could be drawn upon by OWNER in emergency situations.

2. The requirements listed in Paragraph 1.2.B, above, include specific experience requirements. Should a Supplier lack the required five years experience, it will have the option of posting a performance bond in the amount of 100 percent of the system equipment price. This bond shall cover a period of time that a supplier is deficient from the five-year experience requirement. For example, if a Supplier has only two years experience, the Supplier must post, along with an experience certification signed by an officer of the company, a bond in the amount of 100 percent of the system equipment price for a period of three years following acceptance of the system by OWNER. The purpose of this bond shall be to indemnify OWNER against all losses incurred by reason of the failure of any system or equipment in any aspect of the quality standards required or intended by these Specifications. OWNER considers losses to include costs incurred to remove a defective system, modify structures as required, purchase and install replacement systems and costs involved with correcting, to OWNER'S satisfaction, all system and equipment deficiencies to the quality standards required and intended by these Specifications. The premium cost of this bond shall be included in the price bid for this equipment. The bond shall be in addition to any other bonds specified in the Contract Documents. All Suppliers lacking the total five years operating experience shall submit, as part of the specified Technical Proposal submittal, a copy of the bond from an acceptable surety along with a letter from the surety stating that it will issue the bond for the full value of the equipment price.

E. Supplier's Responsibility:

1. CONTRACTOR shall retain the CCS Supplier to undertake the responsibilities specified below. However, execution of these specified duties by the system supplier shall not relieve CONTRACTOR of the ultimate responsibility for the CCS.

    a. Design, fabrication, implementation and applications programming of the CCS and all subsystems in accordance with the Contract Documents and all referenced standards and codes.

b. Preparation, assembly and correction of all CCS submittals in accordance with the Contract Documents.

c. Proper interfacing of the CCS hardware, software, field devices and panels, including required interfacing with packaged control systems furnished by other equipment suppliers, and with the plant electrical system.

d. Supervision of the installation of CCS, instruments, panels, consoles, cabinets, wiring and other components required.

e. Calibration, testing, start-up and commissioning of the CCS.

f. Training of OWNER'S personnel in operation and maintenance of the monitoring and control system.

g. Handling of all warranty obligations for the control system components.

h. Maintenance of two reproducible copies of the complete system and running software at the Supplier's facility for the duration of the warranty period. Software copies shall be maintained on the bulk storage medium used by the Supplier for system program development and shall be directly loadable on the supplied system.

F. Reference Standards:

1. The following organizations have generated standards that are to be used as guides in assuring quality and reliability of components and systems; govern nomenclature; define parameters of configuration and construction, in addition to specific details in the Contract Documents:

a. ISA, The Instrumentation, Systems and Automation Society.
b. API, American Petroleum Institute.
c. UL, Underwriters' Laboratories, Inc.
d. AWWA, American Water Works Association.
e. NRC, Nuclear Regulatory Commission.
f. NEMA, National Electrical Manufacturers Association.
g. OSHA, Occupational Safety and Health Administration.
h. ANSI, American National Standards Institute.
i. MIL, Military Standards.
j. NFPA, National Fire Protection Association.
k. SAMA, Scientific Apparatus Manufacturers Association.
l. NFPA, National Fire Protection Association 79, Annex "D" Standards.
m. IEEE, Institute of Electrical and Electronic Engineers.
n. NEC, National Electrical Code, 1999.
o. FM, Factory Mutual.
p. Applicable local Process Control Standards.

1.3 COORDINATION AND PROGRESS MEETINGS

A. CONTRACTOR shall be responsible for scheduling and coordinating the system installation with regard to all other Work on the site and in accordance with the provisions of the General Conditions. Said coordination shall be documented on the Project Schedule.

B. Routine progress and coordination meetings will be scheduled by ENGINEER. CONTRACTOR and a representative of the system Supplier shall be required to attend two meetings each month.

C. The purpose of the meetings shall be to review the progress of the Work involving the CCS and provide coordination for installation of the equipment to ensure that the Project Schedule is met.

D. Representatives at the meetings shall have the competence and authority to make any and all necessary decisions. Decisions and statements made at the meetings shall commit CONTRACTOR and system Supplier to agreed procedures and schedules.

1.4 SYSTEM SUPPLIER PROJECT PERSONNEL

A. CONTRACTOR shall require the system Supplier to provide the following project personnel:

1. Project Manager:

a. The system Supplier shall appoint a Project Manager who shall coordinate and schedule all Work and assure that the Project Schedule is met.

b. The Project Manager shall act as the liaison with CONTRACTOR for the installation of the CCS equipment and shall assist in all matters required for proper coordination and interfacing of the equipment and processes.

2. On-Site Project Engineer:

a. System supplier to appoint a full-time, on-site Project Engineer to remain during the period from the system supplier's control panel installation through Final Completion of the Work.

b. Project Engineer to ensure control system installation remains on schedule and to communicate to the Project Manager where potential problems may arise.

c. Project Engineer shall assist the Field Engineer with loop testing and to ensure existing plant processes are not interrupted during testing.

3. Field Engineer:

a. The system Supplier shall appoint a Field Engineer with responsibilities as follows:

1) Provide advice and technical consultation relative to installation techniques and procedures for equipment furnished.

2) Installed system checkout, calibration, adjustment, start-up and commissioning, including tuning of every control loop.

3) Maintenance services during availability demonstration.

4) Involvement in the on-site system training of plant personnel.

5) Resolving of control problems encountered during initial start-up, testing and commissioning of all CCS equipment.

b. The Field Engineer shall have a minimum of five years experience in systems engineering and start-up and shall have a thorough working knowledge of both the hardware and software supplied for the CCS.

4. Training Personnel:

a. Comply with requirements of Section 40 60 08, Process Control System Training.

1.5 SUBMITTALS

A. Shop Drawings:

1. General:

a. Shop Drawing submittals are to be in accordance with the requirements of the Contract Documents.

b. Shop Drawing preparation shall not commence until after the Pre-Submittal Meeting specified below.

c. Manufacture of the CCS shall not commence until related submittals have been approved by ENGINEER.

d. Shop Drawings shall be submitted in complete packages grouped to permit review of related items as generally outlined in Paragraph 1.5.A.3., below.

e. Review of Shop Drawings will be for conformance with Contract Documents and with regard to functions specified to be provided.

2. Pre-Submittal Meeting:

a. CONTRACTOR shall arrange and conduct a Pre-Submittal Meeting on the CCS within 3 days of notification of preliminary acceptance of the proposed CCS and Supplier by OWNER and ENGINEER.

b. Pre-Submittal Meeting shall be attended by representatives of CONTRACTOR, OWNER, the CCS Supplier, and ENGINEER. CONTRACTOR shall allot one full eight hour day for the meeting and that time shall be included in the price of this Contract.

c. Purpose of the Pre-Submittal Meeting shall be to review informally and approve the manner in which the CCS Supplier intends to respond to the requirements of the Contract Documents before any submittals are prepared.

d. CONTRACTOR shall prepare the items listed below for presentation at the Pre-Submittal Meeting. The information shall be submitted to ENGINEER three weeks prior to the date of the meeting.

1) List of equipment and materials required for the CCS and the brand and model, which CONTRACTOR proposes to use for each item.

2) List of proposed exceptions to the Contract Documents along with a brief explanation of each. Approval shall be subject to a formal submittal.

3) Sample of each type of submittal specified herein. These may be submittals prepared for other projects.

4) A flow chart showing the steps to be taken in preparing and coordinating each control system submittal to ENGINEER, and a list of proposed submittals.

5) Bar chart type schedule for all CCS related activities from the Pre-Submittal Meeting through start-up, training and commissioning. Particular emphasis shall be given to dates relative to submittals, design, fabrication, programming, factory testing, deliveries, installation and field-testing. The schedule shall be subdivided to show activities relative to each major item or group of items when everything in a given group is on the same schedule.

6) General outline of the type of tests to be performed to verify that all sensors/transducers, instruments and digital processing equipment are functioning properly.

3. Submittal Requirements:

   a. Product information for all sensors/transducers and field and panel instruments. Include the following:

      1) Manufacturer's product name and complete model number.

      2) Instrument tag number from Contract Documents.

      3) Manufacturer's data sheets and catalog literature. Provide data sheets as shown in ISA-20-1981. For instruments not included in ISA-20, submit data sheets using a similar format.

      4) Description of construction features.

      5) Performance and operation data.

      6) Installation and mounting details, instructions and recommendations.

      7) Service requirements.

      8) Dimensions.

      9) List of recommended spare parts.

   b. Panels, Consoles and Cabinets Information:

      1) Layout Drawings, include the following:

      2) Front, rear, and internal panel views to scale.

      3) Dimensional information.

4) Tag number and functional name of components mounted in and on panel, console or cabinet.

5) Product information on all panel components.

6) Nameplate location and legend including text, letter size and colors to be used.

7) Location of anchoring connections and holes.

8) Location of external wiring and/or piping connections.

9) Mounting and installation details.

10) Calculations for cooling.

c. Wiring and/or piping diagrams, include the following:

1) Name of panel, console or cabinet.

2) Wiring sizes and types.

3) Piping sizes and types.

4) Terminal strip numbers.

5) Color coding.

6) Functional name and manufacturer's designation for components to which wiring and piping are connected.

7) Electrical control schematics in accordance with NFPA 79 Standards.

8) Plan showing equipment layout in each area.

d. Field wiring and piping diagrams, include the following:

1) Wiring and piping sizes and types.

2) Terminal strip numbers.

3) Color coding.

4) Conduits in which wiring is to be located.

5) Location, functional name and manufacturer’s designation of items to which wiring and/or piping are connected.

6) Point-to-point wiring diagrams.

7) Instrument loop diagrams for all analog display, control and I/O loops prepared using ISA standard symbols in accordance with ISA Standard S5.4, include the following:

8) Instrument tag numbers from Contract Documents.

9) Functional name of each item.

10) Manufacturer's model, product, or catalog number for each item.

11) Location of each item.

e. Process Control System I/O Loop Wiring Diagrams: Prepare drawings on a module-by-module basis and include the following information:

1) Rack numbers, slot number, module type and module terminal point numbers. Also, include location and identification of all intermediate panel and/or terminal block and strip numbers to which I/O wiring and power supply wiring is connected. Identify all power supply circuit numbers and ratings.

2) Wiring sizes, types, wire numbers and color-coding.

3) Designation of conduits in which field I/O wiring is to be run.

4) Location, functional name, tag numbers and manufacturer model numbers of panel and field devices and instruments to which I/O wiring and power supply wiring is connected. For discrete I/O devices use NFPA 79 electrical symbols tagged with designation shown on the Drawings.

f. Programmable Logic Controller Communication Registers: Listing of all contiguous register locations used in serial communications to the CCS.

B. System Operation and Maintenance Manuals:

1. Furnish Operation and Maintenance Manuals for the CCS in accordance with Section 01 33 04, Operation and MaintenanceManuals, and the supplemental requirements below.

2. The Operation and Maintenance Manuals shall include the following:

a. Name, address and telephone number of the control system Supplier's local service representative.

b. Complete list of supplied system hardware parts with full model numbers referred to system part designations, including spare parts and test equipment provided.

c. Copy of all approved submittal information and system Shop Drawings as specified herein with corrections made to reflect actual system as tested and delivered to the site for installation. Half-size black line reproductions shall be provided for all Shop Drawings larger than 11 by 17-inches.

d. Manufacturer's original copies of hardware, software, installation, assembly and operations manuals for control system components and peripheral devices. Manuals shall include the following information:

1) General descriptive information covering the basic features of the equipment.

2) Physical description covering layout and installation requirements and all environmental constraints.

3) Functional and operational descriptions covering the procedures for start-up, shutdown, and calibration of control system equipment and explaining how the various control functions are performed.

4) Principles of operation explaining the logic of operation; provide information covering operation to a component level.

5) Maintenance procedures covering checkout, troubleshooting, and servicing; checkout procedures shall provide the means to verify the satisfactory operation of equipment, troubleshooting procedures shall serve as a guide in determining faulty components and servicing procedure shall cover requirements and recommended time schedule for calibration, cleaning, lubrication and other housekeeping and preventive maintenance procedures.

6) As-built wiring, schematic and logic diagrams.

7) Safety considerations relating to operation and maintenance procedures.

C. Record Drawings and Documentation:

1. CONTRACTOR and CCS Supplier shall revise all system Shop Drawings, submittals and software documentation to reflect as-built conditions in accordance with the requirements of the Contract Documents and the supplemental requirements below.

2. shall be submitted to the ENGINEER to replace outdated drawings and documentation contained in the System Operation and Maintenance Manuals. Half-size black line sets shall be provided for all drawings larger than 11 by 17-inches. Specific instructions for outdated drawing removal and replacement shall be provided with the Record Drawing submittal.

3. Half-size black line prints of wiring diagrams applicable to each control panel shall be placed inside a clear plastic envelope and stored in a suitable print pocket or container inside each control panel.

D. Reports:

1. Two copies of the following reports shall be submitted to ENGINEER and OWNER:

a. Factory Test Reports if specified in Section 40 60 06, Computer Control System Factory Testing.

b. Installation Inspection, Field Calibration, and Field Testing Reports as specified in Section 40 60 07, Process Control System Start-Up, Commissioning and Field Testing.

1.6 EQUIPMENT DELIVERY, HANDLING AND STORAGE

A. CONTRACTOR shall make all arrangements for transportation, delivery and storage of the equipment and materials in accordance with the requirements of the Contract Documents, requirements of the system Supplier, and requirements of equipment manufacturers.

B. CCS equipment shall be packaged at the factory prior to shipment to protect each item from damage during shipment and storage. Containers shall be protected against impact, abrasion,

corrosion, discoloration or other damages. Clearly label contents of each container and provide information on the required storage conditions necessary for the equipment. Keep OWNER and ENGINEER informed of equipment delivery.

C. All equipment shall be handled and stored in accordance with manufacturer's instructions and relevant organization standards. Equipment shall be protected from weather, moisture and other conditions that could cause damage. Items that require a controlled environment for storage such as panels and microprocessor units shall be stored in a climate-controlled warehouse or facility. System Supplier shall notify CONTRACTOR, in writing, with copies to OWNER and ENGINEER of the storage requirements and recommendations for the equipment prior to shipment.

1.7 GENERAL DESIGN REQUIREMENTS

A. Power Supplies:

1. All electrically powered equipment and devices shall be suitable for operation on 115-volt, 10 percent, 60 Hz, 2 Hz power. If a different voltage or closer regulation is required, a suitable regulator or transformer shall be provided.

2. Appropriate power supplies shall be furnished by CONTRACTOR for all two wire transmitters, loops for monitoring discrete inputs and all necessary outputs. Power supplies shall be mounted in enclosures and installed in the appropriate control room or field panel.

3. Design all power supplies for a minimum of 130 percent of the maximum simultaneous current draw.

4. Furnish a power on-off switch or an air circuit breaker for each item requiring electrical power.

5. Provide isolation transformers, line voltage regulators and power distribution panels for the distributed digital portions of the CCS to eliminate electrical noise or transients entering on the primary power line.

B. Signal Requirements:

1. The control system shall be designed to use 4 to 20mA DC analog signals, unless otherwise specified.

2. Provide signal converters and repeaters, where required. In addition, analog inputs to the computer control system shall be through appropriate repeaters to provide signal isolation where series looped with other devices, and to allow the loop to maintain integrity even if the computer control system is out of service. Power supplies shall be sized adequately for signal converter and repeater loads.

3. Signals shall be isolated from ground.

4. Signals shall not have a transient DC voltage exceeding 300 volts over one millisecond nor a DC component over 300 volts.

5. The system and associated input/output wiring will be used in a plant environment where there can be high energy AC fields, DC control pulses, and varying ground potentials between the sensors/transducers or input contact locations and the system components. The system design shall be adequate to provide proper protection against interferences from all such possible situations.

C. Miscellaneous:

1. All instrumentation and CCS components shall be heavy-duty types, designed for continuous service in a municipal treatment plant environment. The system shall contain products of a single manufacturer, where possible, and consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and be capable of field expansion through the installation of plug-in circuit cards and additional cabinets as necessary. Design all logic and control loops to fail-safe.

2. All instrumentation and CCS components shall be designed to return automatically to accurate measurement within 15 seconds upon restoration of power after a power failure or when transferred to standby power supply.

3. Surge protection shall be provided for all instruments and all other CCS components, which could be damaged by electrical surges.

4. All field-mounted instruments and CCS components shall be designed for installation in humid and corrosive service conditions. All field mounted instrument enclosures and appurtenances shall conform to NEMA 4X requirements, unless otherwise specified.

5. All relays with interconnections to field devices shall be wired through terminal blocks. Terminals as part of the relay base are not an acceptable alternate.

6. All panel mounted instruments, switches, and other devices shall be selected and arranged to present a pleasing coordinated appearance. All front of panel mounted devices shall be of the same manufacturer and model line.

7. All components furnished, including field and rear of panel instruments, shall be tagged with the item number and nomenclature indicated on the Contract Documents and the Instrument Index.

8. Ranges and scales specified herein shall be coordinated to suit equipment actually furnished.

9. Field-mounted devices shall be treated with an anti-fungus spray.

10. Field-mounted devices shall be protected from exposure to freezing temperatures and shaded from direct sunlight.

D. Environmental Conditions:

1. The control system shall be designed and constructed for continuous operation under the following temperature and humidity conditions:

   a. Control Rooms:

      1) Ambient Temperature: 60°F to 80°F normal range; 40°F to 105°F occasional maximum extremes.

      2) Relative Humidity: 80 percent, normal; 95 percent maximum.

   b. Indoor locations for digital processing equipment hardware, control panels and instruments:

      1) Ambient Temperature: 40°F to 120°F.
      2) Relative Humidity: 98 percent maximum.

   c. Outdoor locations for instruments:

      1) Ambient Temperature: -10°F to 131°F.
      2) Relative Humidity: 100 percent maximum.

E. System Designs:

1. Range, scale and setpoint values specified in other Division 40, Instrumentation and Controls, Sections are for initial setting and configuration. Modifications to these values may be required based on actual equipment furnished, as necessary, to implement proper and stable process action determined as systems are placed in operation. These modifications shall be provided at no additional cost to OWNER.

2. For any items where ranges, scales and setpoints may not have been specified, CONTRACTOR shall submit a recommendation to ENGINEER for review.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 05 78 - MISCELLANEOUS VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes miscellaneous valves not included in other Sections for use in pump stations.

B. Section Includes:

1. Air release valves.
2. Combination air/vacuum valves.
3. Vacuum breaker washdown faucet.
4. Ball valves, 2 inches and under.

C. Related Sections:

1. Section 05 50 00, Metal Fabrications
2. Section 09 90 00, Painting and Coating
3. Section 33 11 10, Water Utility Distribution and Transmission Piping.
4. Section 40 05 13, Common Work Results for Process Piping.
5. Section 40 05 51, Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

3. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.

4. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

5. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

2. ASTM A536 - Standard Specification for Ductile Iron Castings.

3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 COORDINATION

A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

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

B. Product Data:

1. Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

2. Submit valve cavitation limits.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.

E. Lining and coating data.

F. Valve Labeling Schedule: Indicate valve locations and nametag text.

G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and actuators.
B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of Manufacturer's recommended spare parts.

B. Tools:

1. Furnish special wrenches and other devices required for Owner to maintain equipment.
2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.7 QUALITY ASSURANCE

A. Cast Manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Maintain clearances as indicated on Drawings.

E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

B. Store materials according to Manufacturer instructions.

1. Store materials in areas protected from weather, moisture, or other potential damage.
2. Do not store materials directly on ground.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.

3. Provide additional protection according to Manufacturer instructions.

D. Handle products carefully to prevent damage to interior or exterior surfaces.

E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 MUD VALVES

A. Not used.

2.3 SOLENOID VALVES

A. Not used.

2.4 AIR RELEASE VALVES

A. Description:

1. Inlet Size: 2-inch diameter and smaller.
2. Cast-iron body and cover. Comply with ASTM A126, Class B.
3. Stainless steel orifice and float. Comply with ASTM A240.
4. Design test pressure: 450 psig.

B. Manufacturers:

1. DeZurik - APCO or equal.

2.5 COMBINATION AIR/VACUUM VALVES

A. Description:

1. Construction: Two independent valves: one air/vacuum valve, one air release valve.
2. Inlet Size: Greater than 2-inch diameter.
3. Cast iron body and cover. Comply with ASTM A126, Class B.
4. Stainless steel orifice and float. Comply with ASTM A240.
5. Valves seats: Buna-N.

B. Manufacturers:

1. DeZurik - APCO or equal.

2.6 BLOW-OFF HYDRANT ASSEMBLIES

A. Not used.

2.7 FLAP VALVES

A. Not used.

2.8 SHEAR GATES

A. Not used.

2.9 VACUUM BREAKER WASHDOWN FAUCET

A. Description:

1. Interior installation wall faucet with vacuum breaker
2. ¾” male hose connection (ASME B1.20.7)

B. Manufacturer:

1. Zurn, Model Z1341 or equal.

2.10 BALL VALVES, 2 INCHES AND UNDER

A. Description:

1. Four hundred-pound. Water, oil, and gas rating (WOG) with bronze body and trim, unless otherwise shown on the Drawings.

2. Seat ring: Tetrafluoroethylene (TFE).

3. O-ring seals: Fluorocarbon.

4. Three-piece construction so that maintenance can be performed without distributing the valve body after installation.

B. Manufacturer:

1. Nibco T-590-Y or equal.

2.11 SOURCE QUALITY CONTROL

A. Testing Pressure-Reducing and Pressure-Sustaining Valves:

1. Leakage Testing:

a. Test each assembled valve hydrostatically at 1-1/2 times rated working pressure for minimum five minutes.

b. Test each valve for leakage at rated working pressure against closed valve.

c. Permitted Leakage: None.

2. Functional Testing:

a. Test each valve to verify specified performance.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install valves per Manufacturer requirements and recommendations.

B. Install all valves with valve seats level.

C. Install protective strainers upstream of solenoid valves, pressure-reducing valves, and pressure-sustaining valves.

3.2 ATTACHMENTS

A. Not used.

END OF SECTION

SECTION 43 21 00 - LIQUID PUMPS GENERAL

PART 1 GENERAL

1.1 SUMMARY

A. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated.

B. Where two or more pump systems of the same type or size are required, all pumps shall all be produced by the same Manufacturer.

C. Provide all labor, equipment and materials and perform all operations in connection with the installation and testing of pumps selected by the Owner.

D. Coordinate and utilize all factory testing, installation, start-up, and field-testing services supplied in conjunction with the pumping equipment.

E. All work performed under this Section shall be in accordance with all approved trade practices and Manufacturer's recommendations.

F. Section includes:

1. General pump material, components and appurtenances for liquid pumps.
2. Quality control factory and field testing.

G. Related Sections:

1. Section 03 30 00, Cast-in-Place Concrete
2. Section 09 90 00, Painting and Coating
3. Section 26 04 25, Variable-Frequency Motor Controllers
4. Section 40 05 78, Miscellaneous Valves
5. Section 43 21 13, Centrifugal Liquid Pumps
6. Section 40 05 13, Common Work Results for Process Piping
7. Section 40 05 13.13, Steel Process Pipe
8. Section 40 05 13.53, Ductile Iron Process Piping
9. Section 40 05 51, Common Work Results for Process Valves
10. Section 40 05 51.12, Ball Valves
11. Section 40 05 51.15, Gate Valves
12. Section 40 05 51.18, Butterfly Valves
13. Section 40 05 51.24, Check Valves
14. Section 43 23 13 Package Water Pump Station

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

2. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

3. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

B. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.
3. NSF 600 - Health Effects Evaluation and Criteria for Chemicals in Drinking Water.

C. Occupational Safety and Health Administration (OSHA):

1. 29 CFR 1910 - Occupational Safety and Health Standards.

1.3 COORDINATION

A. Not used.

1.4 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

A. Submit in accordance with Section 01 33 00, Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Provide the following information:

1. Pump name, identification number, and applicable Section number from Project specifications.

2. Performance Data Curves:

a. Provide performance curve showing head, capacity, horsepower demand, net positive suction head (NPSH) required and pump efficiency over the entire operating range of the pump.

b. Pump Manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions.

c. A family of performance curves at intervals of 100 revolutions per minute (rpm) from minimum speed to maximum speed shall be provided for each pump equipped with a variable speed drive, and a curve for each speed on two-speed pumps.

3. The limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration, known as the Acceptable Operating Range (AOR), per the Hydraulic Institute.

4. Assembly and Installation Drawings: Including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

C. Pump anchorage calculations and analysis. Seismic anchorage calculations shall be provided by a registered Engineer in the State of Arizona.

D. All pump motor information as required in Division 26, including complete motor nameplate data as defined by NEMA, motor manufacturer and any motor modifications.

E. Head lateral analysis as specified herein and where required by individual pump sections.

F. Provide lateral and torsional analysis as specified herein and where required by individual pump specifications.

G. Operation and Maintenance Manual: Containing the required information for each pump section.

H. Spare Parts List: Containing the required information for each pump section.

I. Factory Test Data: Signed, dated, and certified for each pump system which requires factory testing submitted before shipment of equipment. Requirements for factory test data are specified below.

J. Certifications:

1. Manufacturer’s certification of proper installation.
2. Contractor’s certification of satisfactory field testing.

K. All pump motor information as required in Divisions 26 and 43.

L. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

M. Qualifications Statements:

1. Submit qualifications for Manufacturer.
2. Submit Manufacturer's approval of installer.

N. Certificate of Compliance:

1. Submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. See Section 01 78 23, Operation and Maintenance Data for requirements.

1.7 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.
B. Perform Work according to NTUA standards.
C. Maintain 1 copy of each standard affecting Work of this Section on Site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by Manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00, Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection according to Manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. Furnish five-year Manufacturer's warranty for pumping systems.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials and equipment shall be standard products of a manufacturer and distributor regularly engaged in the manufacture and distribution of such products for at least [2] years and shall be suitable for the service intended.

B. All materials and equipment shall be new and unused except for the testing specified herein.

C. Compliance with the requirements of the individual pump sections may necessitate modifications to the Manufacturer’s standard equipment.

D. All centrifugal pumps shall have a continuously rising performance curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine or encroach on the service factor.

E. All components of each pump system provided under the pump sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

F. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond.

G. The pumps shall be warranted by the Manufacturer for a minimum of 1-year from the date of installation.

H. All materials and coatings coming in contact with potable water shall be ANSI/NSF Standard 61 approved.

I. The pumping units shall all be supplied by one vendor (unit responsibility) and shall be complete including pumps, motors, column assemblies, suction cans, baseplates, couplings, guards, and other accessories.

J. The complete pump assembly shall be designed and built for continuous service at any and all points within the specified range of operation, without overheating, without damaging cavitation, and without excessive vibration or noise.

2.2 MATERIALS

A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Casings, Class 30, or equal.

2. Stainless steel pump shafts shall be Type 416 or 316.

3. Miscellaneous stainless steel shall be of Type 316, except in a septic environment.

4. Anchor bolts, washers, and nuts supplied by the Contractor for non-corrosive applications shall be galvanized steel in accordance with the requirements of Section 05 50 00, Metal Fabrications. Anchor bolts, washers, and nuts in corrosive service applications shall be stainless steel in accordance with that Section.

2.3 PUMP COMPONENTS, GENERAL

A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 12, 125, 250, and 800 or B16.5 - Flanges and Flanged Fittings dimensions.

B. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.4 PUMP APPURTENANCES

A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and Manufacturer’s name and model number.

B. Gauges: Provide and install pressure gauges as shown on the Drawings.

1. All pumps (except sample pumps, sump pumps, hot water circulating pumps, and chemical metering pumps) shall be equipped with pressure gauges on the pump discharge.

2. Pump suction lines shall be provided with compound gauges.

3. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.

4. Isolation diaphragms shall be provided for all gauges except where pumping potable water.

5. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

2.5 SHAFT COUPLING GUARDS

A. Comply with OSHA requirements.

2.6 FINISHES

A. As specified in Section 09 90 00, Painting and Coating.

2.7 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Pump Systems: All centrifugal pump systems 100 horsepower (hp) and larger, and as specified in individual pump specification sections, shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) or the American National Standard for Vertical Pump Tests (ANSI/HI 2.6) as approved by American National Standards Institute (ANSI) and published by the Hydraulic Institute.

2. For motors smaller than 100 hp, the Manufacturer's certified test motor shall be acceptable. For motors larger than 100 hp, tests shall be performed using the complete pump system to be furnished, including the motor. The following minimum test data shall be submitted:

a. Hydrostatic test data.

b. A minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.

c. Pump test data curves showing head, flowrate, bhp, and efficiency. Acceptance level shall be Grade 1U as defined by ANSI/HI 14.6.

d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.

e. Mechanical test data per ANSI/HI 14.6 Appendix E, including testing for vibration, lack of leakage at shaft seals, gaskets and other lubricated areas, and satisfactory operation of rotating parts at the rated pump operating conditions.

f. Vibration test results meeting ANSI/HI 9.6.4 requirements.

3. Factory Witnessed Tests: Factory witnessed testing for this Project not required.

4. Acceptance: In the event of failure of any pump to meet any of the requirements, the Contractor and Pump Manufacturer shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be retested at no additional cost to the Owner until found satisfactory.

B. Lateral and Torsional Analysis

1. Where specified in the individual pump sections, the Pump Manufacturer with system responsibility shall perform a complete lateral and torsional analysis of each distinct pump-motor system to be provided on this Project.

2. This analysis shall identify the dry and wet lateral critical and the torsional critical speeds.

3. This analysis shall be performed prior to fabrication of the machinery and shall be submitted for review as part of the pump submittal.

4. The pump and motor manufacturers shall furnish detailed mass elastic data to the Engineer, to be used for an independent evaluation of the lateral and torsional natural frequency analysis.

5. Appropriate lateral and torsional critical speed maps shall be produced, and no active critical speed shall be allowed within 25 percent of the operating speed range. Any encroachment within that range shall be eliminated to the satisfaction of the Engineer.

C. Head Lateral Analysis

1. Where specified in the individual pump sections, the pump manufacturer with system responsibility shall perform a complete head lateral analysis of each distinct pump-motor system that analyzes the head and motor combination.

2. This analysis shall include a Finite Element Analysis (FEA) to determine the natural frequencies of the above grade head and motor assembly, assuming a rigid foundation. The analysis shall show that the natural frequencies do not encroach within plus or minus 25 percent of any normal operating speed.

D. Drive Units:

1. Test electric drive motors as specified in Division 26 and 43.

2. Test variable-frequency drives as specified in Division 26.

3. Perform tests using complete pump system to be furnished, including Project motor and variable-frequency drive, if specified above.

4. Furnish test results to Pump Manufacturer prior to pump testing.

E. Do not ship equipment until test data have been accepted by Engineer.

F. Owner Inspection:

1. Make completed pumping system available for inspection at Manufacturer's factory prior to packaging for shipment.

2. Notify Owner at least seven days before inspection is allowed.

G. Owner Witnessing:

1. Allow witnessing of factory inspections and test at Manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 SERVICES OF PUMP MANUFACTURER

A. As part of this construction contract, the Contractor shall utilize the full value of the Owner-acquired services for start-up and testing services from the Pump Supplier.

B. An authorized service representative of the Manufacturer shall visit the Site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

1. Installation of the equipment.

2. Inspection, checking, and adjusting the equipment.

3. Startup and field testing for proper operation.

4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.

5. Requirements are more specifically detailed herein and in individual pump specifications.

C. Instruction of the Owner’s Personnel:

1. An authorized training representative of the Manufacturer shall visit the Site to instruct the Owner’s personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment.

2. Instruction shall be specific to the models of equipment provided.

3. The Pump Manufacturer’s representative shall have at least 2 years’ experience in training.

4. Training shall be scheduled a minimum of 3 weeks in advance of the first session.

5. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the training materials.

6. The training materials shall remain with the trainees.

7. The Owner may digitally record the training for later use with the Owner's personnel.

3.2 EXAMINATION

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for installation examination.

B. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.3 PREPARATION

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for installation preparation.

B. Disconnect electrical systems scheduled for removal.

C. Provide temporary wiring and connections to maintain existing systems in service during construction.

D. Remove, relocate, and extend existing installations as necessary to accommodate new construction.

3.4 INSTALLATION

A. General: Pumping equipment shall be installed in accordance with the Manufacturer's written recommendations.

B. Alignment:

1. All equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects.

2. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing.

3. Equipment shall be secure in position and neat in appearance.

C. Equipment Bases and Supports:

1. Provide pump bases as shown on Drawings

2. Install anchor bolts and accessories for mounting and anchoring equipment.

3. Supports:

a. As specified and shown on drawings.
b. Brace and fasten with flanges bolted to equipment structure.
c. Provide flexible connections as required to isolate equipment from piping.

D. Lubricants: Provide the necessary lubricants for initial operation, as required by individual pump sections or as recommended by the Manufacturer.

3.5 FIELD TESTS

A. Engineer shall be notified of witness field testing and shall witness portions of the testing, as determined by the Engineer.

B. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings.

C. Test for proper alignment and freedom from binding, scraping, shaft runout, or other defects.

D. Field testing methods and allowable tolerances shall comply with current version of the Hydraulics Institute standards for the type of pumps installed.

E. The following field testing shall be conducted:

1. Startup, check, and operate the pump system over its entire speed range. Where vibration analysis and measurement are required, it shall be within the amplitude limits specified and recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.

2. Obtain concurrent readings of motor voltage, amperage, pump suction head and pump discharge head for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.

3. Determine bearing temperatures by contact type thermometer. A run time of at least 20 minutes shall precede this test unless insufficient liquid volume is available.

4. Electrical and instrumentation tests shall conform to the requirements of the Section under which that equipment is specified.

5. Field vibration readings shall be conducted by an Owner-selected certified testing agency, paid for by the Contractor, with readings taken at the following positions with the average not exceeding the current Hydraulic Institutes standards for the type of pump installed.

a. Measurements shall be taken at the locations as specified in the current Hydraulic Institute standards for the type of pump installed. Provide written proof of vibration readings and provide test data.

6. Sound test not to exceed 83 dbA at 3 feet from motor in any direction.

F. Field testing will be witnessed by the Engineer. The Contractor shall furnish 3 days' advance notice of field testing.

G. Equipment Acceptance:

1. Acceptance shall include a comparison of measured installed pump performance with the Manufacturer's curve values. Any discrepancy shall be resolved prior to acceptance by the Owner.

2. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests until the performance is verified.

3. Make final adjustments to equipment under direction of Manufacturer's representative.

4. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.

H. Contractor shall bear all costs of field tests, including additional services of the Manufacturer’s representative required beyond those specified.

3.6 DEMONSTRATION

A. Section 01 70 00, Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 43 05 20 - COMMON WORK RESULTS FOR LIQUID HANDLING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Lubrication.
2. Pump piping, fittings, and valves.
3. Piping connections.
4. Shaft coupling guards.
5. Accessories.

B. Related Sections:

1. Section 03 30 00 - Cast-in-Place Concrete: Equipment support (housekeeping) pads.
2. Section 09 90 00 - Painting and Coating: Product and execution requirements for painting specified by this Section.
3. Section 26 29 23 - Variable-Frequency Motor Controllers: Three-phase variable-frequency motor controllers of pulse-width-modulated design for variable-speed drives.
4. Section 40 05 13 - Common Work Results for Process Piping: Execution requirements for piping specified by this Section.
5. Section 40 05 13.13 - Steel Process Pipe: Steel piping materials and appurtenances.
6. Section 40 05 13.53 – Ductile Iron Process Piping: Ductile iron piping materials and appurtenances.
7. Section 40 05 51 - Common Work Results for Process Valves: Execution requirements for valves specified by this Section.
8. Section 40 05 51.12 - Ball Valves: Execution requirements for ball valves as required by this Section.
9. Section 40 05 51.15 - Gate Valves: Execution requirements for gate valves as required by this Section.
10. Section 40 05 51.18 - Butterfly Valves: Execution requirements for butterfly valves as required by this Section.
11. Section 40 05 51.24 - Check Valves: Execution requirements for check valves as required by this Section.
12. Section 40 05 78 - Miscellaneous Valves: Execution requirements for miscellaneous valves as required by this Section.
13. Section 43 23 13 – Package Skid-Mounted Water Pump Station.

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers:

1. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

2. ASME B1.20.2M - Pipe Threads, 60 deg. General Purpose (Metric).

3. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

4. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

B. NSF International:

1. NSF 61 - Drinking Water System Components - Health Effects.
2. NSF 372 - Drinking Water System Components - Lead Content.

C. Occupational Safety and Health Administration (OSHA):

1. 29 CFR 1910 - Occupational Safety and Health Standards.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
B. Coordinate Work of this Section with location and placement of utilities and piping.

1.4 PREINSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
B. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

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

B. Product Data:

1. Submit Manufacturer information for:

a. Drive assemblies, pumps, tanks, mixers, panels, and other major components.
b. Schematics, diagrams, panel layouts, ladder diagrams, and sequence of operation.
c. Electric motors and variable-frequency drives.

C. Shop Drawings:

1. Indicate assembly, foundation, and installation with location including critical dimensions, sizes, and support locations.

2. Characteristic Pump Curves: Plot against flow rate and indicate total dynamic head, pump efficiency, brake horsepower, net positive suction head, power input to motor, and [overall efficiency.

3. For multi-speed service, indicate characteristic curves for maximum and minimum speeds specified.

4. Submit pump name, identification tag number, and Specification Section number.

5. Submit elevation of local control panel, indicating panel-mounted devices, power single-line diagram, and input/output list.

6. Submit electrical schematic diagram and wiring diagram of field connections.

D. Manufacturer's Certificate:

1. Certify that pumping systems meet or exceed specified requirements.

2. Pumping Systems Rated Greater than 5 hp (3.7 kW):

a. Certify that pumping system has been installed satisfactorily and is ready for operation.
b. Indicate date of field tests and furnish test data.

E. Test and Evaluation Reports:

1. Performance Data Curves:

a. Indicate head, flow rate, power demand, net positive suction head (NPSH) required, and pump efficiency over entire operating range of pump.

b. Indicate head, power demand, overall efficiency at design, and maximum and minimum flow rates.

c. For variable-frequency-driven pumps, indicate performance at intervals of 100 rpm from minimum to maximum speed.

2. NPSH:

a. Indicate test results of NPSH required, as required by specific pump Section.
b. Otherwise, submit Manufacturer's NPSH calculation.

F. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statements:

1. Submit qualifications for Manufacturer.
2. Submit Manufacturer's approval of installer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Spare Parts:

1. Furnish one set of Manufacturer's recommended spare parts.

C. Tools: Furnish special tools and other devices required for Owner to maintain and calibrate pumping systems.

1.7 QUALITY ASSURANCE

A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.

B. Perform Work according to NTUA standards.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by Manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

C. Store materials according to Manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Provide additional protection according to Manufacturer instructions.

1.10 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.11 WARRANTY

A. Furnish five-year Manufacturer's warranty for pumping systems.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

A. Provide pumping systems designed and constructed for continuous service within specified range of operation, without overheating, cavitation, or excessive vibration.

2.2 LUBRICATION

A. Water-Lubricated Pumps: Provide flow meter and differential pressure switch to de-energize pumping unit in low-water-flow conditions.

B. Ball Bearings and Roller Bearing: Lubricate materials as recommended by Pump Manufacturer.

C. Lubrication Equipment: Provide pumps, piping, tankage, and filters as required to supply lubrication to pumping units.

2.3 PUMP PIPING, FITTINGS, AND VALVES

A. For piping, fittings, and valves furnished with pumps, comply with relevant Section referenced in this Section under "Related Requirements" Paragraph.

B. Drainage Piping:

1. Exposed Copper Tubing:

a. Support as required.
b. Provide cleanout plugs.

2. Buried or Concealed: Cast iron pipe with cleanouts.

3. Route drainage piping to nearest sink or floor drain.

2.4 PIPING CONNECTIONS

A. Flanges:

1. Comply with ASME B16.5.

B. Fasteners:

1. As specified in Section 05 50 00 - Metal Fabrications.

C. Screwed Fittings: Comply with ASME B1.20.1 (B1.20.2M).

2.5 SHAFT COUPLING GUARDS

A. Comply with OSHA requirements.

2.6 FINISHES

A. As specified in Section 09 90 00 - Painting and Coating.

2.7 ACCESSORIES

A. Nameplates:

1. As specified in Section 43 05 53 - Identification for Process Gas and Liquid Handling Equipment.

2. Identify individual pumps with a stainless-steel nameplate, indicating assigned equipment number, serial number, rated head and flow rate, impeller size, speed, and Manufacturer's name and model number.

B. Solenoid Valves:

1. As specified in Section 40 05 78 - Miscellaneous Valves.
2. Provide solenoid valves on water or oil lubrication lines and on cooling water lines.
3. Electrical Ratings: Compatible with motor control voltage.

2.8 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Drive Units:

1. Test electric drive motors as specified in Section 46 05 13 - Common Motor Requirements for Water and Wastewater Equipment.

2. Test variable-frequency drives as specified in Section 26 29 23 - Variable-Frequency Motor Controllers.

3. Furnish test results to Pump Manufacturer prior to pump testing.

C. Hydrostatic Testing:

1. Hydrostatically test each pump.

2. Provide Architect/Engineer minimum two weeks' notification prior to testing.

3. Tests of pumps of same model, speed, head, and capacity rating are acceptable if drive unit is rated at 5 hp (3.7 kW) or less.

4. Perform witnessed hydrostatic and performance tests on pumps where specified and on pumping systems rated at 125 hp (92 kW) or greater.

5. Test Pressure:

a. Centrifugal Pumps: Minimum 150 percent of shutoff head.
b. Positive Displacement Pumps: Minimum 150 percent of maximum head.

D. Performance Testing (Non-positive-displacement Pumps):

1. Test over entire operating range of pump; obtain measurements of head, flow rate, power demand, NPSH required, and pump efficiency.

2. Obtain measurements of head, maximum and minimum flow rates, power demand, and overall efficiency at design.

3. For variable-frequency-driven pumps, test pumps at intervals of 100 rpm from minimum to maximum speed.

4. Demonstrate that pump is free from overheating, cavitation, and excessive vibration overflow rate range.

5. For centrifugal pumps, demonstrate no contact between impeller ring and casing ring overflow rate range.

E. Performance Testing (Positive-Displacement Pumps):

1. Operate pump at least 30 minutes for each specified speed and capacity to demonstrate compliance with specified requirements and to establish that pumping unit is free from overheating and excess vibration.

2. Test pump at maximum rated speed and at minimum, rated, and maximum flow rates, and measure respective head and ampere draw.

3. For pumps with drive unit rated at 5 hp (3.7 kW) or less, test only for excess current draw.

F. Drive Units:

1. Perform tests using complete pump system to be furnished, including Project motor and variable-frequency drive [if specified].

2. For pumps with motors rated less than 100 hp (74 kW), Manufacturer's certified test motor is acceptable.

G. NPSH:

1. Perform test of NPSH required as required by specific pump Section.

H. Do not ship equipment until test data have been accepted by Architect/Engineer.

I. Owner Inspection:

1. Not used.

J. Owner Witnessing:

1. Not used.

K. Certificate of Compliance:

1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

2. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.2 PREPARATION

A. Disconnect electrical systems scheduled for removal.

B. Provide temporary wiring and connections to maintain existing systems in service during construction.

C. Remove, relocate, and extend existing installations as necessary to accommodate new construction.

3.3 INSTALLATION

A. According to Manufacturer instructions.

B. Ensure that equipment is secure in position.

C. Equipment Bases and Supports:

1. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported as indicated on Drawings.

2. Install anchor bolts and accessories for mounting and anchoring equipment.

3. Supports:

a. Provide specified supports as shown on drawings.
b. Brace and fasten with flanges bolted to equipment structure.
c. Provide flexible connections as required to isolate equipment from piping.

D. Provide rigid anchors for pipes after vibration isolation components are installed, as specified in Section 43 05 48 - Vibration and Seismic Controls for Process Gas and Liquid Handling Equipment.

E. Gauges:

1. Except for sump pumps, provide pressure gauges at pump discharge piping and compound gauges on pump suction piping.

2. If subject to shock or vibrations, wall-mount gauges or attach gauges to galvanized channel floor stands and connect with flexible connectors.

F. Lubricants: Provide necessary oil and grease for initial operation.

G. Coat materials and equipment as specified in Section 09 90 00 - Painting and Coating.

3.4 FIELD QUALITY CONTROL

A. Testing:

1. Test for proper alignment and freedom from binding, scraping, shaft runout, or other defects.

2. Where specified by individual Specification Section, field test equipment to demonstrate operation without undue noise, vibration, or overheating.

3. Engineer or NTUA representative will witness field testing.

4. Start control system by energizing system equipment and testing operation of hardware and process control logic under supervision of Manufacturer's representative and in presence of Engineer or NTUA representative.

5. Field-test each pump system after installation in order to demonstrate:

   a. Satisfactory operation without excessive noise and vibration overflow rate range; if pump driven by variable-frequency drive, test at 100-rpm increments.

   b. Required head, flow rate, and efficiency at design point.

6. Certify in writing that pump system has been satisfactorily tested.

B. Manufacturer Services: Furnish services of Manufacturer's representative experienced in installation of products furnished under this Section for not less than 1 day on Site for installation, inspection, startup, field testing, and instructing Owner's personnel in maintenance of equipment.

C. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

2. Make final adjustments to equipment under direction of Manufacturer's representative.

D. Furnish installation certificate from Equipment Manufacturer's representative attesting that equipment has been properly installed and is ready for startup and testing.

3.5 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 43 23 13 - PACKAGE SKID-MOUNTED WATER PUMP STATION

PART 1 GENERAL

1.1 SCOPE

The work shall consist of supplying and installing multi-pump packaged pump station units, complete with controls as defined by these specifications.

A. Contractor is responsible for making all necessary field measurements and coordinating with the packaged pump station manufacturer/supplier to provide a complete working pump station per these specifications and meeting defined layout confines on the Drawings. The layout of the prefabricated building defined on the Drawings are based on Grundfos CR vertical, multistage, centrifugal in-line pumps, and do not purport to show all the necessary measurements and details for installation. Contractor shall prepare their bid in close coordination with the packaged pump station unit manufacturer/supplier so that all components necessary for satisfactory operation are included in the bid. Contractor is responsible for the complete working operation of the proprietary installations.

B. The manufacturer/supplier shall furnish a factory assembled packaged water pump station. The packaged pump station shall be furnished and delivered to the site as a packaged unit.

C. Factory assembly of the package station shall include, but shall not be limited to, an epoxy coated steel base support system, pumps, motors, suction manifold, discharge manifold, shut-off valves, control valves, tank level sensors, separately mounted control panel (MCP), separately mounted or integrated variable frequency drives (VFD) and all needed appurtenances as shown on the Drawings.

D. All equipment specified in this Section shall be furnished by the Packaged Pump Station manufacturer/supplier.

E. In these specifications and on the accompanying Drawings, there is specified and shown material and equipment deemed most suitable for the equipment and service anticipated. Contractors shall prepare their bid on basis of particular equipment and materials that is specified.

F. After execution of contract, substitution of equipment of makes other than those named in the contract shall be considered if the equipment proposed for substitution is superior in construction and/or efficiency to that named in the contract and that high quality, low maintenance and satisfactory service have been demonstrated by at least 10 years of service in prefabricated booster installations.

1.2 EXPERIENCE REQUIREMENTS

A. The package skid-mounted water pump station shall be the product of a manufacturer who has the financial resources, technical qualifications, experience, organization and facilities adequate to design and manufacture package water pump stations of the constant pressure style.

The pump station shall be manufactured by:

Subject to conformance with the Contract Documents, the packaged pump station to be based on Grundfos vertical, multistage, centrifugal in-line pumps as assembled byGrundfos

B. Proof of experience shall be included in the submittal package and shall include facility locations, names and phone numbers of operators or persons familiar with system performance, dates of operation, number and size of pumps, and other pertinent information required by the ENGINEER.

C. Lack of required experience will be grounds for rejection of a submitted package water pump station.

D. The manufacturer of the specified equipment shall be regularly engaged in the manufacturing of packaged water boosters, packaged water control vaults, packaged water meter vaults and packaged sewage lift stations. The manufacturer shall have completed at least four prior successful installations of package skid-mounted constant pressure pump stations for public works applications similar in size and scope to the installation specified herein during the last five years.

1.3 DEFINITION OF TERMS AND RESPONSIBILITY

Packaged Pump Station Supplier: A manufacturer who supplies the factory assembled packaged water pump station. The factory built pump station includes all inherent systems as delineated in the plans and specifications. Packaged Pump Station Supplier shall provide start-up and training services to the OWNER's personnel and coordinate instrument and control testing and start-up with the ENGINEER.

A. Contractor: The Contractor shall prepare site and make all provisions for the installation of the packaged water pump station and provide all additional materials and work necessary and, thereby, satisfy all requirements specified herein. The Contractor is responsible for the site preparation, concrete slab foundation for the pump station, locating the site conduit and piping as it relates to the packaged water pump station. Contractor shall provide crane for offloading and placing the packaged water pump station and securing it to the slab. The Contractor is responsible for providing proper wiring and conduit to connect the electrical equipment provided by the packaged pump station supplier with the electrical equipment provided with the prefabricated building. The Contractor is also responsible for providing and/or installing additional electrical equipment in the prefabricated building as shown on the Drawings. Contractor shall be ultimately responsible for the performance of the packaged pump station.

B. The Contractor shall install the packaged water pump station and all other components and equipment as necessary to provide an operational pump station as specified herein and as shown on the Drawings.

C. The Contractor shall make all final power connections to all equipment provided under this and other sections.

D. The Contractor and Packaged Pump Station manufacturer/supplier shall participate in the field testing of all instrument and control equipment as specified herein.

E. The manufacturer/supplier is responsible for meeting the requirements of Section 33 05 96, Seismic Requirements for Non-Structural Components and Systems for the Packaged Pump Station, and coordinating with the Contractor on installation requirements.

1.4 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Codes and Standards - Comply with the provisions of the following codes, standards and specifications, except as otherwise shown and specified:

AISC - "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings", including "Commentary of the AISC Specifications"

AISC - "Specifications for the Design of Cold-Formed Steel Structural Members"

AWS - "Structural Welding Code"

IEEE – "Institute of Electrical and Electronic Engineers"

NEC – "National Electrical Code" with State and Local amendments

UL – "Underwriter's Laboratory"

B. Welding of Aluminum - Conduct in accordance with Section 10 of the "Specifications for the Design and Construction of Structural Supports for Highway Luminaries", AASHTO, 1971. Welding method shall be either gas tungsten arc or gas metal arc. Rods shall be 4043.

C. Shop Assembly - Pre-assemble items in the shop to the greatest extent possible, so as to minimize field assembly of units at the project site. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

D. Commercial Standards:

ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys

ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and other Special Alloys

ANSI/ASME B1.20.1 General Purpose Pipe Threads (Inches)

ASTM A 36 Specification for Structural Steel

NEMA ICS 6 1988 (Rev. 1) Enclosures for Industrial Control and Systems

NFPA 70 Current National Electrical Code

SSPC-SP1 Solvent Cleaning

SSPC-SP2 Hand Tool Cleaning

SSPC-SP3 Power Tool Cleaning

SSPC-SP6 Commercial Blast Cleaning

ASTM A 125 Hot Dipped Galvanizing

IEEE 519 Recommended Practices and Requirements for Harmonic Control in Electrical Systems

1.5 SUBMITTALS

The information listed below shall be submitted to the ENGINEER for review. The submittal shall, as a minimum, include the following data drawings and other descriptive materials.

A. AutoCAD shop drawings to describe and show booster pump station construction and materials.

B. Pump performance curves showing the head, capacity, speed, efficiency, NSPH, and brake horsepower required when operating at specified conditions. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each vertical, multistage, centrifugal in-line pumps pump. Each performance curve shall show a minimum of four points including shut-off head and maximum capacity.

C. The limits on the performance curves recommended for stable operation without surge, cavitation or excessive vibration.

D. Complete motor nameplate data as defined by NEMA, motor manufacturer and any motor modifications.

E. Information on all pump station equipment outlined by this specification.

F. Manufacturer experience as outlined in Section 1.2

G. Operations and maintenance manual

H. Manufacturer/supplier shall arrange for the services of a structural engineer registered in the State of Washington to design seismic restraint for packaged pump station equipment in accordance with Section 33 05 96 Seismic Requirements for Non-Structural Components and Systems and shall provide submittals in accordance with that Section.

1.6 QUALITY ASSURANCE

A. Pumping Station Responsibility and Coordination

1. The Package Pump Station Supplier shall be responsible for the adequacy and compatibility of all pumping station components. All components provided by the Package Pump Station Supplier should be designed, fabricated, tested, and installed by factory-authorized representatives experienced in the design and manufacture of the pumping station equipment specified herein.

2. The Package Pump Station Supplier shall coordinate the design of the pumping station such that all equipment is compatible and capable of achieving the performance requirements shown in drawings and specified herein.

B. Design Requirements

The pumping station arrangement shown on the Drawings is based upon the best information available to the ENGINEER at the time of design and is not intended to show exact dimensions peculiar to any specific equipment unless otherwise shown or specified. All necessary calculations and drawings for any related design shall be submitted to the ENGINEER for approval prior to beginning the work.

The booster pumps shall be designed to operate without cavitation or damaging vibration over the entire specified range of flow and head conditions. Booster pumps shall not produce undue noise or vibrations during reductions in flow from the specified operating capacity range to zero flow.

1.7 WARRANTY

The Contractor shall warranty the package pumping station to be of quality construction, free from defects in material and factory workmanship. The pump station support structure shall be warranted for a period of one (1) year to be free from defects, resistant to rust, corrosion, or physical failures occurring in normal service, when installed in accordance with the manufacturer's recommendations.

The interior equipment, pumps, motors, and apparatus shall be warranted for a period of one (1) year, excepting only those items normally consumed in service, such as light bulbs, oil, grease, gaskets, or O-rings. The Contractor shall be solely responsible for the pump station and all related components; warranties and guarantees by the suppliers of various components will not be accepted.

Major components which fail to perform as specified by the ENGINEER or prove defective in service during the warranty period shall be replaced, repaired, or satisfactorily modified by the Contractor without cost of parts or labor to the OWNER. After start-up service has been performed, labor to replace accessory items such as blowers, heaters, or other accessible and easily serviced parts, shall be the responsibility of the OWNER. Such components, parts, or repairs determined to have failed because of defects in workmanship or materials will be replaced or repaired F.O.B. factory or other designated location.

PART 2 PRODUCTS

2.1 GENERAL

The package water pumping station shall include pumps, valving and piping, MCC or VFD , control panel mounted separately, and other equipment specified in this Section. In case the MCC or VFD is included in the electrical and I&C design, coordinate with Electrical.

A. The package pump station shall be delivered to the jobsite requiring no additional fabrication or similar work, other than mounting on a concrete pad, connections to supply and discharge pipes, and electrical connections necessary for a fully functional unit. All piping and valving shall be designed for a minimum working pressure of 200 psi.

B. All materials and coatings coming in contact with potable or non-potable water shall be ANSI/NSF Standard 61 approved.

Maximum skid dimensions are as shown to fit in space as shown on Drawings, excluding suction/discharge pipe connections. All suction and discharge header centerlines shall be dimensioned as shown on the Drawings, with final suction/discharge pipe connection locations per final approved Packaged Pump Station submittal. Minimum spacing between equipment is shown on Drawings.

C. In the event the Contractor obtains Engineer's approval on equipment other than that which was specified, contractor shall, at Contractors own expense, make any changes in structures, buildings or piping necessary to accommodate equipment.

It will be assumed that cost to Contractor of equipment proposed to be substituted is less than that of the equipment in the contract, and if a substitution is approved, the contract price shall be reduced by an amount equal to savings.

2.2 STATION SUPPORT STRUCTURE

A reinforced fabricated steel base system shall provide rigid support and bracketing for the pumps, motors, suction manifold, discharge manifold, and all necessary appurtenances. Appropriate mounting holes shall be provided for attachments to a concrete pad. The base system shall be polyester polyurethane powder coated after fabrication. The base shall consist of a steel floor plate and reinforcing box beam, channel and flat as required. All steel members shall be joined by electric arc welding, with welds of adequate section for the joint involved. Where possible, all joints shall be welded on both sides of the base. These welds shall be continuous and watertight. Reinforcing members may be chain welded in an approved manner.

A. CORROSION PROTECTION: After all welding has been completed, all surfaces of the structure and piping shall be factory blasted to remove all rust, mill scales and weld slag. All weld spatter and surface roughness shall be removed by grinding. Surface preparation will comply with SSPC-SP10 specifications. The blast profile on the steel should be 1.5 to 2.5 mils in depth and be of a sharp, jagged nature. Surfaces must be free of grit dust.

Following the blasting procedure a final iron phosphate treatment will be completed to ensure total adhesion of the powder top coat.

The structure and other exposed metal shall receive 3-5 mils of Cardinal Industries P008-GR21 High Gloss Gray Polyester Polyurethane Powder Coating or approved equal.

A touch-up kit for powder coatings, as specified above, shall be provided for the coating of all field welds and for repair of any scratches or abrasions that have occurred during shipment or installation.

2.3 FABRICATED STEEL PIPE

Piping shall be steel and conform to material specification ASTM A-53(CW) for nominal pipe size 4-inch and smaller and ASTM A-53(ERW) Grade B for nominal pipe size 5 inches and larger. Steel butt-welding fittings shall conform to material specification ASTM A-234 Grade WPB and to the dimensions and tolerances of ANSI Standards B16.9 and B16.28 respectively.

Individual pump suction and discharge piping shall be sized by the manufacturer to suit the pumps provided, unless otherwise specified on the Drawings. All pipes shall terminate with connections as shown on the Drawings.

Forged steel flanges shall conform to material specification ASTM A-105 Class 60 and/or ASTM A-181 for carbon steel forgings and to the dimensions and tolerances of ANSI Standards B16.5 as amended in 1992 for Class 150 and Class 300 flanges.

The piping sizes shall be as shown on the Drawings

Size 2" or smaller – Schedule 40 316SS
Size 2.5"-10 inch - Schedule 40 Steel
Size 12" and larger – Standard Weight (.375" wall) Steel

The steel piping in the station shall be supported by rectangular, 3/8" (minimum) flat, or round tubing that shall be bolted to the steel floor and bolted to flanged joints in the piping system. The size of the welded pipe supports shall be determined by the Manufacturer. The welded / flanged joint connection shall allow for lateral and transverse pipe support while allowing for necessary restraint and ease of removal. Kick bracing shall be provided as necessary.

Suction and discharge header piping shall be fabricated utilizing the cut and cope technique to maintain smooth water flows and minimize hydraulic losses in the transition from the branch piping to the header piping. Under no circumstances shall any pump branch or bypass piping connections be made by cutting a hole in the pipe and welding in straight end or a non-coped branch take off. No protrusions from the branch into the header will be allowed.

A single, right angle outlet, smooth nose, sample tap shall be supplied for each suction and discharge header pipe. A standard hose bib with valve and vacuum breaker shall be provided on the pump station suction header piping.

A. CORROSION PROTECTION: After all welding has been completed, all surfaces of the structure and piping shall be factory blasted to remove all rust, mill scales and weld slag. All weld spatter and surface roughness shall be removed by grinding. The interior of all welded steel pipes shall be given a white-metal blast cleaning conforming to SSPC-SP5 by the pipe manufacturer and given the protective coating specified hereinafter. Exterior of "wet" exposure piping shall be prepared per SSPC-SP5, white metal blast. Exterior of "dry" exposure piping shall be prepared per SSPC-SP10, near white metal blast. Exterior coating to be as described below.

   The interior of the pipe shall receive a 4-8 mils dry coating of 3M Scotchkote 134 Fusion Bonded Epoxy or approved equal. The high solids powder coating shall be an advance technology Fusion Bonded epoxy coating and have exceptional corrosion protection. The coating shall be suitable for fresh water immersion and meet NSF 61 for pipes.

   The exterior of the pipe shall receive a 16 mils dry coating of 3M Scotchkote 134 Fusion Bonded Epoxy or approved equal. The high solids coating shall be an advance technology epoxy and have exceptional corrosion protection.

   A touch-up kit containing epoxy coatings, as specified above, shall be provided for the coating of all field welds and for repair of any scratches or abrasions that have occurred during shipment or installation.

2.4 PUMPS

A. General Requirements

The package water booster pump station shall contain vertical, multistage, centrifugal in-line pumps, mounted vertically. Each pump must have continuously rising performance curves to shut-off and be designed for continuous running duty. The pumps shall be Grundfos CRE vertical, multistage, centrifugal in-line pump or approved equal meeting the design conditions included in the drawings.

1. The package pump station minor losses shall be accounted for in the TDH for each of the by the package pump station manufacturer/supplier.

B. Pump Construction

1. All pumps shall be ANSI NSF 61 / NSF372 Listed for drinking water and low lead requirements.

2. The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region.

3. The pump shall be of an in-line vertical multistage design, with the suction and discharge ports located on the pump base at the same level on opposite sides of the pump base.

4. The pump head and base shall be cast iron conforming to ASTM A48, Class 30 for pumps producing equal to or less than 125 gpm nominal flow rate. The pump head and base shall be ductile iron conforming to ASTM A536 65-45-12 for pumps producing greater than 125 gpm nominal flow rate. The pump shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated flow or 1.5 times shut-off head, whichever is greater.

5. The impellers, intermediate chambers and outer sleeve shall be constructed from 304 stainless steel. The impellers shall be free from defects and must be accurately cast, machined and filed for optimum performance and minimum vibration.

6. The pump shaft shall be constructed from type 316 or type 431 stainless steel. It shall be precision ground and polished.

7. Shaft seal shall be a mechanical seal of the cartridge type. Bearing rings shall be silicon carbide. Rubber components shall be EPDM or FKM material.

C. Motors

1. Motors are to be provided with the following basic features:

    a. Motors shall be designed for continuous duty operation, NEMA design B with a 1.15 S.F.

    b. Totally Enclosed Fan Cooled Motors are to be furnished with minimum class F insulation.

    c. Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.

d. Open Drip Proof (ODP) motors shall have drip covers.

e. Motors over 50 lbs shall having lifting provisions.

f. Motors shall have a NEMA C-Flange for vertical mounting.

g. Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

h. Motors shall be standard premium efficiency for use with variable speed drives. Motors shall be suitable for 460 volts, 60 Hertz, 3 phase power. Motors shall be inverter ready.

2.5 VALVES

A. Actuators -- Unless otherwise indicated, all valves and gates shall be furnished with manual actuators. Valves in sizes up to and including six (6) inches shall have direct acting lever or handwheel actuators. Larger valves and gates shall have gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the handwheel. Actuators shall be sized for the valve design pressure in accordance with AWWA C504. All valves six (6) inches to 30 inches in diameter may have traveling-nut actuators, worm-gear actuators, spur- or bevel-gear actuators, as appropriate for each valve.

B. Butterfly Valves

Butterfly valves shall be lug style. Valves shall be oriented to close bubble tight. Butterfly valves shall be cast or ductile iron body, with BUNA-N seat, bronze disc, and stainless steel valve stem, and shall be drilled and tapped to 125# ANSI dimensions. Spools shall be provided as required to prevent butterfly interference with control valves, etc. Butterfly Valve shall be Bray Series 31H or equal.

C. Check Valves

Check valves shall be non-slam, full flow, silent check valve with cast iron ASTM A126 Class B body, seat and disc ASTM B584 Alloy C87600 cast bronze, a stainless steel spring ASTM A313 Type 316. Silent Check Valve shall be Val Matic Series 1400A/1400THR or approved equal.

D. Combination Air/Vacuum Valves

The air/vacuum valve shall be two (2) independent valves, an air/vacuum valve and an air release valve, combined in a dual housing designed to withstand 300 psi. The valve shall be designed to exhaust large volumes of air when filling the pipeline, to release small quantities of air during operation, and to admit large volumes of air upon impending vacuum during draining.

Body and cover materials shall be cast iron ASTM A126, Class B. Orifice floats and orifices shall be ASTM A240 stainless steel type 316. Valve seats shall be Buna-N. Combination air/vacuum valves shall be as manufactured by Val Matic 100S, or approved equal.

E. Pressure Relief Valve

Where required and shown on the drawings, a pilot controlled, hydraulically operated, diaphragm actuated pressure relief valve shall be installed off the discharge header to release excess pressure within the discharge header to the suction header. The pilot systems shall be equipped with shut-off cocks and Y-strainers. Pressure relief valve shall be 2" Cla-Val 50G-01BKC or approved equal, globe pattern, with 150# ANSI flanges. The valve shall include a fusion bonded internal and exterior coating.

F. Ball Valves

Ball valves 2 1/2 inches and under shall be 400 lb. WOG with bronze body and trim, TFE seat ring, and fluorocarbon O-ring seals. The valve shall be of three-piece construction so that maintenance can be performed without disturbing the valve body after installation. Valves shall be Nibco T-590-Y or approved equal.

2.6 HYDROPNEUMATIC DIAGPHRAM TANKS

Not used.

2.7 PRESSURE INSTRUMENTATION

Manufactured to provide 3/4" tap, isolation valve, reducers, 1/4" tubing to instrumentation elements, and Bronze, brass or stainless steel stop cocks shall be provided for removal of gauges without shutting the system off.

A. Pressure Gauges: Gauges will be 4.5" in diameter per ASME B40.100 and shall be graduated in psi. Rated accuracy will be ± .5% of full scale and the operating temperature shall be -40°F to +150°F. Additional error when temperature changes from referenced temperature of 60°F ±0.4% for every 18°F rising or falling (percentage of span). Standard features shall include a black fiberglass-reinforced thermoplastic case, black aluminum pointer, white aluminum with black lettering, dampened movement option, copper alloy C-type bourdon tube, copper alloy (0.6 mm) restrictor, copper alloy with 1/2" NPT lower mount pressure connection with M4 internal tap and be weather resistant (NEMA 3 / IP54).

The 1/2" high pressure ball isolation valve standard features shall include a one piece brass body (UNI 5705-65), PTFE self-lubricating seats with flexible-lip design, double seal system to all the valve to be operated in both directions, chrome plated brass ball, blowout-proof brass stem with Viton O-ring, nylon black wedge handle that clearly shows ball position, and NPT taper ANSI

B. Pressure Transducers

See Electrical Section 40 60 52 for pressure transmitters.

2.8 PRESSURE SWITCH

A. Coordinate with Electrical Section 40 60 52.

2.9 TANK LEVEL INSTRUMENTATION

A. Not used.

2.10 INTRUSION SWITCH

A. Not used.

2.11 INTRUSION DETECTION SYSTEM

A. Not used.

2.12 ALARM DIALER

A. Not used.

2.13 CELLULAR RADIO

A. Not used.

2.14 SMOKE DETECTOR

A. Not used.

2.15 ELECTRICAL PUMP CONTROL REQUIREMENTS

A. Not used. See Electrical and Process Integration.

2.16 CONTROL NARRATIVE

A. See Section 40 60 51 Process Control System Process Control Descriptions

PART 3 EXECUTION

3.1 FACTORY TESTING

The package system shall be tested with water at the manufacturer's factory for leaks in the pumps and piping, excessive vibration, correct operation of all electrical appurtenances, and to ensure that all of the pump controls are operating properly. These tests shall, as closely as shop conditions permit, simulate field design conditions as specified under OPERATING CONDITIONS. Pump shall be tested, to ensure compliance with it's published head-capacity curve and insure full pumping capability. As applicable, pump tests shall include motor running amperage checks, at the design conditions, shut-off and other points along the curve, insuring non-overloading performance and pump efficiency.

A. The following tests shall be conducted on the assembled packaged pump system

1. Piping and valving --After the station piping and valves have been manufactured, the station piping system, including pumps, piping, fittings and all valves that make up the entire station piping shall be first tested with air to test for leaks. High-pressure air shall be pumped into the piping system and a soap solution shall then be sprayed on any welded joints for leak indication. After final assembly of the pumps, piping and valves, the entire

system shall be hydrostatically tested to test for leaks at all joints, connections and weld seams. Any deficiencies found during the air test or the hydrostatic test shall be repaired, and the system shall be retested.

2. Pump Systems -- The pump shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) as approved by ANSI and published by the Hydraulic Institute. Tests shall be performed using the complete pump system to be furnished, including the motor. For motors smaller than 100 hp, the manufacturer's certified test motor shall be acceptable. The following minimum test data shall be submitted:

    a. Hydrostatic test data

    b. A minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.

    c. Pump curves showing head, flow, bhp, efficiency and NPSH requirements.

    d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.

3.2 PACKAGED PUMP STATION

A. The Contractor shall furnish, install, test, and adjust the complete packaged pump station, consisting of the pumps, controls, and manifolds mounted on a base.

B. When the station plumbing is completed, the pressure piping within the station (including valves, pumps, control valves, and fittings), connections as make up the entire system shall be hydrostatically tested at a pressure of 250 psi or a pressure equal to the lowest test pressure rating of the equipment within the tested system, whichever is lesser pressure. The test pressure shall be applied for a minimum of 20 minutes, during which time all joints, connections and seams shall be checked for leaking. Any deficiencies found shall be repaired and the system shall be retested.

C. The results of this testing shall be transmitted in writing to the ENGINEER prior to shipment of the station and shall note test pressure, time at full pressure and be signed by the Quality Control Manager or test technician.

D. Anchors for the unit shall be set in the concrete slab, and the unit shall be mounted to the pad as instructed by the manufacturer. The manufacturer shall supervise installation to ensure that the unit is properly aligned and leveled, that all electrical and water connections are properly made, and that lubricants have been provided and installed.

E. Do not field cut, drill, bond, and weld or alter structural members without approval from manufacturer and ENGINEER.

3.3 SERVICES OF MANUFACTURER

A. An authorized service representative of the manufacturer shall visit the project site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted and readied for operation:

1. Installation of the equipment

2. Inspection, checking and adjusting the equipment

3. Startup and field testing for proper operation

    a. All pumps and equipment shall be field operated and signed off of by manufacturer in the presence of the Owners Representative.

4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.

    a. Field verification and checking of proper pump alignment and balance.

5. Copy of modifications to pump control PLC program (if applicable)

The manufacturer shall provide the services of a service representative for minimum of 16 hours.

B. Instruction of the Owner's Personnel

1. An authorized training representative of the manufacturer shall visit the project site to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

2. The representative shall have at least two year's experience in training.

3. Training shall be scheduled a minimum of three weeks in advance of the first session.

4. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

5. The training materials shall remain with the trainees.

6. The Owner may videotape the training for later use with the Owner's personnel.

The manufacturer shall provide the services of a service representative for minimum of 8 hours.

C. Certifications

1. Certification that the pumping station is fully in conformance with the requirements described and depicted in these Contract documents

2. Manufacturer/ Package Pump Station Supplier's certification of proper installation

3. Certified factory test data

4. Contractor’s certification of satisfactory field testing

END OF SECTION