PART 01100 - WATER SUPPLY SYSTEMS

Section 01120 - Irrigation Systems

Description

01120.00 Scope - This work consists of installing irrigation systems and associated equipment at locations shown or specified and as directed.

01120.01 Qualifications - In order to install certain kinds of equipment or systems, manufacturer's certifications may be required, if described in the Special Provisions.

Materials

01120.10 General - Furnish only commercial quality materials and equipment. All items proposed for use will be subject to testing to ensure compliance with the Specifications. Provide materials of the same function that are of the same type and the same manufacturer.

Submit a list of proposed materials for approval as soon as practicable after Award and before arranging for procurement of any materials, especially those materials or products not shown or specified. If any initially proposed materials are not approved, submit substitutes for approval. Any materials installed without approval will be subject to removal and replacement with acceptable material at the Contractor's expense.

Materials may be designated by trade name or by manufacturer's catalogue information as shown or specified. The use of a substitute material may be permitted if a written request for substitution and proof of equivalent quality and suitability are furnished. Make any request for substitution with ample time for approval without delaying the work.

When alternate equipment, such as sprinkler heads, is proposed for use with hydraulic characteristics differing from that originally shown, the following will be required:

- A redrafted, legible plan that shows the redesigned layout, location, or sizes of every affected system element as required for proper operation as originally designed. Furnish a plan showing every relevant system element, site feature, and plan element that was shown on the original plan. A plan made by marking up the original plan will not be accepted.

- A hydraulic calculation table for the alternate equipment. At a minimum, show a complete calculation for one average sprinkler zone (section) and a complete calculation for the "worst case" sprinkler zone (i.e., the section that is farthest from the point of connection (P.O.C.), is the largest, or otherwise presents the most challenging hydraulics). Starting from the P.O.C., show the calculation with a step-down method with flow and loss at each piece of equipment and length of pipe run between equipment. Show the new total water required for each zone and the total for all zones to ensure that maximums for meter size, pipe sizes, and watering times will not be exceeded.

- Where any controller run-time change will be required, submit a separate page showing the total timing per controller required for each section, to show that timing changes will still allow all zones to be run within a reasonable time period.

- A cost page showing the Contractor's actual discount cost from the supplier(s), comparing the original plan costs versus the proposed equipment costs for each type of item, such as pipe by size, where there is a change required. Show the line total of each type of item and the grand total for the proposed change.

01120.11 Pipe, Tubing and Fittings - Furnish galvanized iron or steel, PVC, or polyethylene pipe as shown or specified that meets the following requirements:

(a) Galvanized Pipe and Fittings - Furnish pipe of standard weight, hot-dip galvanized iron or steel, standard threaded, coupled, and that meets the requirements of ASTM A 53/A 53M. Non-standard threaded fittings will be rejected.

(b) Polyvinyl Chloride Pipe and Fittings - Furnish PVC pipe and fittings of PVC compound Type 1, Grade 1, conforming to ASTM D 2241 and certified approved by the National Sanitation Foundation. Provide pipe and fittings free from defects caused by poor materials, low quality of work, or rough handling. Dimensional and quick burst tests of pipe and fittings may be required after arrival at the job site before materials will be accepted.

Furnish pipe and fittings as follows:

Used for	Class or Schedule
Main and lateral lines	Schedule 40 PVC
Irrigation sleeves	Schedule 40 PVC
Caps	Schedule 80 PVC
Direct bury pipe, not in sleeves, placed under road beds or other paved areas	Schedule 40 PVC

Furnish PVC threaded pipe of PVC 1120, schedule 80 material conforming to ASTM D 1785.

Provide PVC solvent-weld pipe of PVC 1120 materials having a 200 psi minimum pressure rating with SDR 21 walls that conform to ASTM D 2241.

Furnish PVC pipe fittings conforming to ASTM D 2466, Type I, Grades 1 or 2.

Pipe may be belled on one end with the dimensions of the tapered bell conforming to ASTM D 2672.

Install PVC pipe with walls heavier than SDR 21 when shown or specified.

(c) Non-Potable Colored Coded Pipe - Wherever non-potable, reclaimed or reuse water is used, furnish PVC pipe that is tinted purple and imprinted with the warning "Caution: Reclaimed Water - Do Not Drink". Provide pipe meeting the same AWWA and ASTM specifications as the potable water pipe sizes on which they are based.

(d) Polyethylene Pipe - Furnish polyethylene pipe of Class 80, SDR 15, medium density, meeting the requirements of ASTM D 2239, conforming to U.S. Commercial Standard CS-255, and approved by the National Sanitation Foundation (NSF).

(1) Micro Tubing and Fittings - Where drip emitters are not required, furnish a blank type and provide any connections necessary. Provide tubing consisting of nominal-sized linear, low-density, minimum 1/4 inch outside diameter (OD) polyethylene.

(2) Low Volume (Drip) Tubing - Furnish drip tubing manufactured from specially formulated, chemical-resistant, low to medium density, virgin polyethylene or polybutylene which is selected for excellent weatherability and stress cracking resistance, and is designed specifically for use in drip irrigation systems. Provide drip tubing having a minimum wall thickness of 0.044 inch.

01120.12 Automatic Controllers - Provide Underwriter's Laboratories (UL) approved controller(s) as shown or specified. Furnish each outdoor controller with either a pedestal or wall mount brackets when appropriate. Provide and install the controller in a weatherproof and vandal-proof cabinet of corrosion-resistant metal. Furnish the controller housing or cabinet with hasp and lock or locking device. Provide locks or locking devices that are master-keyed and include three sets of keys for the locks. If the irrigation system serves both lawns and planting beds, furnish a controller that has a dual programming capability. Provide controllers that are compatible with and capable of operating the irrigation system as constructed.

The following are definitions of some controller-associated equipment:

Rain Sensor - A sensor able to interrupt the power from the irrigation controller to the valves when the rainfall exceeds a pre-selected amount. Furnish rain sensors that are compatible with the system controller and are fully adjustable.

Soil Moisture Sensor - A sensor that interrupts programmed irrigation cycles until the soil moisture reaches a predetermined condition at the sensor's probe location.

Central Controller - A computer system programmable to receive data from and provide commands to multiple irrigation systems remotely located from the central system location.

Satellite Controller - A satellite controller similar to a normal stand-alone controller and able to operate as one, but designed to be operated by a central controller located off-site.

Flow Sensor - The hardware located in a pipeline that senses water flow and sends resulting data by electronic pulses to the pulse output transmitter.

Pulse Output Transmitter - A device that reads electronic pulses from the flow sensor and sends data to the pulse-decoding device.

Pulse Decoder - A microprocessor-based device designed to read electrical pulses originating at the flow sensor (or other type of monitoring device) and send the data to a central control system for analysis and action. When reading water flow data, the pulse decoder may also be referred to as a flow monitor.

Weather Station - A field station that collects and stores various weather data for access and use by a central control system in modifying an irrigation program for weather conditions. Typical data collected over a time period are wind speed, wind direction, relative humidity, rainfall, solar radiation and air temperature.

01120.13 Quick-Coupling Equipment - Furnish quick coupling equipment with a body of cast leaded semi-red brass alloy No. C84400 conforming to ASTM B 584, and a service rating not less than 125 psi for non-shock cold water. Provide couplers having standard male pipe threads at the top and standard female pipe threads at the base. Ensure that the valve is designed to open only upon inserting a coupler key and close completely after removing the key, with absolutely no leakage of water between the coupler and valve body. Provide valve bodies to receive couplers that are designed with double worm slots to allow smooth opening and closing action with a minimum of effort. Ensure that slots notched at the base will hold the coupler firmly in the open position. Furnish couplers of one piece construction with steel reinforced side handles attached, a locking top and of the same material as the valve body. The coupler shall have stainless steel double guide lugs to fit the worm slots. Furnish two couplers and two hose swivels for operation of the valves, and two keys for the locking caps if quick-coupling valves are required. For non-potable water systems, furnish a color-coded, purple tinted cap that bears the printed warning "Caution: Reclaimed Water - Do Not Drink".

01120.14 Hose Bibs - Furnish bronze or brass hose bibs, with angle-type thread to accommodate a 3/4 inch hose connection, and with a key- operated design that prevents operation by wrench or pliers.

01120.15 Cross-Connection Control Devices - Cross-connection control devices will be shown on the plans. Furnish and install cross-connection control devices meeting the requirements of the Oregon Health Division and the local water authority.

01120.16 Water Meter - Water meter procurement, installation, and associated costs will be the responsibility of the City. Be responsible for coordinating water meter needs in a timely fashion with the City.

01120.17 Valves:

(a) Gate Valves - Furnish gate valves of heavy-duty bronze conforming to the requirements of ASTM B 62. Provide valves of the same size as the pipes on which they are placed and install with union or flange connections. Service rating (for non-shock cold water) shall be 150 psi. Valves shall be of the double disk, taper seat type, with rising stem, union bonnet and hand wheel or suitable cross wheel for standard key operation. The valves shall have the manufacturer's name, type of valve, and size clearly cast on them.

(b) Drain Valves - Furnish bronze or brass drain valves, 1 inch or 3/4 inch in size, manual angle globe type, with rising stem, hex brass union, removable bonnet and stem, and adjustable packing gland. Ensure that valves are designed for underground installation with a suitable cross wheel operable with a standard key. The valves shall have a service rating of not less than 150 psi non-shock cold water. Furnish three standard operating keys.

(c) Check Valves - Furnish heavy duty bronze or steel check valves which function by means of a hinged disc suspended from the body, and which is able to close of its own mass. Furnish valves that are of the same size as the pipes on which they are placed, unless otherwise specified, and with union or flanged connections. Provide valves that are rated for non-shock cold water service of not less than 150 psi. The valves shall have the manufacturer's name, valve type, and size cast on them.

(d) Pressure-Reducing Valves - Furnish pressure-reducing valves with a minimum of 150 psi working pressure and an adjustable outlet range of 20 to 70 psi, rated for non-shock cold water service up to 175 psi. The valves shall be factory set as shown or specified.

(e) Isolation Valve - Furnish isolation valves as shown on the plans or Special Provisions. If no isolation valve is shown, furnish ball valves as shown below.

(f) Ball Valves - Furnish bronzed-bodied ball valves conforming to ASTM B 62 and with a hard, chrome plated ball conforming to ASTM B 124/B 124M. The valve shall be non-shock cold water service-rated at not less than 400 psi. Plastic valves will not be accepted.

(g) Air Relief Valve - The air relief valve automatically relieves air pressure to break an air vacuum in the pipe section where it is located. Install air relief valves at the exact high point of each pipe section where relief is needed. (Note - air relief valves are not associated with backflow prevention).

(h) Control Valves:

(1) Manual Control Valves - Furnish manual valves of bronze or brass, angle type, with hex brass union, and with a service rating not less than 150 psi non-shock cold water. Provide valves for underground installation designed with a cross wheel suitable for operation with a standard key. Furnish three suitable operating keys per irrigation system. Furnish valves that have removable bonnet and stem assembly, with adjustable packing gland housing for the long acme-threaded stem to ensure full opening and closing. Provide valves with discs that are full floating with replaceable seat washers.

(2) Automatic Control Valves - Furnish automatic control valves of a normally closed design, operated by an electric solenoid of the required rating, but not more than 6.5 W and operating on 24 V AC power. Ensure that solenoids directly attached to the valve bonnets or bodies have completely internal control parts. Provide bodies that are not less than 150 psi if brass or bronze and not less than 125 psi if plastic, with a manual control bleed cock to operate the valve without electric current. Ensure that the closing speed is not less than five seconds and the opening speed is not less than three seconds. Both shall be at a constant rate of opening and closing so the water flow is completely stopped when the valve is either manually or electrically closed. Provide valves having manual shutoff stems with cross handles that will adjust the valve from fully closed to wide open with the valve automatically operable in the adjusted position.

(3) Automatic Control Valves with Pressure Regulator - Furnish valves of the same manufacture as the automatic control valves, capable of reducing the inlet pressure to a constant lower pressure regardless of supply fluctuations, and which are fully adjustable.

01120.18 Valve Boxes and Protective Sleeves - Provide automatic control valves, flow control valves, pressure reducing valves, backflow preventers, filters and other serviceable fixtures with valve boxes that are extendable to obtain the depth required. Furnish boxes constructed of thermoplastic, with locking lids, green in color, and of the type shown or specified. Include a protective sleeve and cap with all manual drain valves and manual control valves.

01120.19 Electrical Wire and Splices - Unless otherwise specified, furnish electrical wiring used as a hot wire for each zone between the automatic controller and automatic valves of copper, minimum size AWG No. 14, and red in color. Furnish common wire that is a minimum AWG No.12 and white in color. Furnish type USE that is chemically cross-linked Polyethylene or Thermoplastic. Furnish Type UF that is color-coded or marked with number identification.

Make low voltage splices with one of the following:

- Furnish a kit containing a "T" shaped open cell with a centering device and a plastic bag of urethane and hardener, which is mixed at the time of installation. The resin used with the "T" shaped centering device shall be a quick curing, flexible compound with a set-up time of about four minutes at 70 °F. Acceptable kits are "3-M DBY", "RainBird Snap-Tite", "Pen-tite PVC Socket and Sealing Plus" or approved equal.

- Heat-shrinkable insulating tubing manufactured for use in irrigation electrical systems. Furnish heat-shrink tubing of a mastic-lined, heavy-wall, polyolefin cable sleeve.

Provide and install an extra wire with all wiring runs that Is the same gauge, but of a different color than the hot wire and common wire. The extra wire will be reserved for future use or modifications to the system.

01120.20 Communication Cable - Furnish communication wire in central satellite control systems that is 18 gauge polyethylene (PE) 89, minimum 6 pair, or approved equal. Provide sufficient pairs to connect all decoding, sensing and monitoring devices to the Central Control Unit.

01120.21 Detectable Wire and Marking Tape - Provide a detectable wire at the elevation of all main and lateral lines using continuous #14 gauge, single strand locator wire that is blue in color. Provide marking tape above all main and lateral lines consisting of inert polyethylene plastic that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil. Furnish color-coded tape with the type of line buried below and the word "Caution" imprinted continuously over its entire length in permanent black ink. Provide tape of the width recommended by the manufacturer for the depth of installation used.

Construction

01120.40 General - The irrigation plans are a schematic design and may require adjustment. Do not install the sprinkler system as shown if it is evident that obstructions, grade differences, or differences in area dimensions create conditions different than anticipated in the design. Bring all such obstructions or differences to the attention of the Engineer. In the event this notification is not performed before construction begins on a part of the system where discrepancies exist, any revisions necessary to make the system operate as designed will be the Contractor's responsibility.

(a) Plumbing - Install all parts of the irrigation system according to the Oregon Plumbing Code and State and local laws. Make water service connections as shown and specified. Conform to the requirements of the jurisdictional water authority. Ensure that water velocities in PVC pipe do not exceed 5 feet per second, unless approved in writing by the City. Bring any velocities exceeding 5 feet per second created by pipe sizes shown on the plans to the attention of the City before beginning construction. Correct excess velocities existing after construction, or caused by changes from the plans, at the Contractor's expense, unless a written agreement has been made authorizing otherwise.

(1) Double Check Valve Assembly (DCVA) - Install, inspect, and test the DCVA according to applicable regulations of the Oregon Health Division and the local water authority. Furnish test records on forms approved by the Oregon Health Division. Furnish forms filled out by a State-licensed Backflow Device Tester documenting that the DCVA is in good operating condition before any flushing and testing of downstream water lines. During the life of the Contract, test the DCVA annually, or more often if successive inspections indicate repeated failure. Repair or replace the DCVA whenever it is found to be defective.

(2) Reduced-Pressure Backflow Device (RPBD) - Install, inspect, and test the RPBD according to the applicable portions of the Oregon Plumbing Code and applicable regulations of the Oregon Health Division and the local water authority. Apply the same specific testing requirements as stated for the DCVA above.

(b) Electrical Service - Install electrical service according to 00960.49, the National Electrical Code, and all State and local laws. Power sources will be as shown or as directed. Be responsible for coordination and installation of electrical service. Furnish and install meter bases at the power source conforming to the requirements of the power supplier. Give the power supplier's representative notice before making any installation. Provide a separate, dedicated circuit for the controller.

01120.41 Layout of Irrigation System - Stake the irrigation system, following the schematic design on the plans, before construction begins. With prior approval, make alterations and changes in the layout to conform to ground conditions and to obtain adequate coverage of water. Call before you dig. Comply with the requirements of 00150.50.

01120.42 Excavation - Excavate trenches no wider than necessary to lay the pipe or install the equipment. Keep the top 6 inches of topsoil, if applicable, separate from subsoil and replace this topsoil as the top layer when backfilling. Provide smooth trench bottoms of sand or other material, free from rocks and unsuitable material. Excavate trenches in rock or other unsuitable material at least 6 inches below the required depth and backfill with sand or other suitable material free from rocks.

Exercise care when excavating near existing trees. Where roots are 2 inches and greater in diameter, except in the direct path of the pipe, hand excavate and tunnel the pipe trench. When large roots are exposed, wrap them with heavy burlap for protection and to prevent excessive drying. When digging trenches by machine adjacent to trees having roots 2 inches and less in diameter, hand trim the sides of the trench, making a clean cut of the roots. Treat all cut and trimmed roots 1/2 inch or larger in diameter with an approved tree wound dressing. Backfill trenches having exposed tree roots within 24 hours unless protected by continuously moist burlap or canvas.

Place detectable marking tape in the trench directly above, parallel to, and along the entire length of all nonmetallic water pipes and all nonmetallic and aluminum conduits installed under existing or planned pavement. Use tape widths recommended by the manufacturer for the burial depth.

Pipe installation using a "pipe puller" may be approved if there is adequate topsoil depth and the topsoil is free of rock. Obtain the Engineer’s approval before using a pipe puller. Include any resultant changes in material or design with the request for use of this method.

If unforeseen bedrock is encountered during excavation that prevents the pipe from being buried at the specified depth, immediately bring it to the attention of the Engineer.

01120.43 Piping - Backfill all pipe between the top of the pipe and finished grade with a minimum of 18 inches of fill according to 01120.49. Where possible, place mains and laterals or section piping in the same trench. Separate all pipes by at least 2 inches. Place all pipe lines a minimum of 3 feet from the edge of concrete sidewalks, curbs, guardrail, fences, traffic barriers or walls unless otherwise approved.

Place marking tape above all pressurized mainline, according to the manufacturer's instructions.

Place all live mains to be constructed under existing pavement in sleeves jacked under the pavement, unless otherwise shown. Place all PVC pipe installed under pavement in pipe sleeves of Schedule 40 PVC, unless steel sleeving is shown or specified. Furnish pipe caps of Schedule 80 PVC. Install sleeves 2 feet below subgrade when passing under roadways. Extend sleeves 2 feet beyond the edge of gravel, edge of sidewalk or back of curbs. Mark sleeves with a 2 feet piece of #4 rebar driven flush with the ground or other adjacent surface. Place PVC caps over both ends of sleeves but do not glue. Solvent-weld sleeve sections. Pipe bedding and backfill shall conform to Section 00405. Extend the sleeve a minimum of 12 inches beyond the edge of pavement. Perform all jacking operations according to an approved jacking plan. If obstacles are encountered during required jacking, notify the Engineer, who may authorize corrective measures according to 00140.60. Provide for complete drainage of all pipe lines with manual drain valves installed at section low points. Drain valves may not be shown on the plans.

01120.44 Pipe Jointing:

(a) General - During construction, plug or cap pipe ends to prevent entry of dirt, rocks and other debris.

(b) Galvanized Steel Pipe - Ensure that galvanized steel pipe has clean cut, well fitted standard pipe threads. Ream all pipe to its full diameter and remove burrs before assembly. Construct threaded joints using either a non-hardening, non-seizing multipurpose sealant, Teflon tape, or paste as recommended by the pipe manufacturer. Make all threaded joints tight with wrenches, without using handle extensions. Clean and remake joints that leak with new material. Use of caulking or thread cement to make joints tight will not be permitted.

(c) PVC Pipe - Handle and install PVC pipe, couplings and fittings according to the manufacturer's recommendations. Chamfer the outside of the PVC pipe to a minimum of 1/16 inch at approximately 22°. Join pipe and fittings by solvent welding. Use only solvents that penetrate the surface of both pipe and fitting with a result of complete fusion at the joint. Use solvent and cement only as recommended by the pipe manufacturer. On plastic to metal connections, work the metal connection first. Use a non-hardening compound on threaded connections. Thread connections between metal and plastic using only female threaded PVC adapters with threaded schedule 80 PVC nipples.

(d) Polyethylene Pipe - Install polyethylene pipe and fittings according to the manufacturer's recommendations. Cut the ends of the polyethylene pipe square and insert the fitting to its full depth. Use stainless steel clamps for insert fittings.

01120.45 Installation:

(a) Sprinkler Heads - Position turf heads and other pop-up heads between 1/2 inch and 1 inch above finish grade, measured from the top of the sprinkler. Place sprinklers as close as practical to walks, curbs, pavement and lawn edges, but leave enough space to allow height adjustment. Do not place heads on risers in areas with any potential for pedestrian traffic, unless otherwise shown. Use swing riser assemblies that allow positioning for correct sprinkler height.

(b) Drip Emitters - Install emitters directly above the root mass of the plant being watered, according to the plans or the manufacturer's recommendations.

(c) Low Volume Drip Tubing - Install drip irrigation tubing according to the plans or the manufacturer's recommendations.

(d) Controllers - Install controllers according to the manufacturer's recommendations and as shown. Receive approval of the location before installing. Since the controller will need to be accessed frequently, install it at a height, position, and location that allow ease of access.

(e) Valve Boxes and Quick Couplers - Position the tops of valve boxes, capped sleeves, and quick coupler valves between 1/2 inch and 1 inch above finish grade or mulch.

(f) Valves - Install valves so that access for maintenance is maintained.

(g) Central Control Equipment - If shown or specified, install the following equipment according to the manufacturer's recommendations:

- Rain sensors
- Soil moisture sensors
- Flow meters
- Central control system with satellite controllers
- Weather stations

01120.46 Low Voltage Electrical Installation - Use direct burial wiring between the automatic controller and automatic valves. The wiring may share a common neutral. When more than one automatic controller is required, provide a separate common neutral for each controller and the automatic valves it controls. Run separate control conductors from the automatic controller to each valve. Provide and install an extra wire according to 01120.40.

Install wire adjacent to or beneath the irrigation pipe. Use plastic tape or nylon tie-wraps to bundle wires together at 10 foot intervals. Snake the wire from side to side in the trench to provide slack in the wire run. When it is necessary to run wire separate from the irrigation pipe, bundle and place the wire under detectable marking tape. Splices will be permitted only at junction boxes, valve boxes, pole bases, or control equipment. Leave a minimum of 2 feet of excess conductor at all splices, terminals and control valves to facilitate inspection and future splicing.

01120.47 Flushing and Testing:

(a) General - Provide gauges used in the testing of water pressures that are certified correct by an independent testing laboratory immediately before use on the Project. Retest gauges when directed. Test automatic controllers by actual operation for a period of two weeks under normal operating conditions. Should adjustments be required, adjust according to the manufacturer's direction and test until operation is accepted as satisfactory.

(b) Sprinkler Head Flushing - Flush all sprinkler heads as recommended by the manufacturer.

(c) Sprinkler Head Testing - Test for leaks in heads and connections and correct as required.

(d) Main Line Flushing - To remove debris that may have entered the line during construction, flush main supply lines twice with the supply valve fully open. Flush first before placing valves and again after placing valves and before pressure testing.

(e) Main Line Testing - Purge all main supply lines of air and test with static water pressure of at least 150 psi for 60 minutes without introduction of additional service or pumping pressure. Test with one pressure gauge installed on the line where directed. Install an additional pressure gauge at the pump when directed. Lines showing loss of pressure exceeding 5 psi at the end of the specified test period will be rejected. Correct rejected installations and retest for leaks.

(f) Lateral Line Flushing - Flush all lateral lines once with the supply valve fully open prior to placement of sprinkler heads, emitters and drain valves. Flush long enough to remove any debris that enters the lateral lines during construction.

(g) Lateral Line Testing - Purge all lateral lines of air and test under operating line pressures with risers capped and drain valves closed. Maintain operating line pressures for 30 minutes through open valves and pressure regulating devices. Lines showing leaks when visually inspected at the end of the specified test periods will be rejected. Correct and retest lateral line installations that have been rejected.

(h) Lateral Line Alternate Test Method - When conditions prevent effective visual inspection of lateral lines, the Engineer may require that the lines be tested by use of pressure gauges. In that event, maintain the static water pressure equal to the operating line pressure in the lines for 30 minutes, with valves closed and without introduction of additional service pressure. Lateral lines showing loss of pressure exceeding 5 psi at the end of the specified test period will be rejected. Correct and retest lateral line installations that have been rejected.

(i) Testing of Micro Tubing - Micro tubing will be tested by visual inspection while operating and before burial. Tubing that has obvious leaks or that doesn't operate as designed will be rejected. To fully test micro tubing, a water collection procedure recommended by the manufacturer may be required. Correct all faults before retesting.

01120.48 Adjusting System - Before final inspection, adjust and balance all sprinklers to provide adequate and uniform coverage. Balance spray patterns by adjusting individual sprinkler heads with the adjustment screws or by replacing nozzles to produce a uniform pattern. Unless otherwise specified, water spray will not be permitted on pavement, walks or structures.

01120.49 Backfill - Do not start backfill until all piping has been inspected, tested and approved. Complete backfilling as soon as possible after approval. Ensure that backfill material placed within 6 inches of the pipe is free of rocks or other unsuitable material that might cut or otherwise damage the pipe. Backfill from the bottom of the trench to approximately 6 inches above the pipe with continuous compaction in a manner that will not damage the pipe or wiring, and proceed evenly on both sides of the pipe. Thoroughly compact the remainder of the backfill without using heavy equipment within 18 inches of any pipe. Ensure that the top 6 inches of the backfill is topsoil material or, if suitable, is the first 6 inches of material removed in the excavation.

Pipe bedding material conforming to 00405.12 may be authorized in quantities determined by the Engineer. When authorized to proceed, fill the bottom 2 inches of the trench with approved bedding before laying pipe. After the pipe is in position, add enough bedding material to bring the backfill height to 2 inches above the pipe. Continue backfilling as usual.

If sufficient suitable backfill material is not available from trench excavation or other sources on the Project, notify the Engineer. Provide an estimate of imported backfill required, if possible. Unless otherwise shown or specified, imported pipe bedding material will be authorized according to 00140.60.

Maintenance

01120.60 System Operation - Repair, flush and test all main and lateral lines that sustain a break or disruption of service. Upon restoration of the water service, bring the affected lines up to operating pressure. After pressurizing, conduct a thorough inspection of all sprinkler heads, emitters, and other fittings, located downstream of the break or disruption of service, and repair. This inspection is required to ensure that the entire irrigation system is operating properly.

Completely install and test the irrigation system, and make it automatically operable before planting in a unit area except where otherwise shown, specified, or approved. Be fully responsible for all maintenance, repair, testing, inspection and automatic operation of the entire system until all work is complete and approved.

This responsibility includes, but is not limited to, draining the system before winter and reactivating the system in the spring and at other times as directed.

Be responsible for having annual inspections and tests performed on all cross connection control devices as required by the State Health Division.

In the spring, when the drip irrigation system is in full operation, make a full inspection of all emitters. This involves visual inspection of each emitter under operating conditions. Make all adjustments, flushing or replacements to the system at this time to ensure the proper operation of all emitters.

01120.61 Drip Line Warranty - The warranty of 00170.85(b) applies to drip tubing installed under this Section. Provide a written warranty from the manufacturer against defects in manufacturing, rot, electrolytic corrosion, and stress cracking for at least five years from the time of installation.

Finishing and Cleaning Up

01120.70 As-Built Plans and System Orientation - Upon completion of the work, submit corrected working drawings, schematic circuit diagrams, or other drawings necessary for the Engineer to prepare corrected plans showing the work as constructed. Provide drawings of sizes conforming to 00150.35(m). Prepare and present a training and orientation session covering the operation, adjustment and maintenance of the irrigation system. Review corrected drawings and explain all features. At this session, provide the Engineer with parts lists and service manuals for all equipment. Notify the Engineer in writing two weeks before the proposed date of the training and orientation session. The date and time of the session will be mutually agreed to.

Measurement

01120.80 General - There will be no separate measurement of work done under this Section.

Payment

01120.90 General - Payment will be made at the Contract lump sum amount for the pay item "Irrigation System", which will be payment in full for furnishing and placing all materials, equipment, labor, and Incidentals necessary to complete the work, including excavation and backfill, electrical service and system orientation.

Section 01140 – Potable Water Pipe and Fittings

Description

01140.00 Scope - This work consists of constructing potable water pipe and fittings. Install pipe in the materials, sizes and lengths and at the locations shown or as directed to the lines and grades established. Furnish and construct joints, fittings, accessories and appurtenances as necessary, for complete installation of the potable water system.

Materials

01140.10 General - Materials shall meet the following requirements:

Bolted, sleeve-type couplings for plain end pipe.....02475.60
Commercial grade concrete in thrust blocks.....00440
CLSM.....00442
Concrete Cylinder Pipe.....02470.36
Detectable marking tape or wire.....02470.60
Ductile iron pipe fittings.....02475.20
Ductile iron pipe.....02470.20
Polyethylene encasement.....02470.50
Reinforcement.....00530
Restrained joints.....02475.50
Steel pipe - 6 inches and larger.....02470.30
Steel pipe fittings - 6 inches and larger.....02475.30
Steel pipe fittings - under 6 inches.....02475.35

01140.11 Handling Pipe and Fittings:

(a) General - Handle pipe and fittings so as to prevent damage to the pipe, fitting, lining, or coating. Load and unload pipe and fittings using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped, skidded, or rolled against other pipe or fittings. If any part of the coating or lining is damaged, repair in an approved manner. Damaged pipe and fittings will be rejected. Immediately separate all damaged pipe and fittings and remove from the job site.

(b) Thread Protection - Protect threaded pipe ends with couplings or other means until installed. Inspect the pipe and fittings and notify the City of any defects.

(c) Storage and Delivery- Pipe shall be delivered with protective covering on pipe ends to prevent entry of dirt, groundwater, or other foreign material. Store pipe on cradles and maintain protective covering during storage.

(d) Bracing - For concrete cylinder pipe and steel pipe, furnish pipe and fittings with temporary bracing inside as shown or as recommended by the manufacturer. Bracing shall be installed as soon as practicable after cement mortar lining is applied. Maintain bracing in place until the pipe zone backfill has been placed and compacted. Prevent damage to the pipe when removing bracing. Pipe end shall be sealed by the manufacturer to keep moisture in and prevent crackling of lining material.

(e) Placement - Keep the pipe or pipe joint free of dirt or other foreign material during handling and laying operations.

01140.12 Cutting Pipe:

(a) General - The minimum length of cut pipe used for adjustments, proper spacing of valves, tees or special fittings shall be no less than 2 feet.

(b) Cutting Operation - Cut pipe with abrasive saws or by special pipe cutters. Square all pipe ends with the longitudinal axis of the pipe. Ream and otherwise smooth the cut ends so that good connections can be made. Cut threads cleanly. Flame cutting of ductile iron pipe will not be allowed. Inspect trimmed pieces to ensure cement lining was not damaged during the cutting process per manufacturer recommendations.

Construction

01140.40 Trench Work - Excavate trench, install bedding, pipe zone material, backfill, and dispose of excavated material according to Section 00405 and the following:

(a) Dewatering Trenches - Remove water encountered in the trench during pipe laying operations and maintain the trench until the ends of the pipe are sealed and provision is made to prevent floating of the pipe. Do not allow trench water or other deleterious or foreign materials to enter the pipe at any time. Pipe shall not be installed in standing water.

(b) Bedding and Pipe Zone - For the purpose of these Specifications, all potable water pipes are considered flexible pipes. Use bedding and pipe zone material for flexible pipes as described in 00405.12 and 00405.13 and as shown.

(c) Work in Contaminated Soils - Contract Work in Contaminated Soils or Suspected Contaminated Soils, cleanup and treatment of the contaminated soils must be done in accordance with DEQ regulations and requires special training and certification from DEQ. If unexpected contaminated soils are encountered, comply with 00290.20 (h).

(d) Installation in Paved Areas - If pipe is installed within paved areas to be preserved, perform the installation according to Sections 00405 and 00495.

(e) Scheduling - Schedule work so that pipe trench is backfilled daily.

01140.41 Pipe Installation:

(a) General - Lay pipe to the lines and grades shown and established.

(b) Ductile Iron Pipe - Install ductile iron pipe according to AWWA C600 and the manufacturer's recommendations.

(1) Depth of Cover – Depth of cover shall be from the finish grade to the top of the pipe. Where no pipe grade elevations are shown, install pipe with at least 36 inches of cover for pipe 8 inches in diameter and smaller; install pipe with at least 42 inches of cover for pipe 12 inches in diameter; install pipe with a minimum of 48 inches of cover for pipe 16 inches in diameter and larger. Do not backfill pipe unless approved.

(2) Curves and Deflections - Lay long radius curves, either horizontal or vertical, with standard pipe by deflecting the joints. If the pipe is shown curved in the plans and no special fittings are shown, assume that curves may be achieved by deflecting the joints with standard lengths of pipe. Do not exceed 80% of the manufacturer's printed recommendations for the amount of deflection at each joint when the pipe is laid on a horizontal or vertical curve.

(3) Pipe Laying Procedure - When ductile iron pipe is laid on a curve, join the pipe and fittings in a straight alignment and then deflect it to the curved alignment. Pipe shall not hug trench wall. Make trenches wider on curves for this purpose.

(4) Layout - Pipe may be strung along the street a maximum distance of 300 lineal feet or enough pipe for one day of installation, whichever is less. Do not block driveways or otherwise interfere with the use of private property. Distribute the pipe so that no hazard will be presented to occupants of the adjoining property, or pedestrian and vehicular traffic. Ensure all pipe, fittings and construction materials are secured from movement while staged.

(5) Fittings – Do not use cast plain-end fittings. Fabricated ductile iron spools are permitted.

(c) Steel Pipe and Concrete Cylinder Pipe:

(1) Installation - Install steel pipe and concrete cylinder pipe according to the manufacturer's recommendations. Install steel pipe and concrete cylinder pipe on curves in the same manner described above for ductile iron pipe according to 01140.41(b)(3).

(2) Steel Welds - Steel welds shall conform to the requirements of AWWA C206. For 36 inch nominal diameter and larger pipe, lap joints shall be full fillet double welded. The City shall perform weld inspection that may include a certified welding inspector (CWI).

(d) Compliance with OAR 333 – Install new water lines and appurtenances in compliance with OAR 333 regulations governing the horizontal and vertical separations between water and sewer facilities.

(1) Variance - If variance is proposed, submit written proposal for review and approval. by the Portland Water Bureau. 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 the corrective measures proposed. Each variance will be considered on a case-by-case basis.

(2) Review Time - Allow a minimum of 5 working days review and response to each proposal.

(e) Restraint – All joints within the designated restrained joint area shown or as directed, shall be restrained. Additional restrained ductile iron pipe and fittings may be required to resolve conflicts with utilities and obstructions, or for changes in alignment, change in location of appurtenances, or change in testing locations or change in connection locations.

(f) Utility Crossings – Install schedule 40 PVC pipe or 40 mil reinforced geomembrane for encasement of waterlines where the new waterline crosses any cathodically protected utility lines for 20 feet of length, 10 feet on each side of the crossing. See Section 01180 for additional requirements.

(g) Pipe Cleanup – As pipe-laying progresses, keep the pipe interior clean and free of all debris. Completely clean the interior of the pipe, including fittings and appurtenances, and remove any sand, dirt, mortar splatter, and any other debris before testing and disinfecting the system.

01140.42 Jointing Pipe:

(a) General - Clean all parts of the pipe ends, couplings, fittings, and appurtenances to remove oil, grit, or other foreign matter from the joint. Keep the joint from contacting the ground. When assembling gasketed joints, apply an ANSI/NSF Standard 61, Drinking Water System Components – Health Effects, or equivalent (NSF 61) approved lubricant as specified by the pipe manufacturer. Maintain cover on pipe ends until installation. Mark pipe not furnished with a depth mark before joint assembly. Plug, cap, or otherwise close the last section of pipe installed with a watertight plug. Coating of field joints shall be applied after all welding operations are complete and inspected. Refer to Section 01180 for additional requirements.

(b) Steel Pipe: 6 Inches and Larger Joint Protection:

(1) Inside Joints – Install cement mortar in joints as specified by AWWA C205 – Field Joints. Apply the lining after the pipe is installed, backfilled, compacted and interior surfaces have been cleaned. Cement mortar lining must be NSF 61 approved and as recommended by the pipe manufacturer.

(2) Outside Joints:

a. Tape Coating - Apply a hot or cold applied coal tar tape coating in accordance with AWWA C203 or AWWA C209 respectively. The cold applied coal tar tape can be used only if the Contractor furnishes an affidavit of compliance with AWWA C209 and the tape meets the materials specifications with a minimum width of four (4) inches and a total wrapping thickness of not less than 80 mils.

b. Mortar Coating - Clean the exposed metal at the exterior space and fill the annular space with a portland cement grout. Grout shall be one part cement to one and one half parts fine sand with sufficient water to form a mixture the consistency of thick cream. Wrap the joint with a strip of clean woven fabric and band around the pipe at each side of the joint. The fabric shall be woven to allow the escape of air and excess water, but prevent escape of mortar. The fabric shall be no less than 80 mil thickness. Grout the joint full through a space in the woven fabric slightly to one side of the top. Rod the grout with a beaded wire or chain as it is poured into the joint. Immediately after completing the exterior joint, place approved pipe zone backfill material over and around the joint to prevent rapid drying per pipe manufacturer's recommendations. Commercially approved diapers with integral banding may be used.

(c) Concrete Cylinder Pipe Joint Protection:

(1) Inside Joints - After the trench backfill has been placed and compacted, dampen the inside joint space with water or a neat cement slurry and fill by compacting into the joint an NSF 61 approved portland cement grout. Grout shall be one part cement to not more than two parts fine sand with sufficient water to form a stiff mix. Finish the surface to a dense troweled surface free of projections or depressions and flush with the inside pipe surface. Do not put the pipeline into service until the mortar has cured per the manufacturer's recommendations.

(2) Outside Joints – Clean the exposed metal at the exterior space and fill the annular space with a portland cement grout. Grout shall be one part cement to one and one half parts fine sand with sufficient water to form a mixture the consistency of thick cream. Wrap the joint with a strip of clean woven fabric and band around the pipe at each side of the joint. The fabric shall be woven to allow the escape of air and excess water, but prevent escape of mortar. The fabric shall be no less than 80 mil thickness. Grout the joint full through a space in the woven fabric slightly to one side of the top. Rod the grout with a beaded wire or chain as it is poured into the joint. Immediately after completing the exterior joint, place approved pipe zone backfill material over and around the joint to prevent rapid drying per pipe manufacturer's recommendations. Commercially approved diapers with integral banding may be used.

01140.43 Polyethylene Encasement:

(a) Installation - Install 8 mils thickness polyethylene encasement according to AWWA C105 and the manufacturer's recommendations. Exercise care during backfilling to prevent puncturing or otherwise damaging the polyethylene encasement. Overlap tears with one foot minimum width of polyethylene and secure with tape. Use sand backfill only with polyethylene. Fittings shall be wrapped with 40 mil geomembrane. Valves shall have two layers of the polyethylene tube encasement.

(b) Connections - When connecting to existing polyethylene-encased pipe, cut the existing encasement within 1 foot of the connection couplings or fittings. After the connections are made, overlap the existing polyethylene encasement with a minimum of 3 feet of additional polyethylene encasement and seal the overlaps with 2-inch wide polyethylene adhesive tape.

01140.44 Concrete Thrust Blocks - Place concrete thrust blocks when shown or directed, at bends, tees, dead ends, and crosses. Wrap pipe or fittings with 8 mils thickness polyethylene encasement before pouring concrete. Cast concrete thrust blocks in place against solid, undisturbed earth at the sides and bottom of the trench excavation. Shape the blocks so as not to obstruct access to the joints of the pipe or fittings. At no time allow fly ash or calcium containing cementation materials to come into contact with the ductile iron or ferrous materials.

01140.45 Detectable Marking Tape or Wire:

(a) Installation - Install detectable marking tape or wire over all nonmetallic water lines, including service connections. Place the tape or wire approximately 1 foot above the top of the pipe for its full length. Tracer wire shall be blue 18 gauge minimum. Splices are allowed with an approved kit only. Detection tape shall have printed along length "water" or "water line".

(b) Accessibility - Make ends of tape or wire accessible in water meter boxes, valve boxes or casings, or outside the foundation of buildings where the pipe enters the building. Provide detectable marking tape or wire access at locations less than 1,000 feet apart or as shown.

01140.46 Connections to Existing Mains:

(a) Service Connections and Main Tie-ins - The City will make the service connections and the main tie-ins to the existing water system, unless otherwise specified or directed.

(b) Valve Operation - Do not operate any valves on the existing water system. Coordinate with the Engineer to make all necessary arrangements for notification and temporary services prior to disrupting any existing services.

01140.47 Maintaining Service:

(a) Coordination - Where existing services are to be transferred from old to new mains, plan and coordinate the work with that of the City so that service will be resumed with the least possible inconvenience to the public. City will review potential disruptions of service on a case by case basis.

(b) Connection Work by Contractor - Verify line and grade on all key connection points. Do not operate the system once it has been connected without direct preapproval.

(c) Connection Work by the City - The City will make connections of the new pipe at such locations as the City may elect to supply customers with water, after the affected section of pipe has passed hydrostatic and bacteriological tests. The installation of any such connections by the City shall not be construed as an acceptance by the City of any part of the work required under the contact.

01140.48 Backfilling - After the pipe is installed and inspected, backfill the trench according to Section 00405 and as shown.

01140.49 Out-of-Service Water Mains - Submit abandonment plan identifying locations and limits of work, CLSM mix design, method of installation of CLSM and CLSM volumes for each pipe section. Drain out-of-service potable water mains and install plug or cap on opposing pipe ends or as directed. Remove valve boxes, risers, and meter boxes. Remove out-of-service pipes as shown or approved in writing. For mains larger than 12 inches that are not removed, install tapped caps with vent/grout/standpipe piping and fill pipe with CLSM. Vent/grout/standpipe piping shall allow water and air to be expelled from the pipe and verification that pipe section is completely filled. CLSM shall attain a 28 day compressive strength of 100 - 150 psi. CLSM shall be pumped or gravity fed into one end of the out-of-service pipe section. After CLSM filling is complete, cut and remove vent/grout/standpipe piping.

Testing

01140.50 Filling and Flushing:

(a) Pipe Filling - Fill pipes slowly with potable water at a maximum velocity of one foot per second in the main while venting all air. Take all required precautions to prevent entrapping air in the pipes. Refer to 00170.02 and 00405.49 for batch discharge permit.

(b) Pipe Flush - Flush sections of pipe to be tested and disinfected to remove any solids or contaminated material that may have become lodged in the pipe during manufacture, delivery or construction. Flushing shall not exceed the allowances listed in the discharge permit from the applicable regulatory authority.

(c) Pre-Test Preparation - Provide all labor, materials, and equipment such as but not limited to fittings, pumps, hoses, valves, and meters, necessary to fill and test the line. Fill the mains with water and allow to stand under pressure at least 12 hours at minimum 75 percent of test pressure to allow the escape of air and to allow the lining of the pipe to absorb water. The City will provide the water to fill the pipeline at no cost to the Contractor for flushing and testing the water pipeline on water projects only.

(d) Disposal of Treated Water - Dispose of treated water flushed from mains. Neutralize the waste water for protection of aquatic life in the receiving water before disposal into any natural drainage channel. Dispose of disinfecting solution to the satisfaction of the Engineer and the applicable agencies. If approved, disposal may be made to any available sanitary sewer provided the rate of disposal will not overload the sewer. Refer to the applicable discharge permit for maximum flow rates.

01140.51 Hydrostatic Testing:

(a) General - Test all water mains and appurtenances under a hydrostatic pressure equal to one and one-half times the working pressure, but at least 150 psi, measured at the highest point of the test section. High pressure systems will require higher test pressures. Furnish all labor, materials and equipment necessary for performing the test. City will furnish a calibrated pressure gauge for hydrostatic testing. Refer to 01180 to coordinate hydrostatic testing with corrosion protection testing.

(1) Backfill - Do not begin hydrostatic test until backfill has been placed, compacted and passed required testing at 95% of Standard Proctor. Place all thrust blocks and allow time for the concrete to cure to meet design strength of 75% minimum before testing. Where permanent blocking is not required, furnish and install temporary blocking and remove it after testing.

(2) Materials and Equipment - Provide all labor, materials, and equipment such as but not limited to air tanks, fittings, pumps, hoses, valves, and meters, necessary to fill and test the line except for the calibrated pressure gauges to be furnished by the City. Fill the mains with water and allow to stand under 75% test pressure for at least 12 hours to allow the escape of air and to allow the lining of the pipe to absorb water. Transportation of the water from the source to the site shall be the Contractor's responsibility. A hydrant permit and an approved backflow prevention device are required for water main testing.

(3) Test Time - Test by pumping the main up to the required pressure for at least two hours. Provide additional pumping during the test period to continuously maintain pressure within 5 psi of that required. During the test, observe the section being tested to detect any visible leakage. Use a clean container to hold water for pumping up pressure on the main being tested. Sterilize this makeup water by adding chlorine to a concentration of 25 mg/L.

(4) Measure Quantity - The City will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.

(5) Loss Formula - The maximum allowable hourly leakage rate calculation is as follows:

$$L = \frac{SD\,(P)^{1/2} \times 128}{148{,}000}$$

In the above formula:

L = Allowable leakage in ounces per hour
S = Length of pipe tested, in feet
D = Nominal diameter of pipe, in inches
P = Test pressure during the leakage test in psi

The test lasts for 2 hours and each hour's loss stands on its own and will not be averaged. This formula is not applicable to HDPE or PVC pipe.

(6) Pressure Loss - There shall be no appreciable or abrupt loss in pressure during the test period.

(7) Leakage - Correct any visible leakage regardless of the allowable leakage specified above. After correcting the leak, restart the test for two hours.

(8) Use of Hydrant Valves - Make all tests with the hydrant auxiliary gate valves open and pressure against the hydrant valve. After the pipe test has been completed, test each gate valve in turn by closing it and relieving the pressure beyond. This test of the gate valve will be acceptable if there is no immediate loss of pressure on the gauge when the pressure beyond the valve is relieved. Verify that the pressure differential across the valve does not exceed the rated working pressure of the valve.

(9) Test Section Length - Limit section to be tested to 1,200 feet, unless otherwise shown or approved. The City may require that the first installed section of pipe, not less than 1,200 feet in length, be tested. Do not continue pipe laying more than an additional 1,200 feet until the first section has been tested successfully.

(10) Test Equipment Readiness - Prior to calling out the City to witness the pressure test, set up all equipment completely ready for operation and successfully perform the test to ensure that the pipe is in a satisfactory condition.

(11) Defective Materials or Workmanship - Replace defective materials or workmanship discovered during hydrostatic testing. Whenever it is necessary to replace defective material or correct the workmanship, repeat the hydrostatic test until a satisfactory test is obtained. Repairs shall be at the Contractor's expense.

(b) Air Hydrostatic Testing – Air testing may be used in lieu of hydrostatic testing on steel pipe for full double welded lap and double welded butt strap joints. Air test method shall conform to the requirements of AWWA C206 and as modified:

(1) Tap Installation - Provide a 1/4 inch IPT tap into the welded joint. Apply a static air pressure of 100-psi minimum into the joint for a minimum of 10 minutes.

(2) Welds - While the joint is under pressure, coat welds, inside and out, with a soapy water solution.

(3) Leakage - If bubbling or leakage is visible, repair or replace the defective joint and repeat the test.

01140.52 Disinfecting:

(a) General - After passing the hydrostatic testing, disinfect the new water mains according to the procedure outlined in 01140.52(d). Allow a minimum of 5 days for testing and disinfection.

(b) Temporary Sample Points - For temporary service and air release sample points, temporary 2-inch construction, test and flushing/sample risers, sample stations are required at 1200-foot maximum intervals and on all side branches, or as directed. Hydrants may not be used as temporary sample points.

(c) Dechlorination - All water having chlorine residual shall be dechlorinated and disposed of in a manner which meets the DEQ standards and is accordance with 01140.50(d). No chlorinated water shall be discharged into a storm drainage system or stream prior to approved dechlorination treatment.

(d) Disinfection - Disinfect all new mains according to the following procedure:

(1) Isolate Main - Ensure that the main is completely isolated (physical separation or closed valve) from the system before proceeding with the disinfection process. Approved backflow protection is required if the source water for flushing and/or disinfection is the active distribution system. Do not test against a closed isolation valve on a live system.

(2) Valve Position - Make sure all non-isolation valves on new main, fire hydrants and branches are in the fully open position.

(3) Pipe Flush - Flush new main, branches and services thoroughly with potable water to remove any sediment and debris. The minimum flushing velocity for this step is 2.5 feet per second (per AWWA Standard C651) unless conditions in the batch discharge permit make this flushing velocity unattainable. De-chlorinate and properly dispose of all water generated by this flushing activity in accordance with 01140.52(c).

(4) Chlorine Amount - Calculate the amount of liquid sodium hypochlorite bleach (chlorine) necessary to disinfect the main, branches and services. Any bleach used for the disinfection process must be NSF 61 certified and conform to AWWA B300. The minimum residual required by DHS regulations is 25 ppm. In order to ensure that this is achieved; use a target dose of 50 ppm unless otherwise directed. Maximum dosage is 75 ppm unless otherwise directed.

(5) Chlorine Application - Inject the main with 50 ppm chlorinated water. Use a flowmeter or pitot tube to measure flow and maintain a steady flow rate. The objective is to achieve a uniform mixture throughout the length of the pipe that is close to the target dose. Flow (bleed) a blow-off, standpipe, or hydrant at the high point(s) to allow air to escape and ensure that all interior pipe surfaces are wetted.

(6) Chlorine Residual - Measure chlorine residual with the high-range chlorine test kit at a point somewhere close to the injection point while filling the main. These measurements ensure that the applied chlorine dose is close to the target dose. Adjust the dose rate as necessary.

(7) Residual Measurements - Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 1200 feet of main and once for each main branch, or 2-inch service or as directed. The measured chlorine residual shall be at least 25 ppm and not greater than 75 ppm. If any chlorine residual measurement is less than 25 ppm or greater than 75 ppm, de-chlorinate and properly dispose the chlorinated water in the main and repeat steps (3) through (6).

(8) Retention Time - Wait 24 hours. The City will measure another set of chlorine residuals with the high-range chlorine test kit. The measured chlorine residuals shall be at least 10 ppm. If not, de-chlorinate and properly dispose the chlorinated water in the main and repeat steps (3) through (7). If chlorine residual is 10 ppm or higher, then de-chlorinate and properly dispose of chlorinated water in the main, branches, and service lines and proceed to the next step.

(9) Refill and Flush - Refill the main, branches, and services with potable water and flush thoroughly. There is no minimum flushing velocity for this step. The City will measure the chlorine residual with the low-range test kit to ensure that the main is clear of all chlorinated water. System water is generally less than 2 ppm and if the reading is higher than that, further flushing of the main is necessary to remove the remaining chlorinated water. Dechlorinate and properly dispose of all water according to 01140.52(c). No samples will be taken until the chlorine residual of water in the main is approximately the same as the source water.

(10) Bacteria Sampling - If trench water or excessive quantities of dirt and debris have entered the main during construction, then follow this step. Otherwise, proceed to step (11). Bacteriological samples will be taken by the City at a maximum of 1,200-foot intervals on the main and all branches. The samples shall be taken not less than 16 hours after final flushing has occurred. Allow 24 hours for the test results. Proceed to step (12). Service laterals of 2 inches or less shall be sampled at a rate and frequency defined by the City.

(11) Sampling Locations - The City will take one bacteriological sample from the end of the main and on each branch. For long runs of main, at least one sample will be taken for every 1200 feet of new main. Allow 24 hours for results to return. DHS rules and the AWWA standards referenced therein require that a main pass two successive sets of bacteriological tests (the successive sets of samples shall not be collected on the same day). Two consecutive passing (negative) test results are required. Allow 24 hours for the test results.

(12) First Sample Set - If one or more samples in the first set test positive for coliforms, then the City will take another set of samples (including one or more samples of the source water). This is to determine if the source water is a problem or if there is a sampling error. Allow 24 hours for the test results. If all main re-samples and source water sample(s) are negative for coliforms, take a second set of bacteriological re-samples. If any main re-samples or source water samples are positive for coliforms, the Engineer will determine how to proceed.

(13) Second Sample Set - If all bacteriological samples in the second set of re-samples are negative for coliforms, the disinfection process is complete. Notify the City in writing that the main is ready to be tied in.

(14) Positive Test Results - If one or more bacteriological sample(s) in the second set of re-samples are positive for coliforms, perform another round of sampling. Allow 24 hours for the test results. If any positive samples occur in the re-sampling, the Engineer will determine how to proceed, up to and including rejecting the pipe.

(15) Negative Test Results - If all results are negative, take another set of samples. Allow 24 hours for results to return. If all results for coliforms are negative, the disinfection process is complete. Notify the City in writing that the main is ready to be tied in.

(16) Resampling - If any of the bacteriological re-samples test positive for coliforms, the Engineer will determine how to proceed.

Measurement

01140.80 Trench Work - Quantities for trench work will be measured according to Section 00405.

01140.81 Installation Under Pavement:

(a) Pavement Replacement – Quantities for replacement of pavement will be measured according to Section 00495.

(b) Tunneling, Jacking, or Boring - When the pipe is installed under pavement by tunneling, jacking, or boring methods, measurement will be according to Section 00406.

01140.82 Pipe:

(a) Unrestrained Pipe - The quantities of the various kinds of pipe will be measured by the foot. Measurement will be horizontal measurement along the top of the trench with no deduction for fittings, valves, and couplings.

(b) Restrained Pipe - The quantities of the various kinds of pipe will be measured by the foot. Measurement will be horizontal measurement along the top of the trench with no deduction for fittings, valves, and couplings. Measurement will only include the quantities of restrained pipe shown. No measurement will be made of additional restrained pipe installed for Contractor convenience.

(c) Sanitary Sewer Crossings - Pay length for sanitary sewer replacement or encasement when listed as separate bid items will be measured on a foot basis along the horizontal centerline of the finished trench.

01140.83 Couplings - Flex couplings and insulated flex couplings will be measured on a per each basis by size. All other couplings will not be measured.

01140.84 Additional Ductile Iron Pipe and Fittings - Measurement for additional ductile iron pipe and fittings added to resolve conflicts with utilities and obstructions will be made per the restrained ductile iron pipe bid item and Sections 00195, 00196 and 00197.

01140.85 Incidental Basis - There will be no separate measurement for fittings, concrete thrust blocks, detectable marking tape wire, temporary blow offs, temporary blocking and restraint, flushing, hydrostatic testing, and disinfection test sampling points, and geomembrane or polyethylene for encasement of water line and appurtenances.

Payment

01140.90 General:

(a) Accepted Quantities - The accepted quantities will be paid for at the contract unit price per unit of measurement for each of the pay items listed in the Schedule of Items. Payment will be payment in full for furnishing and placing materials, including all equipment, labor and incidentals necessary to complete the work as specified.

(b) Price Amount - The Contract unit price for the appropriate pay items reflects plan requirements or the Contractor's choice from the applicable options listed on the Pipe Data Sheets (if provided in the plans).

01140.91 Pipe and Couplings - Pipe and couplings will be paid at the contract unit price for one or more of the following pay items:

	Pay Item	Unit of Measurement
(a)	_____inch Ductile Iron Pipe	Foot
(b)	_____inch Ductile Iron Pipe Restrained	Foot
(c)	_____inch Concrete Cylinder Pipe	Foot
(d)	_____inch Concrete Cylinder Pipe Restrained	Foot
(e)	_____inch Steel Pipe	Foot
(f)	_____inch Steel Pipe Restrained	Foot
(g)	_____inch Sanitary Sewer Crossing	Foot
(h)	_____inch Flex Couplings	Each
(i)	_____inch Insulated Flex Couplings	Each

Payment for trench work will be according to Section 00405.

Payment for trench resurfacing will be according to Section 00495.

Payment for tunneling, jacking or boring will be according to Section 00406.

01140.92 Incidental Basis - There will be no separate payment for the following, which are considered incidental to the appropriate pipe pay items:

- Concrete thrust blocks
- Detectable marking tape or wire
- Fittings
- Flushing, hydrostatic testing and disinfection
- Geomembrane
- Polyethylene encasement
- Temporary blocking and restraint
- Abandoning out-of-service pipes
- Temporary blow offs
- Test sampling points
- All coupling, other than flex couplings and insulated flex couplings

Section 01150 - Potable Water Valves

Description

01150.00 Scope - This work consists of furnishing and installing valves in potable water systems at the locations shown or at other locations as directed.

Materials

01150.10 General - Materials shall meet the following requirements:

Backflow prevention devices	02480.70
Ball valves	02480.23
Blowoff assemblies	02480.71
Butterfly valves	02480.22
Combination air release/air vacuum valves	02480.60
Commercial grade concrete in precast concrete blocks	00440
Commercial grade concrete in thrust blocking	00440
Gate valves	02480.20
Hydraulic cushion check valves	02480.40(c)
Hydraulically operated valves	02480.50
Power-actuating devices	02480.24
Spring-loaded plug or disc check valves	02480.40(b)
Swing check valves	02480.40(a)
Tapping sleeve and valve assemblies	02480.30
Valve boxes	02480.25
Valve operator extensions	02480.26

01150.11 Handling:

(a) Damage Prevention - Handle valves so as to prevent damage to the valve, lining or coating. Load and unload valves using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped or skidded. Damaged valves will be rejected. If damage is confined to the coating or lining, replace or propose a repair method to be approved. Immediately remove damaged valves from the site.

(b) City-Furnished Materials - Arrange with the Engineer to obtain City-furnished valve boxes a minimum of 2 working days in advance, with pickup times between 9 a.m. and 3 p.m. Monday through Friday. No pick up will be allowed on weekends and City observed holidays. Confirm order approval with Engineer prior to pick up.

(c) Materials Return - Return all unused and surplus City-furnished materials to the City's "Interstate Yard" no later than 3 working days prior to final inspection. Make arrangements with Engineer for material return time and date. The City will not accept the returned materials if they are not clean and in the same good condition as originally supplied. Cost for unacceptable returned materials will be deducted from the final payment.

01150.12 Connecting Ends - Furnish valves with connecting ends as shown and as required for connection to pipe and fittings furnished.

Construction

01150.40 Valves:

(a) General – Install valves according to the plans and the manufacturer's recommendations. Install valves in a manner that prevents any injury or damage to any part of the valve. Join to the pipe as set forth in Section 01140 and AWWA Standards for the type of connecting ends furnished. Thoroughly clean and prepare joints prior to installation. Where full face gaskets of a flanged type are used, no trimming of material will be allowed.

(b) Valve and Valve Box Installation - Set valves and valve boxes plumb. Operating nut on butterfly valves shall face the nearest curb, if applicable. Center the valve boxes over the operating nut of the valve. Place valve boxes over the valve or valve operator so that the valve box does not transmit shock or stress to the valve. Valve boxes installed in gravel or native landscaping shall be set in a circular concrete pad 18 inches in diameter, 6 inches minimum in depth. Do not bury or block access to any valve.

(c) Valve Operator Extensions - Install a valve operator extension with rock guard on any valve where the valve nut operator is installed more than 4 feet below finish grade. Extensions shall be hot dip galvanized after fabrication. Extension operator nuts shall be 2 feet from finish grade.

(d) Backfilling - Carefully tamp backfill around the valve box to a distance of 3 feet on all sides or to the undisturbed face of the trench, whichever is closer. Backfill around valves shall be in accordance with Section 00405. Set the cast iron valve box cover flush with the roadbed or finish paved surface. Prior to substantial completion, all valve box covers and PVC risers shall be cleaned and free of all debris.

(e) Large Valve Installation - For all valves 16-inch and larger, place pre-cast concrete block or valve pad concrete on undisturbed earth in the trench bottom. Construct valve pads with reinforcing steel to elevations and dimensions shown. Allow a minimum of five days curing time before placing the valve on the pad.

01150.41 Combination Air Release/Air Vacuum Valves - Install combination air release/air vacuum valves as shown. Slope all piping to permit escape of any entrapped air. Perform trenching and backfilling according to 01170.40 and Section 00405.

01150.42 Blowoff Assemblies - Construct blowoff assemblies as shown.

Testing

01150.50 Valve Operation Testing - After installation and hydrostatic testing, operate valves from full open to full closed to make sure valves do not bind during operation. Correct any malfunction in the operation of the valves. Verify and record the number of turns to 1/4 turn and direction from full open to full closed and submit documentation for the City's records prior to completing final project as-constructed drawings. Leave all valves open after testing is complete.

01150.51 Hydrostatic Testing - Subject valves to hydrostatic testing according to 01140.51. Correct any defects in design, materials or workmanship to the satisfaction of the Engineer.

01150.52 Disinfection - Disinfect valves according to 01140.52.

Measurement

01150.80 General - The quantities of valves will be measured on the unit basis, per each by actual type, size and count of units in place as specified. There will be no separate measurement for valve boxes, valve stem extensions or valve pads.

01150.81 Blowoff Assemblies - Blowoff assemblies will be measured on the unit basis, per each, by actual size and count of units installed.

Payment

01150.90 General - The accepted quantities will be paid for at the Contract unit price per unit of measurement for each of the pay items listed in the Schedule of Items. Payment will be payment in full for furnishing and placing the materials, including all equipment, labor and incidentals necessary to complete the work as specified.

01150.91 Valves - The pay items for valves will be as follows:

Pay Item	Unit of Measurement
(a) ____ inch Gate Valve, MJ	Each
(b) ____ inch Butterfly Valve, MJ	Each
(c) ____ inch High Pressure Butterfly Valve, MJ	Each
(d) ____ inch Combination Air Release/Air Vacuum Valve	Each
(e) ____ inch Air Release	Each

In items (a) through (e) the size of the valve or assembly will be inserted in the blank.

01150.92 Incidental - Payment for 6-inch gate valves used for hydrants shall be incidental to the fire hydrant assembly specified in 01160.91. Payment for 2-inch valves for 2-inch service lines are also incidental to the 2 inch service specified in Section 01170.

01150.93 City Furnished Materials - Payment will be for obtaining, installing, and returning unused City-furnished valve boxes and for furnishing and installing the valves complete in place, including all earthwork not covered under other pay items, jointing, blocking of valves, protective coatings, valve boxes, PVC riser, valve operator extensions, valve pads, and hydrostatic testing.

01150.94 Blowoff Assembly - Payment for the item "____ inch Blowoff Assembly" will be payment in full for furnishing and placing all materials including main line tee or tapping sleeve, gate valve, fittings, ductile iron pipe or copper pipe, joint restraint, valve operator extension, testing and cleanup, all earthwork and surface restoration for this item.

Section 01154 - Precast Concrete Vaults and Appurtenances

Description

01154.00 Scope –This work consists of furnishing and installing precast concrete vaults for meters, control valves, and other water system appurtenances at the locations shown or at other locations directed.

Materials

01154.10 General - Materials shall meet the following requirements:

Construction

01154.40 Precast Concrete Vault - Install the vault plumb, free from movement and firmly set in place in location shown or as directed. Vault shall be installed watertight.

01154.41 Structural Backfill:

(a) Bedding - Place the vault on a minimum 6 inch thick bedding layer of 1”-0 or ¾”-0 aggregate placed and compacted to 95% Standard Proctor. Place and level fill material to reduce the occurrence of voids between the vault and the backfill. Additional thickness of aggregate may be necessary if inferior subgrade soil conditions are encountered.

(b) Sidewall Backfill - Place 1”-0 or ¾”-0 aggregate along each wall of the vault and compact to 95% Standard Proctor.

01154.42 Pipe, Fittings and Appurtenances - Install pipe, fittings, valves and appurtenances as shown. Hydrostatically test and flush all piping through the vault. Test for bacteria during the same time as main line testing.

01154.43 Pipe Penetrations - Core drill penetrations of piping, valve boxes and electrical conduits. Verify location of holes prior to core drilling. All core drills shall be water tight once piping is complete.

01154.44 Paint, Sealers and Coatings - Apply paint and sealant as shown. All vaults shall be crystal seal coated.

01154.45 Ladder and Ladder Extension - Ensure that ladder is securely fastened to concrete vault wall. Ladder installation shall conform to all safety requirements of the Oregon Occupational Safety and Health Code, Stairways and Ladders. Ladder installation shall provide a minimum 3 feet extension and a maximum of 4 feet extension above finish grade.

01154.46 Finishing and Cleanup - Prevent entrance of dirt, grout, and other materials into drainage piping. Clean out rock, debris, and asphalt from around CIVs, access hatch and sump.

Measurement

01154.80 Unit Basis – The quantities of vaults and assemblies will be measured on the unit basis, per each by actual type, size and count of units installed in place as specified.

01154.81 Incidental Basis - There will be no separate measurement for valves, appurtenances, excavation, or acceptance testing.

Payment

01154.90 Unit Basis – The accepted quantities will be paid for at the Contract unit price per each for the pay item listed below:

Pay Item	Unit of Measurement
_____ Inch, _____Type Vault and Assembly.....	Each

In the item above, the following will be inserted in the blanks:

- The size of the vault and assembly in inches will be inserted with a separate pay item for each size
- The dimension type of the vault and assembly will be inserted in the second blank

Payment will be payment in full for furnishing and placing all materials including all equipment, labor, and incidentals necessary to complete the work as specified or as shown.

01154.91 Incidental Basis – Valves, appurtenances, earthwork and acceptance testing will be considered incidental to the work with no separate payment being made.

Section 01160 - Hydrants and Appurtenances

Description

01160.00 Scope - This work consists of furnishing and installing dry-barrel fire hydrants and appurtenances in potable water systems at the locations shown or at other locations as directed.

Materials

01160.10 General - Materials shall meet the following requirements:

Auxiliary gate valves	02480.20
Concrete hydrant pad	00440
End connections	02485.20
Fire hydrants	02485.10
Guard posts	02485.70
Hydrant dimensions	02485.30
Hydrant extensions	02485.40
Traffic flange	02485.50
Valve boxes	02480.25
Valve operator extensions	02480.26

01160.11 Handling of Hydrants:

(a) Loading and Unloading - Handle hydrants so as to prevent damage to the hydrant, lining or coating. Load and unload hydrants using hoists and slings so as to avoid shock or damage, and under no circumstances allow them to be dropped, skidded or rolled against other hydrants. Damaged hydrants will be rejected. If damage is confined to the coating or lining, it may be repaired in an approved manner. Immediately place all damaged hydrants apart from the undamaged and remove the damaged hydrants from the site as soon as possible. Damaged hydrants shall be marked with a tag or a steel crayon until removed.

(b) End Caps - Provide factory-applied end cap on pipe connection end. Maintain end cap through shipping, storage and handling to prevent damage and prevent dirt and moisture from entering the hydrant.

Construction

01160.40 Setting Hydrants:

(a) Delivery Inspection - Inspect hydrants upon delivery in the field to ensure proper working order.

(b) Hydrant Installation - Install hydrant assemblies as shown and in conformance with applicable provisions of Section 01140. Set hydrants plumb with nozzles parallel, or at right angles to the curb, with the pumper nozzle facing the curb. Set the traffic flange (breakaway flange) at least 2 inches but not more than 6 inches above the finish grade. Measure from the back of the hydrant flange at the lowest bolt elevation. Provide a minimum 6-foot unobstructed working area extending from the hydrant center out on both sides, and a minimum 3.5 feet unobstructed working area extending behind from the hydrant center, around all hydrants including proximity to any permanent structures including guard posts, signs, guy wires, buildings, and other vertical objects. Maintain a 4-foot skin-to-skin clearance between all hydrants and poles supporting or conducting electrical power. In curbed locations, set hydrant back from street as shown.

(c) Drainage Gravel - Place drainage gravel around the pier block and bottom of hydrant to 6 inches above the hydrant drain opening.

(d) Drain Rock Cover - Place textile fabric to cover drain rock prior to placement of backfill. Setting shall allow the hydrant barrel to drain into drainage gravel at base of hydrant.

(e) Touchup Painting - After installation and testing is complete, paint the exposed portion of the hydrant with a minimum of one coat of the type and color coating as directed. Paint hydrants according to Section 02485.

(f) Out-of-Service Hydrants - To indicate that a fire hydrant is not operational, secure with reflective tape a yellow or orange plastic bag over the entire hydrant assembly or an approved out-of-service cover. The Contractor may also use an out-of-service ring in addition to the bag or cover in case of removal of the cover. Maintain the plastic bag or cover until the waterline is accepted or the water line has been connected to the live water system.

01160.41 Hydrant Laterals - Install hydrant laterals, consisting of 6 inch ductile iron pipe, from the auxiliary gate valve at the main to the hydrant, according to Section 01140 and as shown.

01160.42 Hydrant Restraints - Fully restrain all hydrant laterals with mechanical restraint from the main to the hydrant assembly as shown.

01160.43 Auxiliary Gate Valves and Valve Boxes - Install auxiliary gate valves and valve boxes according to Section 01150.

01160.44 Hydrant Guard Posts - Construct hydrant guard posts at the locations shown. Excavate holes 16 inches in diameter for hydrant guard posts to a depth of 36 inches. Install hydrant guard posts plumb, and center in the holes. Backfill the holes and fill the hydrant guard posts with Commercial grade concrete. Paint the exposed portion of each guard post with one coat of the type and color coating as directed.

01160.45 Reconnect Existing Hydrants - Reconnect existing hydrants where shown. Leave the location and elevation of the existing hydrant unchanged, but change the existing hydrant lateral to connect with a new auxiliary gate valve and hydrant tee provided in a new main. Install new hydrant lateral according to Section 01140 where the lateral must be extended to connect to the new main. Where existing hydrants were not restrained with tie rods to the old main, restrain the new connections with tie rods as shown, or by other joint restraint method as directed.

01160.46 Hydrant Extensions - Install hydrant extensions where required. Set the traffic flanges a minimum of 2 inches above finish grade and a maximum of 6 inches above finish grade from back of flange at lowest bolt elevation.

01160.47 Hydrant Pads - Hydrants shall have a 3' x 3' x 6", 4,000 psi concrete pad installed after the hydrant has been set to grade as shown. Center hydrant pad on hydrant. Set hydrant pad flush with surrounding surfaces or as directed. Hydrant pads may be adjusted to reach the back of curb if the hydrant pad is no less than one foot in any one direction.

Testing

01160.50 General - After installation, operate hydrants from full open to full closed to make sure they do not bind during operation. Correct any malfunction in the operation of the hydrants.

01160.51 Hydrostatic Testing - Subject hydrants to hydrostatic testing in accordance with 01140.51.

01160.52 Disinfection - Disinfect hydrants according to 01140.52.

Measurement

01160.80 General - The quantities of hydrant assemblies, resetting existing hydrants, moving existing hydrants, reconnecting existing hydrants, hydrant extensions, and hydrant guard posts will be measured on the unit basis, per each, by actual count of units in place as specified.

Payment

01160.90 General - The quantities of hydrant assembles will be measured on the unit basis, per each.

01160.91 Hydrant Assemblies - Payment for fire hydrant assemblies will be full payment for all labor, materials, and equipment necessary to furnish and install a complete fire hydrant assembly, including hydrant, hydrant tee, 6 inch resilient-seated gate valve, 6 inch ductile iron pipe, fittings, hydrant extension for grade adjustment, restraint on hydrant run and the main run for the hydrant tee, excavation, bedding, backfill, 3’ x 3’ x 6” concrete hydrant pad, 8 inch PVC for valve box, valve operator extension, hydrant guard posts, out-of-service cover, concrete hydrant pier block, painting, compaction, testing, surface restoration, and clean up. Costs of installing City-furnished valve boxes and making any interim and final adjustments to match final grade are incidental to this pay item.

Section 01170 - Potable Water Service Connections, 2 Inches and Smaller

Description

01170.00 Scope - This work consists of furnishing and installing service connections, 2 inches in diameter and smaller, from the main to the water meter, and furnishing and installing sampling stations. The water meter will be furnished and installed by City unless specified otherwise in the Special Provisions or on the plans.

01170.02 Definitions:

Short Run – A short run service is a service connection up to the meter box that lies on the same side of the roadway as the main.

Long Run – A long run service is a service connection that crosses the roadway centerline between the main and the meter box.

Materials

01170.10 General - Materials shall meet the following requirements:

Brass and bronze pipe nipples ..... 02490.40(d)
Brass and bronze service fittings ..... 02490.40(c)
Copper pipe ..... 02490.40(a)
Corporation stops 02490.30
Meter boxes 02490.70
Meter setters 02490.50
Saddles 02490.20
Sampling stations 02490.80

01170.11 PVC Casings or Sleeves - PVC casings or sleeves shall meet the requirements of AWWA C900

01170.12 Steel Casings or Sleeves - Steel casings or sleeves shall meet the requirements of AWWA C200 for sizes 6 inch and larger.

Construction

01170.40 Service Lines:

(a) General - All copper service lines shall be installed continuous, without joints or splices, complete from the new water main (insulating corporation stop) to the new meter location, install all facilities to the new meter location. Install service pipelines perpendicular to the main, unless shown otherwise. Install service runs parallel to existing services with a perpendicular distance of 2 feet minimum to 5 feet maximum from existing services and a minimum perpendicular distance of 18 inches from property line.

(b) Excavation Depth - Construct the depth of trench for service connection piping to provide a minimum of 30 inches of cover over the top of the pipe from finish grade or street profile. Do not damage the main in any way during the installation of the service. Excavate and backfill for service connections according to Section 00405. Where no meter is to be installed, place angled meter stop at 18 inches from face of curb with 12 inches to the springline in an approved box.

(c) Fittings and Appurtenances - Install necessary service saddles, valves, valve boxes, tubing, pipes, bends, fittings, and couplings necessary to complete service line installations.

(d) Corrosion Protection - Install cathodic protection items when required including dielectric insulating corporation stops, dielectric insulating joints, tape wrap, and grounding rod.

(e) Pipe Tools - Cut service pipes using tools specifically designed to leave a smooth, even and square end on the pipe. Ream cut ends to the full inside diameter of the pipe. Clean pipe ends to be connected using couplings that seal to the outside surface of the pipe to a sound, smooth finish before the couplings are installed. Adjust the meter box to the finished grade after the surface has been acceptably restored.

(f) Testing and Disinfection Preparation - Install temporary risers and appurtenances as required to facilitate testing and disinfection. Place a Valve Box and Cover (CIV) over the test riser after testing and disinfection.

(g) Service Line Connections - City will connect all service lines at the new meters or to existing service piping as shown.

(**h) Services** - Install services through casings or sleeves as shown.

01170.41 Reconnecting Existing Services - When new service lines are not installed for existing services, City will connect all existing service lines to the new mains.

01170.42 Sampling Stations - Install sampling stations at the locations shown or as directed. Set at the depth shown or specified. Perform trenching and backfilling according to 01170.40.

01170.43 Service Taps:

(a) Installation Equipment - All direct service taps shall be made with a drilling and tapping machine intended for use on ductile iron pipe as manufactured by Mueller or approved equal. The drilling and tapping machine shall have alignment tool guides and a placement strap. Direct threaded taps shall engage a minimum of 4 full threads. Hand held equipment is not allowed. Coupons shall be removed from pipe.

(b) Thread Tape - Direct service taps shall require the use of 2 layers of 3 mil tetrafluoroethylene (TFE) tape on the threads of the corporation stop. Liquid TFE will not be allowed. Direct taps for 1 inch services are allowed only on mains that are 6 inches in diameter or larger.

(c) Service Saddles - Service Saddles are required on water mains 4 inches in diameter and for all services taps larger than 1 inch. Double strap service saddles are required on all service taps larger than 1 inch.

(d) Swing Joint - Install combination of swing joint and elbow or a wide bend to allow limited movements by the main or the service piping.

Testing

01170.50 Testing - Testing shall be performed according to Section 01140.

Measurement

01170.80 General - Measurement of service line installation will be made on a per each basis by size for short runs and per each by size for long runs. Any service length greater than 20 feet will be measured by lineal foot for the distance beyond 20 feet.

01170.81 Service Start - Services will begin at the centerline of the main for 1 inch and 2 inch copper services.

01170.82 Casing or Sleeve - Casings or sleeves for services will be measured by the foot.

Payment

01170.90 General - The pay items for potable water service connections will be as follows:

	Pay Item	Unit of Measurement
(a)	____ inch Service Line, Short Run	Each
(b)	____ inch Service Line, Long Run	Each
(c)	____ inch Service Line, Footage Exceeding 20 ft	Foot
(d)	____ inch Casing or Sleeve	Foot

In items (a) through (d), the size will be inserted in the blank.

Payment for service line installation will be made at the contract unit price for each size and type of service. Any service length exceeding 20 feet will be paid at the contract unit price per foot for that portion exceeding 20 feet. Payment will be payment in full for all equipment, labor and incidentals necessary to complete the work as specified including excavation, bedding and backfill, piping, tapping saddles, fittings, valve, vaults, meter boxes, restraint, tape wrap, testing, flushing, disinfection, cathodic protection, complete restoration and clean up.

01170.91 Valve Boxes and Covers (CIV) - Valve boxes and covers (CIV) will be City-furnished and installed by the Contractor. The Contractor is responsible for picking up these materials according the requirements of 01150.11(b). No separate payment will be made for the installation and for any interim and final adjustments to match final grade.

Section 01180 - Water System Piping Corrosion Control

Description

01180.00 Scope - This work consists of requirements for corrosion control materials and construction methods for the City water system piping. Provide the corrosion control system specified herein for transmission mains; for distribution mains and service lines proximate to foreign pipelines and to electric rail; for casing pipe; for pipe in vaults and above ground facilities; and for pipe on bridges. Impressed current corrosion protection systems are not covered.

01180.01 Abbreviations:

MDFT - Mils Dry Film Thickness, referring to coating applications.

NACE - National Association of Corrosion Engineers.

01180.02 Definitions:

Casings and Sleeves - Protective pipe or geomembrane through which the main or service is run.

Distribution Mains - Piping systems designed to distribute water to services.

Exothermic Welding - A specialized process used for electrical connections to the exterior of pipe and fittings.

Pipe on Bridges - Pipe, fittings, and appurtenances above ground and exposed, generally attached to bridge structures.

Piping in Vaults - Pipe, fittings, and appurtenances enclosed inside vaults, pump stations, or other buildings.

Services - The piping between the distribution main and the water meter.

Transmission Mains - Piping systems with minimal service connection, includes conduits, interties, supply mains, and pump mains.

01180.07 Submittals:

(a) Products - Provide submittals for all products referenced in this section.

(b) Testing - Submit written documentation of experience as a professional engineer regularly performing cathodic protection work or certification as a NACE Cathodic Protection Specialist for all personnel performing field testing.

(c) Test reports - Submit 3 copies of all field test reports.

Materials

01180.10 Exothermic Welds:

(a) Weld Materials - Molds, cartridges, and all required materials for exothermic (copper) welding shall be as produced by “Cadweld”, Erico Products, Inc., or approved equal. Provide molds and cartridges of a size and material as recommended in writing by the manufacturer. Molds for exothermic welding shall be graphite; ceramic molds are not acceptable.

(1) Ductile Iron Pipe - For connection to ductile iron pipe, use “Cadweld” XF-19 alloy weld metal or approved equal.

(2) Cast Iron Pipe - For connection to cast iron pipe, use “Cadweld” XF-19 alloy weld metal or approved equal.

(3) Steel Pipe - For connection to steel pipe, use "Cadweld" F-33 alloy weld metal alloy or approved equal.

(b) Terminals - All wires used with exothermic welds shall have formed sleeve terminals and shall be welded using the reduced weld size and special weld mold for formed terminals, as specified in writing by the manufacturer. The formed terminals may be factory fabricated or may be field formed using sleeves and a hammer die. Connections to mortar coated steel or concrete cylinder pipe shall be exothermically welded to a factory installed 1/2 inch diameter steel rod.

(c) Weld Caps - Furnish weld caps of high-density polyethylene plastic, 15 mils (minimum) thickness, as manufactured by Royston Laboratories, Phillips Petroleum, or approved equal. Provide caps that incorporate a dome for the weld, a tunnel to contain the lead wire from the weld connection, and a base plate to cover the prepared pipe surface. Weld caps shall be provided pre-filled with mastic/adhesive and supplied with primer/activator.

01180.11 Galvanic Anodes - Supply galvanic anodes of the quantity, composition, dimensions, metal weight, and packaged backfill as shown or noted on the drawings. Provide magnesium anodes, nominal 20 inches long and nominal 30-lb bare metal weight. Magnesium anodes shall meet the requirements of ASTM B-843-M1C High Potential Magnesium Alloy with an open circuit potential of (-)1.7VDC to CSE. The anodes shall be prepackaged in a permeable cloth bag containing the manufacturer’s prescribed backfill and the packaged anode shall be a minimum of 2.5 times the bare anode weight. The anode lead wire shall be solid copper wire, AWG #12 or #10, with USE- or THHN-type insulation, and the connection to the anode shall be silver soldered by the manufacturer and shall be of an un-spliced length specific to the application but not less than 15 feet.

01180.12 Test Stations and Coupons:

(a) Test stations - Flush-mounted test stations will be City-furnished cast iron valve boxes and covers (CIVs).

(b) Cathodic Protection Monitoring Coupons - Provide coupons, steel or ductile iron, to match the pipe material type. The coupon shall have 2 wires connected with a silver soldered potted connection, and with a minimum length of 10 feet. Provide MC Miller IR-Free coupons or approved equal. The coupon access drop tube shall be schedule 40 PVC pipe, 2 inches in diameter.

01180.13 Wire - Wire for test stations and joint bonds larger than AWG #12 shall be single-conductor, stranded copper, with USE-type insulation. Wire AWG #12 or smaller shall be solid not stranded, with TW-, THHN-, or USE-type insulation. Provide the wire size as specified or shown.

01180.14 Split Bolts and Insulation for Split Bolt Connections - Provide bronze split bolts, sized for the wire to be joined; insulating putty, 3M Scotchfill or approved equal; and vinyl electrical tape, 3M Scotch Super 33 or approved equal.

01180.15 Ground Rods and Clamps - Provide hot-dipped galvanized ground rods, 5/8 inch diameter 8 ft length. Provide bronze clamps, and AWG #6 or #4 stranded copper wire with USE-type insulation for connections between pipe and ground rod.

01180.16 Insulation for Dielectric Isolation:

(a) Insulating Flange Joints – Flange insulation shall include a full face insulating gasket, a full-length insulating sleeve for each bolt, and two insulating washers and two steel bearing washers for each flange bolt.

(1) Sleeves and Washers - Insulating sleeves and washers shall be Pyrox G-10. Both the insulating washers and the steel washers shall fit over the outside diameter of the sleeve and shall fit within the bolt facing of the flange.

(2) Gaskets - Gaskets shall be full faced, Styrene Butadiene Rubber (SBR)**,** Nitrile (Buna-N), Neoprene, or compressed vegetable fiber. Gaskets shall have adequate dielectric properties, 300V/mil minimum, and shall be suitable for the operating and test pressures of the pipe system.

(3) Joint Assembly - An insulating joint assembly shall consist of 2 flange by plain end or 2 flange by mechanical joint (FLG x PE or FLG x MJ) adapters, a full face insulating gasket, with full length insulating sleeves, two insulating washers, and two steel bearing washers for each flange bolt.

(b) Insulating Flexible Couplings - Flexible couplings size 12 inches in diameter or smaller shall be ductile iron and couplings larger than 12 inches in diameter shall be steel. All flexible couplings shall be fusion-bonded epoxy coated and furnished with high strength alloy bolts and nuts.

(1) Insulating Boots - Provide insulating flexible couplings with two insulating boots that cover and prevent contact between pipe ends. Insulating flexible couplings shall be Romac Industries, Inc. style IC501 or IC400 or approved equal.

(2) Reducing Couplings - Where couplings are for differing pipe sizes use reducing couplings. Transition couplings are not acceptable. Couplings shall be specially ordered and sized for an insulating boot on one side and restraining pins on the other side.

(c) Insulating Copper Service Fittings - Fittings shall have insulators integral to the body of the fitting, as manufactured by Meuller Company or approved equal. The design of the fitting shall include a mechanical restriction to prevent the copper tube from passing through the insulation.

(d) Insulating Wall Seals - Wall seals shall consist of compression disks and pressure plates made of dielectric materials. Insulating wall seals shall be Model C Insulating Type as manufactured by Link Seal or approved equal.

01180.17 Casings and Seals:

(a) Casing Insulators and Casing End Seals - Casing insulators shall be constructed with fusion-bonded epoxy coated steel bands and reinforced insulating runners. Casing end seals shall be pull-on style with stainless steel clamps, custom sized for the OD of the casing and carrier pipe. Provide end seals, Type C, as manufactured by PSI or approved equal. Polyethylene encasement shall extend through the end seal and casing.

(b) Sleeves and Sleeve End Seals – Sleeves shall be schedule 40 PVC pipe, 4 inch minimum pipe diameter.

(1) Sleeved Pipe End Seals - End seals for sleeved pipe shall be pull on molded pipe sleeve seals with stainless steel clamps. Provide pipe sleeve seals by FERNCO, Inc. or approved equal. Molded end seals shall be sized to specific pipe type and sizes.

(2) Copper Services End Seals - End seals for sleeved copper services shall be pull on molded pipe sleeve seals with stainless steel clamps. Provide pipe sleeves by Fernco, Inc. or approved equal. Step down from 4 inch to the required copper tube size with schedule 40 PVC reducers. Molded end seals shall be sized specific to the pipe type and sizes.

01180.18 Encasement and Tape Wrap:

(a) Polyethylene Encasement - Furnish 4 mil Type 2 high density cross laminated polyethylene film in accordance with AWWA C105 tube type encasement. Polyethylene sheet is not acceptable. Furnish polyethylene encasement from the same manufacturer that supplies the ductile iron pipe.

(b) Geo-membrane - Furnish 40 mil PVC reinforced geo-membrane with 300V/mil dielectric strength and minimum 150-lb puncture resistance and 150-lb tensile strength.

(c) Tape Wrap Coating for Casing - Provide tape wrap coating for casing pipes in accordance with AWWA C203, AWWA C209, AWWA C214, and AWWA C216. Provide tape system per manufacturer's requirements for repair and to complete holdbacks. Provide petrolatum wax tape system per AWWA C217 with an auxiliary thin film conforming stretch outer wrap.

(d) Tape wrap for Copper Tube - Provide a 20 mil minimum PVC tape wrap coating for copper services and insulating joints. Provide Scotchwrap 51 or approved equal.

01180.19 Thin Film Coatings:

(a) Epoxy Coating for Buried Pipe, Fittings, and Specials - Provide coating materials per AWWA C210 or AWWA C213, except no coal tar epoxy will be allowed.

(b) Epoxy Repair for Buried Pipe Coating – Provide 100% solids two component quick cure epoxy coating, NSF approved for potable water. Provide 3M Scotchkote 323 brush grade or approved equal.

(c) Coatings for Pipe on Bridges and Pipe in Vaults:

(1) Ductile Iron Pipe - Provide a leafing aluminum epoxy mastic.

(2) Steel Pipe - Provide epoxy primer and intermediate coats with an aliphatic polyurethane topcoat. Provide Pota-Pox epoxy primer and intermediate coats and an Endura-Shield polyurethane topcoat all by Tnemec or approved equal.

(3) Alternative - As an alternative for steel pipe provide a zinc and micaceous iron oxide moisture-cured urethane system. Provide an MC-Miozinc primer, an MC Miomastic intermediate coat, and a Ferrox A topcoat all by Wasser High Tech Coatings or approved equal.

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(d) Thixotropic Mastic Coating – Provide a thixotropic mastic coating for field repair of existing coal-tar enamel that is not in contact with potable water. Provide Carboline Bitumastic 50 or approved equal.

(e) Leafing Aluminum Epoxy Coating - Provide a leafing aluminum epoxy mastic for marginally prepared surfaces. Provide Carbomastic 15 LO by Carboline or approved equal.

(f) Galvanizing - Galvanized items shall be per ASTM A123 & ASTM A 153. Provide zinc base alloys for repair per ASTM A780, zinc-rich paints are not acceptable.

(g) Silicate Concrete Coating – Provide a water based silicate sealer for waterproofing the exterior surface of new concrete vaults.

01180.20 Mortar, Grout, Grout Band - Mortar and grout shall be a chloride free portland cement and sand mix with not less than 1 part cement to 3 parts sand or a proprietary cementitious chloride free mix approved in writing by the pipe manufacturer. The grout band shall physically contain the mortar/ grout and prevent moisture loss.

01180.21 Backfill - Backfill in the pipe zone shall be aggregate or sand. Controlled density fill (CDF) and controlled low strength material (CLSM) are not acceptable. For tape wrapped pipe and polyethylene encased pipe, backfill shall be Class C backfill produced from crushed gravel.

01180.22 Miscellaneous:

(a) Pipe Hangers – All pipe hangers shall be hot-dip galvanized after fabrication.

(b) Aluminum - Aluminum in contact with concrete or stainless steel shall be paint coated in areas of contact with a non-alkyd based paint suitable for contact with concrete.

(c) Stainless Steel - The exterior surface of stainless steel that is in contact with ductile iron shall be paint coated with a coat tar mastic or surface tolerant epoxy.

01180.23 Polyvinyl Chloride (PVC) Pipe – Use PVC pipe conforming to 02410.70.

01180.24 Gravel – Use gravel conforming to 00405.14(c).

Construction

01180.40 Corrosion Protection:

(a) Transmission Mains - Transmission mains are piping systems with minimal service connections including conduits, interties, supply mains, and pump mains. Transmission mains shall be made electrically continuous with welded joints or joint bonds, shall be dielectrically isolated at all connections, and shall be dielectrically isolated into sections of 750 ft maximum length.

(1) Transmission mains crossing an electric rail track shall be cased under the track and for a minimum of 10 ft horizontal distance beyond the track slab.

(2) Test stations shall be provided at dielectric isolation joints, casings, where transmission mains cross cathodically protected foreign lines, and as shown.

(3) Transmission mains made of ductile iron pipe shall have polyethylene tube encasement and anodes. Steel transmission mains shall have tape wrap and anodes. Mortar-coated steel and concrete cylinder pipe (CCP) transmission mains shall have continuous mortar coating over all in-line valves, fittings, and special appurtenances. All branch lines that are not mortar-coated shall be dielectrically insolated from the mortar-coated main.

(b) Distribution Mains and Services:

(1) Cathodically Protected Foreign Lines - Distribution pipe and copper services crossing a cathodically protected foreign line shall be sleeved in PVC pipe or sleeved with a PVC geo-membrane wrap for a minimum of 10 feet from the centerline of the foreign line. Copper service pipe shall be tape-wrapped within the PVC pipe or geo-membrane wrap. Distribution pipe paralleling a cathodically protected foreign line shall be installed with a minimum of 5 feet skin-to-skin separation between pipes.

(2) Electric Rail Systems - Distribution pipe crossing an electric rail system shall be cased under the track and for a minimum of 10 feet beyond the track slab. Copper services crossing electric rail track shall be tape wrapped and sleeved in PVC pipe under the track and for a minimum of 10 feet beyond the track edge. Distribution pipe paralleling an electric rail shall be installed with a minimum of 10 feet horizontal separation between track slab and edge of the pipe. The pipe shall be made electrically continuous with joint bonds, shall be dielectrically isolated at all connections, and shall be dielectrically isolated into sections of 500 feet maximum length. In addition, the pipe shall have polyethylene encasement, anodes, and test stations.

(c) Casings - Casing pipe shall have welded joints, dielectric coating, and be protected with galvanic anodes. Casing pipe installed in an open trench shall have tape wrap coating, and casing pipe that is bored shall have epoxy coating with field-coated joints. Casing installations shall include dielectric spacers, end seals, anodes, and test stations.

(d) Piping in Vaults - Piping in vaults and above ground facilities shall be painted with a leafing aluminum epoxy mastic.

(e) Pipe on Bridges - Pipe on bridges shall be painted with an epoxy coating system, an epoxy/polyurethane coating system, or a moisture-cured urethane coating system. All pipe hangers and pipe supports shall be hot-dip galvanized.

01180.41 Exothermic Welding and Underground Electrical Connections:

(a) General - Unless otherwise specified, all electrical connections to the pipe shall be by exothermic welding. Properly cover exothermic welds with weld caps or in the case of mortar coated steel or Concrete Cylinder pipe (CCP), tape wrap all exposed copper of weld and wire then encase all in mortar. Provide sufficient space between adjacent exothermic welds to install a full sized weld cap on each weld. Repair all damaged pipe coating in accordance with the manufacturer's recommendations. Prior to coating, test all welds by striking with a hammer in a manner approved by the professional engineer or specialist in cathodic protection.

(b) Pipe Joint Bonds - Provide pipe joint bonds to assure electrical continuity except where electrical isolation is specified. Connections to the pipe shall be by exothermic welding. Bond wires shall be un-spliced wire with field welds made in the trench. Alternatively, "pig tails" can be pre-welded (exothermic) to the pipe then the pigtails spliced together in the trench with split bolt connectors. To permit inspection of the welds and to prevent damage to the weld caps, apply all protective coating after the joint is in place and complete. Insulate the split bolt and all exposed copper wire by encapsulating with electrical insulation putty, Scotchfill® Insulating Putty or approved equal, molding the connection smooth, and then wrapping the connection at 50% overlap with vinyl electrical tape, Scotch Super 33 or approved equal.

(c) Joint Bond Configuration - There shall be a minimum of two parallel joint bond wires, AWG #2, at each pipe joint. Valves and fittings may be bypassed by bond wires, but the valve or fitting must be made electrically continuous with the pipeline by a single wire, AWG #2 or AWG #4 that connects directly to a pipe section or connects to a joint bond wire (header run) with a split bolt connection. An assembly of valve and fittings may have a single bond wire (tap) from each component piece split bolt connected to a header run (AWG #2) that connects at each end, directly to a pipe section by exothermic weld or by split-bolt connection to a joint bond wire.

(d) Wiring - All wiring is to be splice-free, except where splices are specified or shown or as approved. Coil or snake all buried wire with sufficient slack to prevent stress from backfill operations and earth settlement. All wire is to be buried a minimum of 30 inches below finish grade or installed in rigid conduit. All wire at test stations shall extend a minimum of 30 inches below finished grade or shall be installed in rigid conduit. Repair any damage to the wire insulation with self-adhering butyl rubber electrical tape, Scotch No. 130C or approved equal, and over wrap with vinyl electrical tape, Scotch No. 33 or approved equal. Spirally apply each layer at 50% overlap. This repair method is not applicable to repair of any wire in an impressed current system.

(e) Split Bolt Connections - Split bolt connections shall be limited to the connection of two wires. Three or more wires at one split bolt are not allowed. Connection of taps to header runs may be accomplished by stripping an appropriate length of insulation from the header without cutting the wire and connecting the tap at that point with a split bolt for each tap.

01180.42 Ground Rods - If the service is dielectrically isolated from the main, provide a ground rod, installed per National Electric Code, and connected to the customer side of the service.

01180.43 Galvanic Anode Installation:

(a) General - Unless specified otherwise, install anodes 5 feet below the pipe invert, positioned under the pipe or up to 3 feet perpendicular from the pipe edge. Do not place the anodes within 3 feet of a neighboring metallic structure. When anodes are distributed along the pipeline, alternate the perpendicular offset from one side of the pipe to the other.

(b) Location - Install the anode in clean, native backfill and not in the select bedding material. Locate anodes a minimum of 5 ft apart. Thoroughly soak the anode in water prior to installation. Compact the backfill to 95% of maximum density to 1 foot above the anode. Evenly distribute anodes along main and branch line installations. Anodes may be grouped at the ends of casings and short runs of pipe; maintain 5 ft minimum distance between anodes.

(c) Connection - The anode lead wire shall be exothermically welded to the pipe. Alternatively the anode shall be connected to a joint bonding wire by using a split-bolt connection. Distances between anodes are nominal lengths and anode connections shall be made at pipe joints. Unless otherwise specified, for ductile iron water mains and steel pipe and casings, provide anodes as shown.

01180.44 Test Station Installation - Locate test stations as follows:

(a) Isolation Joint Test Stations (TSIJ) - Provide a test station at all buried insulated flanges and insulating couplings, except insulated connections on copper services. Provide a test station at the dielectric isolation between mortar coated steel or CCP lines and dielectrically isolated branch lines, unless the Engineer elects to not install test stations at these locations. Insulating Joint Test stations shall have (2) AWG #8 wires welded to each side of the dielectric joint, 4 wires total.

(b) Casing Test Stations (TSC) - Provide one test station at each end of the casing. Casing Test Stations shall have (2) AWG #8 wires welded to the main and (2) AWG #8 wires welded to the casing, 4 wires total.

(c) Monitoring Test Stations (TSM) - Provide a monitoring test station with cathodic protection monitoring coupons where water mains cross cathodically protected foreign lines and where water mains cross electric rail tracks. Monitoring Test Stations shall have (2) AWG #8 wires welded to the main, and (2) cathodic protection monitoring coupons, each with (2) AWG #12 wires, 6 wires total.

(d) Combination Test Stations (TSC/IJ) - When two or more test stations on the same pipe are adjacent to each other (within 15 feet) they may be combined and the test wires run to a single flush mounted test station. A TSIJ near the end of a casing may be combined with the TSC into a single test station with two AWG #8 wires to the casing, two AWG #8 wires to the casing side of the dielectric joint and two AWG #8 wires to the far side of the dielectric joint, 6 wires total. A TSM can be included in the combined test station by providing cathodic protection monitoring coupons without additional wires to the pipe or casing.

01180.45 Dielectric Isolation:

(a) General – Provide pipe isolation with insulating flange joints, or insulating flexible couplings. Insulating joints shall be separate assemblies and not incorporated into joints with valves or other appurtenances with the exception of branch lines connected to Mortar Coated Steel Pipe (MCSP) or Concrete Cylinder Pipe. Where a branch line connects to a flange integral with a section of MCSP or CCP, a separate assembly is not required. Copper services shall be isolated with meter stops designed with integral insulation. Use insulating wall seals at all concrete wall penetrations.

(b) Insulating joints - Mechanical joint assemblies of flange coupling adapters may be assembled above grade complete with attached test wires. Trap wrap the flange edge of insulating joints with PVC tape to prevent particle bridging across the flange faces. Insulating flexible couplings shall have an insulating boot on each pipe end. Reducing insulating flexible couplings shall have a boot on one pipe end and restraining bolts on the other. Transition couplings are not acceptable. Use reducing couplings to accommodate differing pipe size. Joint restraint at flexible couplings shall only use hot-dip galvanized rod and nuts and shall be insulated from the non-cathodically protected side of a joint, or insulated from the mortar coated side of a joint or insulated on one side of the joint if both sides are cathodically protected.

01180.46 Polyethylene / Geo-membrane Encasement and Tape Wrap:

(a) Polyethylene Encasement Installation - Install polyethylene encasement, tube type, on all ductile iron pipe and appurtenances. Install one length of polyethylene tube encasement for each length of pipe in accordance with AWWA C105, Method A. Every 6 feet along the pipe, secure the polyethylene tube encasement with tape full circumference. The use of polyethylene sheets will not be allowed.

(b) Geo-membrane Installation - Install geo-membrane when crossing a cathodically protected foreign line where the pipe configuration does not allow for a PVC pipe sleeve. Install 40 mil geo-membrane around mechanical joints and similar connections where the polyethylene can be punctured or ripped. Tape the ends and seams of the geo-membrane with polyethylene tape and then cover the pipe joint with the adjoining polyethylene encasement. Bedding and backfill around polyethylene or geo-membrane encased pipe shall be Class C backfill produced from crushed gravel.

(c) Tape Wrap Coating for Pipe and Casings - Apply tape wrap coating on steel casing pipe in accordance with AWWA C203, AWWA C209, AWWA C216 for manufacturer applied tape wrap and AWWA C214 for minor field applications. For tape wrap coating repairs and other coating holdback areas, apply repair tape system per manufacturer's requirements. Apply petrolatum wax tape per AWWA C217 with outer wrap only where directed.

(d) Tape Wrap Coating for Copper Services – Provide 20 mil PVC tape wrap and apply at 50% overlap, 40 mil total. Wrap the copper tube, and all fittings including corporation and meter stop.

(e) Mortar Coated Steel (MCSP) and Concrete Cylinder Pipe (CCP) - Transmission mains shall have continuous mortar coating over all in-line valves, fittings, and other appurtenances, regardless of underlying coating, except as permitted, to allow the application of a dielectric coating and installation of anodes at a valve, fitting or other appurtenance in lieu of mortar coating.

01180.47 Thin Film Coatings:

(a) Paint for Buried Pipe, Casings, Casing Welds - Provide an epoxy coating per AWWA C210 and AWWA C213. For field repairs, prepare the surface by power tool cleaning, SSPC-SP3, and repair with a 100% solids epoxy, one coat of 25 mil dry film thickness (mdft), or with a thixotropic coal tar mastic, one coat of 20 mdft.

(b) Paint Coating for Pipe in Vaults and Facilities - Coat all piping except copper, brass, and fittings and specials that are factory coated with fusion-bonded epoxy. Prepare the surface by power tool cleaning, SSPC-SP3, or shop abrasive brush blasting, SSPC-SP7. Use a needle gun or abrasive blast to disrupt the asphaltic coating on ductile iron pipe and fittings, but it is not necessary to remove all asphaltic coating. All work in vaults and facilities shall be done with HEPA filter equipment. Do not coat bolt areas such as flanges or restrained joint holdback areas until connection is complete. Coat with a leafing aluminum epoxy mastic, Carboline Carbomastic 15 or approved equal, 2 coats minimum with 6 mdft per coat, 12 mdft total.

(c) Paint Coating for Pipe on Bridges – Shop blast and shop coat pipe except for hold back areas. Surface preparation and application of coatings shall be in accordance with manufacturer's written recommendations

(1) Ductile Iron (DI) Pipe - For ductile iron pipe prepare the surface by power tool cleaning, SSPC-SP3, or shop abrasive brush blasting, SSPC- SP7. Use a needle gun or abrasive blast to disrupt the asphaltic coating on DI pipe and fittings, but it is not necessary to remove all asphaltic coating. Do not coat bolt areas such as flanges or restrained joint holdback areas until connection is complete. Coat with a leafing aluminum epoxy mastic, Carboline Carbomastic 15 or approved equal, 2 coat minimum with 6 mdft per coat, 12 mdft total.

(2) Steel Pipe - For steel pipe prepare the surface by near white abrasive blasting SSPC-SP10. Coat with an epoxy coating system, 3 coats of 3-4 mdft per coat, 9-12 mdft total. Alternatively coat with a moisture-cured urethane system at 3 mdft prime coat, 3 mdft intermediate coat, and 2 mdft topcoat, 8 mdft total.

(d) Galvanizing - Repair of galvanizing shall be per ASTM A780 using the zinc based alloys "hot stick" method. Zinc-rich paint is not permitted.

01180.48 Testing and Verification:

(a) Quality Assurance - The portion of the work that involves the installation and testing of the galvanic cathodic protection system shall be conducted by a professional engineer regularly performing cathodic protection work or by an individual who is registered or certified by the National Association of Corrosion Engineers (NACE) as a cathodic protection specialist. Submit verification of registration or certification for written approval prior to the start of the work.

(b) Field Verifications - The professional engineer or specialist in cathodic protection shall field verify the adequacy of the Contractor's personnel in handling and placing anodes, monitoring coupons, exothermic welding, installation of split bolt connectors, repair of coatings including weld caps, and measurements of dielectric isolation and bonding. The professional engineer or specialist in cathodic protection shall at the start of the work provide a list of qualified Contractor personnel and only these listed individuals shall perform such work for the Contractor.

(c) Testing During Construction - Test all isolation joints after installation and prior to backfilling.

(d) Continuity and Isolation Testing - Perform testing as follows:

(1) General - Test all sections of pipeline, appurtenances, services, hydrants, regulator vaults, and appurtenances that are cathodically protected and dielectrically isolated for electrical continuity and dielectric isolation after all Contractor connections have been made.

(2) Test Current Response - Measure the response of the pipe to the application of cathodic protection test current. If the application of the test current causes the pipe-to-soil potential to become more negative, electrical continuity of the pipeline, service runs, and appurtenances is indicated between that point and the point at which the test rectifier negative connection was made. The response of the potential shall be of a magnitude to demonstrate low resistance joint bonds. Electrical isolation across insulating fittings shall be indicated by the pipe-to-soil potential being more positive or only slightly negative in relation to the structure connected to the test rectifier.

(e) Lack of Continuity or Isolation - If electrical continuity or electrical isolation is not achieved, locate the deficiency and complete the necessary repairs. The engineer or specialist shall retest the system before final acceptance.

(f) Repairs - Make all repairs necessary to correct any deficiencies and repair any joint not passing the electrical continuity or isolation test at no cost to the City.

(g) Final System Testing - Final system testing shall be performed prior to the hydrostatic testing of each segment and prior to the substantial completion. Final testing shall be performed directly by the professional engineer or specialist in cathodic protection and witnessed by the City and shall include the following as a minimum:

(1) Test and Service Locations - Provide pipe-to-soil potential measurements for all test stations and for all service connections.

(2) Continuity and Isolation Measurements - Provide a report consisting of continuity and isolation measurements and other data for all cathodically protected sections of pipe, appurtenances, and for all service connections.

(3) Documentation - Provide 3 copies of a report documenting all testing and installation of cathodic protection system. The professional engineer shall stamp or the cathodic protection specialist shall sign the report. Include the specialist's NACE registration or certification number.

(h) Warranty - The 2 year warranty period specified in the Contract shall apply to the entire corrosion control system installed.

Measurement

01180.80 Lump Sum Basis - No separate measurement of quantities will be made for corrosion control.

01180.81 Insulating Flex Couplings - There will be no separate measurement of insulating flex couplings.

Payment

01180.90 Lump Sum Basis - Payment for work performed under this Section will be made at the Contract lump sum amount for the item “Corrosion Control”.

Payment will be payment in full for all materials, equipment, labor, and incidentals necessary to complete the work as specified.

01180.91 Insulating Flex Couplings - When insulating flex couplings are required, payment will be according to Section 01140.

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