

DIVISION 1
GENERAL REQUIREMENTS - STREETSCAPE

1.01 DESCRIPTION

- A. Work Specified Herein and Elsewhere
 - 1. This Section includes:
 - a. Summary of work.
 - b. Coordination.
 - c. Cutting and patching.
 - d. Abbreviations and symbols.
 - e. Preconstruction meeting.
 - f. Submittals.
 - g. Quality control.
 - h. Construction facilities and temporary controls.
 - i. Materials and equipment.
 - j. System startup.
 - k. Testing, adjusting, and balancing systems.
 - l. Contract closeout.
 - 2. Related work specified elsewhere includes:
 - a. Measurement and payment - Division 1.
 - b. Manufacturer's services - Division 1.

1.02 SUMMARY OF WORK

- A. Work Covered by Contract Documents
 - 1. The work to be performed under this Contract consists of the construction of Highland Street Streetscape Project. Perform all work in accordance with the Contract Documents. Furnish all materials, equipment, tools, and labor which is reasonably and properly inferable and necessary for the proper completion of the Work, whether specifically indicated in the Contract Documents or not.
 - 2. All fees and permits for the permanent construction which are required by controlling agencies or authorities, including fees for the review of Contract Documents prior to construction, will be procured by the Owner. Other licenses or permits for construction facilities of a temporary nature which are necessary for the prosecution of the work shall be secured and paid for by the Contractor.
- B. Contracts
 - 1. Construct the Project under a single Lump Sum Contract.
- C. Work Included in This Project
 - 1. The project generally includes the construction of streetscape, hardscape, landscaping and irrigation as required to provide a complete project.
 - 2. In addition, repair, replace, or otherwise settle with the Owner, if damage to property or existing facilities occurs, including damage to pavements, utilities, lawns, structures, etc.

- D. Work Sequence
 - 1. Perform work in the sequence indicated on the Drawings, or the sequence agreed to in the preconstruction conference and as shown on the Contractor's latest schedule, as approved by the Engineer prior to construction.
- E. Contractor Use of Premises
 - 1. Confine operations at the site to areas permitted by applicable laws, ordinances, permits, and by the Contract Documents. Do not unreasonably encumber the site with materials or equipment. The Contractor shall assume full responsibility for protection and safekeeping of products stored on the job site. Contractor shall ensure that his work does not impede the normal operations of the facility and that any interruption to normal operations are coordinated with the Owner and Engineer.

1.03 COORDINATION

- A. The Contractor shall be fully responsible for the coordination of his work and the work of his employees, subcontractors, and supplier and to assure compliance with schedules.
- B. The coordination requirements of this Section are in addition to the requirements of the General and Supplementary Conditions of this document.

1.04 CUTTING AND PATCHING

- A. Cutting and patching for inspection and testing shall be as specified in the General Conditions.
- B. The Contractor shall, at no additional expense to the Owner, perform cutting and patching necessary to the completion of the Project. Perform cutting and patching in a manner to prevent damage to the structure or previously completed work.
- C. Refinish surfaces as necessary to provide an even finish. Refinish continuous surfaces to the nearest intersection.

1.05 ABBREVIATIONS AND SYMBOLS

- A. Referenced Standards
 - 1. Any reference to published specifications or standards of any organization or association shall comply with the requirements of the specification or standard which is current on the date of Advertisement for Bids. In case of a conflict between the referenced specifications or standards, the one having the more stringent requirements shall govern.
 - 2. In case of conflict between the referenced specifications or standards and the Contract Documents, the Contract Documents shall govern.
- B. Abbreviations
 - 1. The following are definitions of abbreviations used within the Project Manual:
 - a. AA - Aluminum Association
 - b. AASHTO - American Association of State Highway and Transportation Officials
 - c. ACI - American Concrete Institute
 - d. ANSI - American National Standard Institute

e.	ASTM	-	American Society for Testing and Materials
f.	AWS	-	American Welding Society
g.	AWWA	-	American Water Works Association
h.	CRSI	-	Concrete Reinforcing Steel Institute
i.	Engineer	-	Engineer and/or Architect
j.	FS	-	Federal Specifications
k.	NEC	-	National Electrical Code
l.	NECA	-	National Electrical Contractors' Association
m.	NEMA	-	National Electrical Manufacturers Association
n.	NSF	-	National Science Foundation
o.	OSHA	-	U.S. Department of Labor, Occupational Safety and Health Administration
p.	PS	-	United States Products Standards
q.	STD, SPEC.	-	Applicable State Department of Transportation Standard Specifications for Road and Bridge Construction
r.	SSPC	-	Structural Steel Painting Council
s.	UL	-	Underwriter's Laboratories, Inc.

1.06 PRECONSTRUCTION MEETING

- A. The Engineer shall schedule a preconstruction meeting prior to beginning the Work to review shop drawing procedures, construction methods, and to establish a construction and payment schedule.

1.07 CONSTRUCTION SCHEDULES

- A. Contractor shall submit a schedule of operations to the Engineer for approval prior to any construction operations and inform the Engineer of any changes in the schedule. Schedule is to be updated monthly and provided to the Engineer and Owner.

1.08 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

- A. Shop Drawings
1. Shop drawings are original drawings, prepared by the Contractor's subcontractor, supplier, or distributor, which illustrate some portion of the Work; showing fabrication, layout, setting, or erection details.
 2. Shop drawings shall be prepared by a qualified detailer and shall be identified by reference to sheet and detail numbers on the Contract Drawings. Reproductions for submittal shall be full size opaque diazo prints or other print acceptable to the Engineer. Reduced size prints will not be reviewed nor approved.
- B. Product Data
1. Product data are manufacturer's standard schematic drawings and manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts illustrations, and other standard descriptive data.
 2. Standard drawings shall be modified to delete information which is not applicable to the project and supplemented to provide additional information applicable to the project.
 3. Catalog sheets, brochures, etc., shall be clearly marked to identify pertinent materials, products, or models.

C. Samples

1. Samples are physical examples to illustrate materials, equipment, or workmanship and to establish standards by which work is to be evaluated.

D. Contractor's Responsibilities

1. Prior to submission, the Contractor shall thoroughly check shop drawings, product data, and samples for completeness and for compliance with the Contract Documents and shall verify all dimensions and field conditions and shall coordinate the shop drawings with the requirements for other related work.
2. The Contractor's responsibility for errors and omissions in submittals is not relieved by the Engineer's review of submittals.
3. The Contractor shall notify the Engineer, in writing at the time of submission, of deviations in submittals from the requirements of the Contract Documents. The Contractor's responsibility for deviations in submittals from the requirements of the Contract Documents is not relieved by the Engineer's review of submittals, unless the Engineer gives written acceptance of specific deviations.
4. Begin no work which requires submittals until return of submittals with Engineer stamp and initials or signature indicating the submittal has been reviewed.

E. Submission Requirements and Engineer Review

1. Submit six (6) prints of each shop drawing. Submit at least six (6) copies of product data. Submit the number of samples indicated in the individual Specification Sections.
2. Shop drawings, product data, and samples shall be submitted by the Contractor to the Engineer. Submittals shall be properly identified with the name of the project, dated, and each lot submitted shall be accompanied by a letter of transmittal referring to the name of the project and to the specification page number and/or Drawing number for identification of each item. Submittals for each type of work shall be numbered consecutively, and the numbering system shall be retained throughout all revisions.
3. Submittals shall bear the Contractor's stamp of approval certifying that they have been checked and indicate appropriate specification section and/or drawing location. Submittals without the Contractor's initialed or signed certification stamp and submittals which, in the Engineer's opinion, are incomplete, contain numerous errors or have not been properly checked, will be returned unchecked by the Engineer for resubmission.
4. The Engineer will review submittals with reasonable promptness. The Engineer's review of submittals shall not be construed as a complete check and shall not relieve the Contractor from responsibility for complete compliance with the Contract requirements. No corrections, changes, or deviations indicated on Submittals reviewed by the Engineer shall be considered as a change order.
5. If a submittal is acceptable, the Engineer will retain three (3) sets of prints and return the remaining prints to the Contractor. If the submittal is not satisfactory, one set of prints will be retained by the Engineer and the remaining prints returned to the Contractor for appropriate action.
6. In the event a third submittal is required, due to previous submittals of incomplete or incorrect data or not in compliance with the Contract Documents, the Contractor will be charged one-half of the cost incurred by the Engineer for the review of the third

submittal. The Contractor shall bear the total cost incurred by the Engineer for all subsequent reviews. The Engineer costs charged to the Contractor will be at the cost plus rate generally charged by the Engineer and will be deducted by the Owner from payments due to the Contractor.

7. Distribution of copies of acceptable submittals will be as mutually determined by the Contractor, Owner, and Engineer on an individual item basis during or following the preconstruction conference.

E. Record Drawings

1. As the Work progresses, the Contractor shall mark on a set of Contract Documents all changes from the Contract Documents.
2. Mark on the Contract Drawings all changes in direction and location of structure, piping, equipment, electrical, and mechanical work.
3. Mark on the Specifications the manufacturer, trade name, catalog, and supplier of each product actually installed, and mark changes made by Change Order or Field Order.
4. At the completion of the Work, deliver the record documents to the Engineer, in good condition and free from any extraneous notation, signed and sealed by a Professional Surveyor and Mapper.

1.09 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall be responsible for obtaining installation, operation, and maintenance manuals for each equipment item from manufacturers and suppliers. Submit five (5) copies of manuals to the Engineer within 30 days after approval of shop drawings, product data, and samples but not later than the date of shipment of each item of equipment to the project site whichever comes first. Manuals shall be bound in three-ring binders, divided into individual equipment sections.

- B. The manual shall contain the following:

1. Manufacturer's identification, including order number, model , and serial number and manufacturer's representative contact information such as phone number and address.
2. Spare parts list, a list of recommended stock of parts, and location of parts and service centers.
3. Performance data and rating tables.
4. Specific instructions for installation, operation, adjustment, and maintenance.

1.11 QUALITY CONTROL

- A. Laboratory Testing Services

1. Except where specified in individual Specification Sections, the Contractor will employ and pay for an independent testing laboratory to perform specified testing services.
2. The Contractor shall notify the laboratory sufficiently in advance of operations to allow scheduling of tests. The Contractor shall furnish casual labor and facilities to obtain and handle samples at the site and to store and cure test samples as required.

3. Any testing laboratory utilized by the Contractor shall be an independent laboratory acceptable to the Owner and the Engineer and complying with the latest edition of the "Recommended Requirements for Independent Laboratory Qualifications", published by the American Council of Independent Laboratories.
4. Testing laboratories, whether provided by the Owner or the Contractor, shall promptly notify the Engineer and the Contractor of irregularities or deficiencies of work which are observed during performance of services. Laboratories shall submit two (2) copies of all reports directly to the Engineer and two (2) copies to the Contractor.

B. Testing of Materials

1. Unless otherwise specified, all materials shall be sampled and tested in accordance with the latest published standard methods of ASTM in effect at the time bids are received. IF no ASTM Standards apply, applicable standard methods of the Federal Government or of other recognized agencies shall be used.
2. The Contractor shall not make use of or incorporate in the work, the materials represented by the sample until tests have been made and the material found to be in accordance with the requirements of the Specifications.
3. Materials to be tested and the applicable test procedure shall be as outlined in the individual sections of these Specifications.

C. Source and Quality of Materials and Equipment

1. The source of materials to be used shall be in accordance with the Contract Documents and as approved by the Engineer before delivery. The approval of the source of any material shall continue as long as the material conforms to the Specifications.
2. All material not conforming to the requirements of the Specifications shall be considered as defective and shall be removed from the work. If in place, faulty materials shall be removed by the Contractor at his expense and replaced with acceptable material unless permitted otherwise by the Owner. No defective materials which have been subsequently corrected shall be reused until approval has been given.
3. Upon failure of the Contractor to comply immediately with any order of the Engineer to remove and replace defective material, the Owner shall have authority to remove and replace defective materials, and to deduct the cost of removal and replacement from any monies due or to become due to the Contractor. Failure to install shall in no way prevent later rejection when such defects are discovered, nor obligate the Owner to final acceptance.

1.12 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

A. Responsibility

1. All construction facilities and temporary controls remain the property of the Contractor establishing them and shall be maintained in a safe and useful condition until removed from the construction site.

B. Temporary Electric Service

1. Furnish and maintain temporary lighting and power required to perform the work. Include in the Bid all costs for providing temporary electrical service and pay for all temporary power used.

2. Temporary service shall include protective enclosures, branch wiring, outlets, lamps, and grounding as required by NEC and Local Electrical Codes.
- C. Temporary Heating
1. The Contractor shall furnish fuel or power and provide and operate all temporary heating units. Heat shall be provided as necessary to perform the Work. Temporary heating units shall be adequately vented and approved devices which will not damage finished areas. The Contractor shall also furnish all tarpaulins and temporary enclosures necessary to provide this protection.
- D. Temporary Ventilation
1. The Contractor shall provide, operate, and furnish power for temporary ventilation required for the proper installation and curing of materials and safety of workmen.
- E. Temporary Telephone
1. The Contractor shall provide and maintain a telephone with a loud outside bell at his job office. The Contractor shall pay for all local calls; toll calls shall be paid for by persons making such calls.
 2. The Contractor shall include in his Bid and pay for all telephone company hookup costs, connection charges, service fees, etc., required for the connection of the automatic telephone dialer system.
- F. Temporary Water
1. Provide a temporary water distribution system for all construction purposes and pay for all water used.
 2. Furnish potable drinking water in suitable dispensers and with cups for use of all employees at the job.
 3. Provide all temporary piping, hoses, etc., required to transport water to the point of usage by all trades.
 4. When the permanent water supply system has been installed, it may be used for construction purposes, provided the Contractor pays for all water until acceptance by the Owner.
- G. Temporary Sanitary Facilities
1. Provide temporary toilet facilities as required. Maintain these during the entire period of construction under this Contract for the use of all construction personnel on the job. Enough chemical toilets shall be provided to conveniently serve the needs of all personnel. Chemical toilets and their maintenance shall meet the requirements of State and local health regulations and ordinances.
- H. Temporary Pumping and Site Drainage
1. The Contractor shall keep the site free from water at all times to permit continuous access and to prevent damage to the work.
- I. Material Hoists and Cranes

1. Provide material hoists required for normal use by all trades and employ skilled hoist operators. Provide all necessary guards, signals, safety devices, etc., required for safe hoist operation. The construction and operation of material hoists shall be in accordance with the applicable ANSI Standards, the "Manual Code of Accident Prevention in Construction" of the Associated General Contractors of America, OSHA, and of other Federal, State, and Municipal Codes or Ordinances. The Contractor shall prohibit the use of hoists for transporting personnel. Hoists shall be located to avoid risk of damage to completed work.
2. Special rigging and hoisting facilities shall be provided by each trade requiring their use.

J. Temporary Runways, Scaffolding, and Ladders

1. Provide temporary ladders, ramps, and runways as required for performance and inspection of the work. The above facilities shall be constructed and maintained in accordance with the applicable Federal, State, and Municipal Regulations and Codes.
2. Furnish, erect, and maintain all scaffolding required for this work. Scaffolding shall be constructed and maintained in accordance with applicable State and Federal laws and local ordinances. Scaffolding shall be promptly removed after serving its purpose.
3. The structural strength and safety of scaffolding, runways, covers, railing, ladders, stairs, etc., and compliance with law shall be the sole responsibility of the Contractor.

K. Temporary Chutes

1. No materials shall be dropped from structures except through enclosed wooden or metal chutes which shall be performance of the work by the various trades.

L. Security

1. Full time watchmen will not be specifically required as a part of the Contract, but the Contractor shall provide inspection of work area daily and shall take whatever measures are necessary to protect the safety of the public, workmen, and material, and provide for the security of the site, both day and night.

M. Access Roads and Parking Areas

1. Construct temporary roadways and parking areas within the site as required to provide proper access to the site for delivery of material and equipment of all trades. Locations of temporary parking, trailers etc, must be approved by Owner prior to beginning work.
2. At completion of the work or when directed by the Engineer, surfacing and subbase material used for the road and parking areas shall be removed, unless otherwise approved by the Engineer.

N. Dust and Mud Control

1. Take all necessary precautions to control dust and mud associates with the work of this Contract, subject to the approval of the Engineer. In dry weather, spray dusty areas daily with water in order to control dust. Take necessary steps to prevent the tracking of mud onto adjacent street and highways.

O. Traffic Regulation

1. The Contractor shall be responsible for the protection and maintenance of traffic by the

proper use of barricades, warning lights, flares, and necessary traffic control and safety devices, and shall conform to Federal, State, and Local regulations regarding their use.

2. All forms of traffic control on public roadways required by the construction operators shall be in accordance with the Manual of Uniform Traffic Control for Highway Construction, and Maintenance Operations.

P. Contractor's Field Office and Storage Sheds

1. The Contractor shall provide field office and storage sheds as required for the performance of the work and protection of materials and equipment.

Q. Removal of Temporary Construction

1. Remove the various temporary facilities, services, and controls and legally dispose of them as soon as the Engineer deems permissible. Portions of the site used for temporary facilities shall be properly reconditioned and restored to a condition acceptable to the Engineer.

1.13 MATERIALS AND EQUIPMENT

A. Transportation and Handling

1. Manufactured materials and products shall be delivered to the project site as needed for installation, undamaged, in original packages, containers, or bundles, as packaged by the manufacturer with manufacturer's name, brand, seals, and labels intact.
2. Materials other than those designated within the Specifications or approved by the Engineer shall not be delivered to the project site.

B. Storage and Protection

1. The Contractor shall be responsible for protection and preservation of all materials until final acceptance of the Project.

C. Protection of Completed Work

1. Provide temporary weather tight enclosures to protect work from damage by the elements, and protect finished surfaces to prevent any damage resulting from the work of any trade.

D. Substitutions and Product Options

1. The intent of these Specification is to provide the Owner with a quality facility without discouraging competitive bidding, however, compatibility with existing City Equipment is Paramount. Therefore, all equipment listed in the Bid Form shall utilize one of the choices given with no substitutions allowed. All materials not directly specified shall be subject to approval by the Engineer.

1.14 SYSTEMS STARTUP

A. Applicable Codes

1. All potable water line disinfection work shall be acceptable to the State health authority. If any requirements of this Section are in conflict with requirements of the authority for disinfection, those of the authority shall govern. Methods of disinfection for all water

containment devices and piping systems shall conform to AWWA C601.

B. Qualifications

1. All work performed for and in connection with disinfection shall be under the direction of an experienced supervisor.
2. All equipment used in disinfection work shall be in proper working condition, and shall be adequate for the specified work.

C. Submittals

1. Prior to starting any disinfection work, furnish for the Engineer's approval, a detailed outline of the proposed sequence of operation, manner of filling and flushing units, source and quality of water to be used, and disposal of wasted water. Admission of contaminated water into previously disinfected units must be prevented.

D. Chlorine Source

1. Chlorine gas-water solution of direct chlorine feed is preferred for disinfection. Use of high-test calcium hypochlorite or the tablet method of disinfection must be approved by Engineer and must be in accordance with AWWA procedures. Tablet form calcium hypochlorite may be used only for water lines up to 12 inches in diameter and less than 2,500 feet in length.
2. The Contractor shall be liable for all damages arising from direct contact of granular calcium hypochlorite with solvent welding materials used to join PVC pipe, if any.

E. Preparation of Liquid Chlorine

1. A chlorine gas-water solution shall be applied by means of a solution-feed chlorinating device, or, if approved by the Engineer, the dry gas may be fed directly through proper devices for regulating the rate of flow and providing effective diffusion of the gas into the water within the unit being treated. Chlorinating devices for feeding solutions of the chlorine gas shall provide means to prevent the backflow of water into the chlorine cylinder.

F. Preparation of Calcium Hypochlorite

1. Granular calcium hypochlorite shall be prepared as a water mixture before introduction into the unit. The dry powder shall first be made into a paste and then thinned to approximately a one percent chlorine solution. To prepare of calcium hypochlorite (65 - 70 percent available Cl_2) to 7 - 1/2 gallons of water.

G. Preliminary Disinfection Procedures

1. After pressure and leakage tests have been completed, all units shall be thoroughly flushed to remove all foreign material. Entrapped air shall be released at high points, and the unit shall be completely filled with water to allow the disinfecting agent to come in contact with all interior surfaces. In the event that complete venting cannot be accomplished through available outlets, furnish and install necessary corporation cocks and vent piping, with no additional compensation.

H. Application of Disinfectant

1. Chlorinating agent shall be applied at the supply end of the unit being disinfected. For

pipes, disinfectant shall be applied through a corporation cock installed in the top of the pipe. Tablets shall be placed in accordance with AWWA C601.

2. Water shall be introduced at a controlled rate in order to regulate the chlorine dosage. The rate of chlorine mixture flow shall be proportioned to the rate of water entering the unit so the chlorine dose applied shall produce at least 25 mg/1 chlorine residual after a period of 24 hours. The method of determining the rate of flow of water into the unit being disinfected shall be approved by the Engineer.
3. Valves shall be manipulated to keep the strong chlorine solution and/or contaminated water from flowing into units that have been previously chlorinated and/or flushed.

I. Quality

1. The chlorinated water shall be retained in the unit long enough to destroy all nonspore-forming bacteria. The minimum retention period shall be 24 hours with a chlorine residual at the end of this period of not less than 25 mg/1 (ppm).

J. Disinfecting Valves

1. All valves and appurtenances shall be operated while the line or unit is being disinfected to insure that all surfaces of the valves are disinfected.

K. Swabbing

1. Disinfection for pipe, fittings, or valves that must be placed in service immediately shall be accomplished by thoroughly flushing and swabbing with a strong (5 percent) solution of calcium hypochlorite immediately prior to assembly. Approval must be secured from the Engineer before this method of disinfection will be accepted.

L. Final Flushing and Test

1. Following chlorination, the unit shall be flushed until the replacement water in the system is proven to be comparable in quality to the water which will enter that unit or system. This acceptable condition of water delivered by each unit or system shall continue for at least two days, as demonstrated by laboratory examination of samples. Laboratory tests shall show a chlorine residual after final flushing of less than one mg/1 (ppm).

M. Repetition of Flushing and Testing

1. If the initial treatment results in an unsatisfactory bacterial test, disinfection shall be repeated by the Contractor at no additional cost until satisfactory results are obtained.

N. Equipment

1. Before startup, properly lubricate all bearings and other items which normally require lubrication, and fill each gear case and oil reservoir to the proper operating level, using the equipment manufacturer's recommended lubricant.
2. The Contractor or an authorized Manufacturer's Representative shall be responsible for the start-up, adjustment, preliminary maintenance, and check-out of equipment and instrumentation. All systems shall be carefully checked for conformance with the design criteria.
3. If any equipment or system does not operate properly, the Contractor shall immediately

replace or repair components until it operates properly.

4. When the equipment startup is complete, each manufacturer shall submit a startup report to the Engineer. Final payment will not be made until above has been complied with.

O. System Startup

1. Immediately prior to final acceptance make a final check of all lubrication requirements, and leave all equipment properly lubricated, ready for Owner's use.
2. When the equipment is placed in operation by the Owner, the Contractor shall demonstrate to the Owner's personnel the proper manner of operating the equipment, making adjustments, and maintaining the system.

P. Testing, adjusting, and balancing systems

1. Piping System Testing, General Requirements

- a. Test procedures and method of disposal of water shall be approved by the Engineer. All tests shall be made in the presence of the Engineer. Preliminary tests made by the Contractor without being observed by the Engineer will not be accepted. Notify the Engineer at least twenty four hours before any work is to be inspected or tested.
- b. All defects in piping systems shall be repaired and/or replaced and retested until acceptable. Repairs shall be made to the standard of quality specified for the entire system.
- c. Sections of the system may be tested separately, but any defect which may develop in a section previously tested and accepted shall be promptly corrected and retested. Pressure tests shall be made between valves to demonstrate ability of valves to sustain pressure.
- d. All piping shall be tested in accordance with the following test methods, in addition to any test required by local and state codes or building authorities.
- e. Prior to testing, flush all piping systems with water to remove construction debris.

2. Underground Gravity Sewer Testing, General - Not Used

3. Infiltration Tests of Gravity Sewers - Not Used

4. Exfiltration Tests of Gravity Sewers - Not Used

5. Air Testing of Gravity Sewers - Not Used

6. Pressure Piping Testing

- a. All force mains, water mains and services, and any other piping subject to pressure testing shall pass the following hydrostatic pressure test and leakage test.
- b. Tests for any exposed piping shall be made before covering and insulation is placed. Testing of all piping under a concrete slab shall be made prior to

pouring the concrete.

- c. The pressure and leakage test for buried piping shall be made after all jointing operations are completed and any concrete reaction blocks, and restraints have cured at least 7 days. Lines tested before backfill is in place shall be retested after compacted backfill is placed.
 - d. All service connections to water mains shall be completed prior to testing.
 - e. Sections of piping between valves and other short sections of line may be isolated for testing. If shorter sections are tested, test plugs or bulkheads required at the ends of the test section shall be furnished and installed by the Contractor, together with all anchors, braces, and other devices required to withstand the hydrostatic pressure without imposing any thrust on the pipe line. The Contractor shall be solely responsible for any damage which may result from the failure of test plugs or supports.
7. Hydrostatic Tests for Pressure Piping
- a. Piping shall be slowly filled with water and all air expelled. Care shall be taken that all air valves are installed and open in the section being filled, and that the rate of filling does not exceed the venting capacity of the air valves.
 - b. After the section of line to be tested has been filled with water, the specified test pressure shall be applied and maintained for a minimum period of 10 minutes and for such additional period necessary for the Engineer to complete the inspection of the line under test. Do not exceed pipe manufacturer's suggested time duration at the test pressure. If defects are noted, repairs shall be made and the test repeated until all parts of the line withstand the test pressure.
 - c. Hydrostatic test pressure shall be 100 psi unless otherwise indicated on the Drawings.
8. Leakage Test for Pressure Piping
- a. After the specified hydrostatic test has been completed, the line shall be subjected to a leakage test under a hydrostatic pressure of 150 psi. The pressure shall be maintained within a maximum variation of 5 percent during the entire leakage test. The duration of the leakage test shall be 2 hours minimum, and for such additional time necessary for the Engineer to complete inspection of the section of line under test. Leakage measurements shall not be started until a constant test pressure has been established. The line leakage shall be measured by means of a water meter installed on the supply side of the pressure pump.
 - b. No leakage is allowed in exposed piping, buried piping with flanged, threaded, or welded joints or buried non-potable piping in conflict with potable water lines.
 - c. Tested sections of buried piping with slip-type or restrained joints will not be accepted if it has a leakage rate in excess of that rate determined by the formula:

L = 0.00027 NDP, in which;

L = Maximum permissible leakage rate, in gallons per hour, throughout the entire length of line being tested.

N = Number of gasketed joints (two for each flexible coupling joint coupling joint) in the line under test.

D = Nominal internal diameter (in inches) of the pipe.

P = The square root of the actual pressure in psi on all joints in the tested portion of the line. This actual pressure shall be determined by finding the difference between the average elevation of all tested pipe joints and the elevation of the pressure gauge and adding the difference in elevation head to the authorized test pressure.

d. All apparent leaks discovered within one year from the date of final acceptance of the work by the Owner shall be located and repaired by the Contractor, regardless of the total line leakage rate.

9. Testing Equipment

a. Completed items of mechanical equipment shall be given an operational test as specified for each equipment item.

b. Field testing shall be scheduled and coordinated with the Engineer and performed in his presence. Unless otherwise indicated, the Contractor shall be responsible for and pay for all water, chemicals, electricity, etc., used in testing equipment and systems.

c. The Contractor's attention is called to testing of pumps and blowers. The Contractor shall confirm the factory test results under field conditions. The Contractor shall obtain Head-Capacity curves as well as overall efficiency for the pumps and blowers. Field test results shall be submitted to the Engineer for approval prior to final acceptance.

10. System Testing

a. All items including valves and controls shall be given a thorough test. The entire system shall be operated for two days to prove compatibility of equipment and to achieve proper adjustment for operation. Continuously operating motor driven equipment shall be tested for proper levels of operation and output. Valves, pipes, tanks, and other items that are non-operating or occasional-operating shall be tested for ability to meet design criteria.

11. Adjustments

a. When an item of equipment is found to be in conflict with the stated design criteria, an adjustment shall be made to the item by experienced personnel of the Contractor or a manufacturer's representative.

b. If adjustments fail to correct the operation of a piece of equipment, remove the equipment from the Project Site and replace it with a workable replacement that will meet the Specification requirements.

Q. Manufacturer's Services

1. Work Specified Herein and Elsewhere

- a. Work under this Section includes:
 - 1. Mechanical start-up services.
 - 2. Process start-up services.
 - 3. Training services.

1.16 CONTRACT CLOSEOUT

A. Clean-Up Operations

- 1. The entire project site shall be thoroughly cleaned at the completion of the work.
- 2. The Contractor shall be responsible for the removal of excess dust and mud created by the construction project from all sidewalks, streets, and highways as directed by the Engineer. Equipment to clean these surfaces shall be subject to approval by the Engineer.

B. Closeout Submittals

- 1. Upon completion of the project, or portions thereof, the Contractor shall transfer to the Owner all applicable items accumulated throughout construction. These include but are not limited to the following items:
 - a. Service manuals, installation instructions, special tools, and specialties.
 - b. Spare parts ordered as part of this Contract.
 - c. Submittal of the Contractor's one year guarantee.
 - d. Submittal of manufacturer's guarantees, bonds, and letters of coverage extending beyond the time limitations of the Contractor's guarantee.
 - e. Delivery of any salvaged or borrowed materials or equipment to the Owner.
 - f. Record document of completed facilities.
 - g. All keys to all doors, gates, and equipment.
 - h. Checklist indicating satisfactory completion of all furnished items from the final inspection.
 - i. Waivers of lien, both from the contractor and from all subcontractors.