

CITY OF ALBANY

Standard Specifications Technical Provisions

Section 19

Landscape Irrigation

19-1 General

19.1.1 Scope

Furnish all labor, tools, equipment, materials, transportation, and perform all operations necessary for the proper execution and completion of all irrigation work in accordance with the Drawings and Specifications. The work shall include, but not necessarily be limited to, trenching and backfill, water and electrical points of connection, backflow preventers, controllers, sleeves, conduits, main lines, lateral lines, remote control valves, pressure reducing valves, hose bibs, quick couplervalves, gate valves, risers, heads, emitter flush valves, emitters, emitter line and tubing, testing, adjustment of heads, maintenance and providing as-built drawings.

Coordinate installation of irrigation system with layout and installation of the plant materials to insure that there will be complete and full irrigation coverage of planting in accordance with these drawings, specifications and contract documents. Irrigation system shall be installed and tested prior to installation of plant material.

The “Model Water Efficient Landscape Ordinance” by the State Department of Water Resources shall apply.

19-1.2 Related Work

Section 020: Landscaping

19-1.3 Applicable Publications — The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. Federal Specification (Fed. Spec.):

- WW-H-001220 Head, Sprinkler, (Underground Connection)
- WW-V-51F Valve, Angle, Check and Globe, Bronze; 125-, 150-, and 200-pound, Threaded End, Flange Ends, Solder Ends, and Brazed End, for Land Use.
- WW-V-54D Valve, Gate, Bronze (125-, 150-, and 200 pound, Int Am 3 Screwed, Flanged, Solder End, for Land Use)
- B. American National Standards Institute (ANSI) Publications:
- B2.1-68 Pipe Threads (Except Dryseal) Specifications, Dimensions and Gauging for Taper and Straight Pipe Threads, Including Certain Special Application
- B16.3-77 Malleable Iron Threaded Fittings, Class 150 and 300.
- C. American Society for Testing and Materials (ASTM) Publications:
- A53-81A Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- A120-81 Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless for Ordinary Uses.
- B61-80 Steam or Valve Bronze Castings
- B62-80 Composition Bronze or Ounce Metal Castings
- D1785-76 (Poly Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2241-80 (Poly Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
- D2287-81 Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- D2464-76 Threaded (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- D2466-78 (Poly Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

19-1.4 Submittals

- A. The following items shall be submitted to the City for review:
1. Materials List
 2. Shop Drawings
 3. Manuals
 4. As-built Drawings
 5. Controller Charts
- B. Controller Charts
1. As-built drawings shall be approved by the City before controller charts are prepared.
 2. Provide one controller chart for each controller controlling this area.
 3. The chart shall show the area controlled by the automatic controller and shall be the maximum size which the controller door will allow.
 4. The chart is to be a reduced drawing of the actual as-built system. However, in the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a size that will be readable when reduced.
 5. The chart shall be a blackline or blue-line ozalid print and a different color shall be used to indicate the area of coverage for each station.
 6. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum of 10 mils.
 7. These charts shall be completed and approved prior to final inspection of the irrigation system.

19-1.5 Explanation of Drawings

- A. Due to the scale of the drawings, it is not possible to indicate all off-sets, fittings, sleeves, etc. which may be required. The Contractor shall carefully

investigate the structural and finished conditions affecting all of this work and plan his work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between existing and contract installation of irrigation systems, planting including existing trees and shrubs, architectural features, above and below grade utilities, hydrants, and drainage system.

The Contractor shall be responsible for modifications to the irrigation system to prevent blockage of sprinkler irrigation patterns; to prevent overspray and excessive runoff onto walkway and parking areas; and to provide full irrigation coverage to the planted areas.

Modifications shall be reviewed by the City prior to installation. All costs associated with modifications to the irrigation system and verification of utility and underground structure locations including potholing shall be considered as included in the Contract Prices paid for the various items of work and no additional compensation will be made therefor. Damage to utility lines, underground structures, etc., shall be repaired at the Contractor's expense to the satisfaction of the City.

- B. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.
- C. The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering or that will affect layout of the planting. Such obstructions or differences should be brought to the attention of the City. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.

19-1.6 Equipment to be Furnished

- A. Supply as a part of this contract the following tools:
 - 1. Two (2) sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.
 - 2. Two (2) keys for each automatic controller.
 - 3. Two (2) keys for each controller enclosure.

4. Six (6) quick coupler keys and matching hose swivels for each type of quick coupling valve installed.
5. Two (2) keys for the hose bib.
6. The above mentioned equipment shall be turned over to the City at the conclusion of the project. Before final inspection can occur, evidence that the City has received material must be shown by the Contractor.

19-1.7 Handling of PVC Pipe and Fittings — The Contractor is cautioned to exercise care in handling, loading, unloading, and storing of PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded and, if installed, shall be replaced with new piping.

19-1.8 Verification of Site Conditions & Surveys

Contractor shall, to the satisfaction of the City, lay out the work from the plans and shall establish all bench marks, monuments, lines and levels necessary for the construction covered by this contract unless otherwise specified herein. The Contractor shall employ a qualified land surveyor registered in the State of California, to lay out the work and to verify the lines and elevations as the work progresses. All dimensions shall be checked against existing conditions and discrepancies reported immediately to the City. Contractor shall be responsible for establishment of basic layout of entire area to the satisfaction of the City prior to beginning any portion of construction. Any discrepancies arising from preliminary layout shall be resolved prior to construction. During the progress of construction, the Contractor shall provide surveying service as necessary, or upon request of the City, to assure that the construction complies with the plans and specifications.

Prior to installation, Contractor shall carefully check all grades to satisfy himself that the work may proceed.

19-2 Materials

19-2.1 General — Use only new materials of brands and types noted on the drawings, specified herein, or approved equals.

19-2.2 PVC Pressure Main Line Pipe, Fittings and Fabrication Materials

- A. Pressure main line piping for sizes 1-1/2" and larger, shall be Ring-Tite PVC Class 200.

Ring Tite Pipe: Pipe shall be made from an NSF approved Type I, Grade I, PVC compound conforming to ASTM specification D1784. All pipe must meet requirements as set forth in Federal Specifications PS-22-70, with an appropriate standard dimension (S.D.R.).

- C. Field fabrication of ring-tite fittings will not be allowed. Use molded ring-tite type fittings for PVC as manufactured by Flo Control or approved equal.
- D. Pressure main line piping for sizes 2" and smaller shall be PVC Schedule 40 with solvent-weld joints.
- E. Solvent Weld Pipe: Pipe shall be made from NSF approved Type I, Grade PVC compound conforming to ASTM specification D1785. All pipe must meet requirements as set forth in Federal Specification PS-21-70.
- F. PVC solvent-weld fittings shall be Schedule 40, 1-2, II-I NSF approved conforming to ASTM test procedure D2466.
- G. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation methods prescribed by the manufacturer.
- H. All PVC pipe must bear the following markings:
 - 1. Manufacturer's name
 - 2. Nominal pipe size
 - 3. Schedule of class
 - 4. Pressure rating in P.S.I.
 - 5. NSF (National Sanitation Foundation) approval.
 - 6. Date of extrusion
- I. All fittings shall bear the manufacturer's name or trademark, material designation, size applicable I.P.S. schedule and NSF seal of approval.

19-2.3 PVC Non-Pressure Lateral Line Piping

- A. Non-pressure buried lateral line piping shall be PVC Type 1120 - Class 315 for 1/2 inch and Class 200 for 3/4 inch and larger. Joints to be solvent welded.
- B. Pipe shall be made from NSF approved, Type I, Grade II PVC compound conforming to ASTM specification D1784. All pipe must meet requirements set forth in Federal Specification PS-22-70 with an appropriate standard dimension ratio.

- C. Except as noted in 19-2.2 A and B this section, all requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure main line pipe and fittings as set forth in section 19-2.2 of this section.

19-2.4 Quick Coupling Valves

- A. Quick coupling valves shall have a brass, two piece body, designed for working pressure of 150 P.S.I. operable with quick coupler. Key size and type shall be as shown on the plans.
- B. Quick coupling valves shall be installed from 6" to 12" from nearest adjacent paved area.

19-2.5 Hose Bibs

- A. Hose bibs shall be brass construction with removable key handle as indicated on plans.

19-2.6 Gate Valves

- A. Gate valves 3" and larger shall be iron body, bronze mounted, double discs, parallel seats with pin disc spreader mechanism and shall conform to the specification of the American Water Works Association.
- B. Gate valves 3" and larger shall have 2" square operating nut, with arrow cast in metal indicating direction of opening.
- C. Gate valves 3" and larger shall have ends compatible with pipe in which they are being installed.
- D. Gate valves 3" and larger shall be similar to those manufactured by Kennedy Valve Mfg. Co., or approved equal.
- E. Gate valves 2-1/2" and smaller shall be bronze construction, screwed connections, equipped with operating wheel, and similar to those manufactured by Stockham Valve Co., or equal.
- F. All gate valves shall be installed per installation detail.

19-2.7 Control Wiring

- A. Connections between the automatic controllers and the electrical control valves shall be made with single strand, direct burial solid copper wire AWG-U.F., 600 volt. Install in accordance with the valve manufacturer's

specifications and wire chart. In no case shall wire size be less than #14 gauge.

- B. Control wires shall have an insulating jacket with a color that is unique for each controller. The common wire shall have a white insulating jacket with a stripe of color to match the control wire it serves. The spare wire shall have an insulating jacket with a color that is different from all control or common wires.
- C. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible.
- D. All wiring shall be run inside a conduit. Conduit for conductor wire shall be as specified by Section 19-2.13.
- E. An expansion curl shall be provided within three (3) feet of each wire connection and at least every 100 feet in length. Expansion curls shall be formed by wrapping at least five turns of wire around a one inch diameter pipe, then withdrawing pipe. Expansion curl shall be of sufficient length at each splice connection at each electric control valve, so that in case of repair, the valve bonnet may be brought to the surface without disconnection of the control wires.
- F. All splices shall be made in a valve or splice box with 3M-DBY wire splice pack, DS-400 Dri-Splice Wire, or approved equal. Use one splice per connector sealing pack.
- G. Field splices between the automatic controller and electrical control valves will not be allowed without prior approval of the City.

19-2.8 Automatic Controllers

- A. Automatic controllers shall be of size and type shown on the plans, Rainbird, or approved equal.
- B. Final location of automatic controllers shall be approved by the City.
- C. Unless otherwise noted on the plans, the 120 volt electrical power to the automatic controller location is to be furnished by a licensed electrical subcontractor and not by the irrigation subcontractor. The final electrical hook-up shall be the responsibility of the irrigation contractor.
- D. Label each new control line wire at controller. See installation section of these specifications.

- E. All controllers shall be equipped with a rain sensing override device.

19-2.9 Electrical Control Valves

- A. All electrical control valves shall be as listed on the drawings.
- B. All electrical control valves shall have a manual flow adjustment.
- C. Provide and install one control valve box for each electric control valve. Box to be lockable.
- D. Label control line wire at each valve. See installation section of these specifications.

19-2.10 Control Valve Boxes

- A. Use 10" round valve box with extension and bolt down cover for all gate valves and quick coupling valves, Carson Industries 910-12B or approved equal. Box to be bolt lockable.
- B. Use 11 3/4" x 17" x 12" rectangular box and bolt down cover for all electrical control valves, Carson Industries 1419-12B or approved equal. Box to be bolt lockable.

19-2.11 Sprinkler Heads

- A. All sprinkler heads shall be Champion, approved equal, or as listed on the drawings.
- B. Spray heads shall have a manual screw flow adjustment.
- C. Riser units shall be fabricated in accordance with the details shown on the plans.
- D. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body.
- E. All sprinkler heads shall be brass and of the same type shall be by the same manufacturer.

19-2.12 Sleeves

- A. All water lines installed under paving or through architectural features shall be installed in Class 200 PVC pipe. Size as required, unless specified otherwise on Drawings.

- B. Sleeves shall extend 12" beyond edges of pavement.
- C. There shall be no ring tite couplings inside of sleeves.
- D. Where length of sleeve exceeds 15' in length and where ring tite pipe is designated to be installed at sleeve location, substitute class 315 solvent weld pipe and Schedule 40 solvent weld fittings inside sleeve.
- E. Coordinate sleeve and pipe locations with other trench work and paving installations prior to construction.

19-2.13 Conduit

- A. All low voltage electrical wire shall be installed in schedule 40 PVC gray conduit. Size as required unless specified otherwise on the drawings. 120 volt electrical wires shall be installed in conduit in accordance with applicable codes and regulations.
- B. Conduit shall extend into splice boxes, or other enclosures. Where splice box is located in paved area, provide capped stub-out conduit piece extending out from box at least 12" into planting bed area.
- C. Splice boxes which must be installed in paved areas are to be concrete valve boxes approved by the City. Boxes shall not be installed in streets, driveways, or in locations where there is vehicular traffic.
- D. Coordinate conduit locations with other trench work and paving installations prior to construction.

19-2.14 Backflow Prevention Device

19-2.14.1 Reduced Pressure Type Backflow Preventer — ASSE 1013, backflow preventer shall be of the reduced pressure principle type conforming to the applicable requirements of AWWA C506. A certificate of Full Approval or a current Certificate of Approval shall be furnished for each design, size, and make of backflow preventer being provided for the project. The certificate shall be from the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California, and shall attest that this design, size and make of backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. A Certificate of Provisional Approval will not be acceptable in lieu of the above.

Reduced pressure type backflow preventer shall be Febco 825Y, Wilkins Model 575R, or approved equal in accordance with the Details.

The backflow preventer shall be installed in an enclosure as detailed on the plans.

19-2.14.2 Double Check Valve Assembly — Double check valve assembly shall be a Febco No. 805, Hershey No. 1 or approved equal, in accordance with the Details. Install check valve in a concrete box with lockable reinforced concrete lid.

19-2.15 Flushing End Plug

- A. Provide and install one flushing end plug at the end of each lateral in the drip irrigation system shown on the plans.
- B. Install flushing end plug in a Carson Box No. 910-12B.

19-2.16 Pressure Reducing Valve

- A. Pressure reducing valve shall be Wilkins Model 90 - 3/4", or approved equal. Discharge pressure is to be set at 30 PSI.

19-2.17 Filter

- A. Filter shall be installed on emitter manifold and shall be Irri-Delco 3/4"-39-0 filter with 155 mesh stainless steel screen and flush valve, or approved equal. Install emitter manifold assembly in a lockable box.

19-2.18 Pressure Gauge

- A. Pressure gauge shall be Irrrometer model 7-100 (0-100 PSI), or approved equal.

19-2.19 Emitter Riser

- A. Emitter riser shall be 1/2" IPS Flexible Hose (.840 O.D.) Use only IPS Weld-on #795 solvent weld cement on this hose.

19-2.20 Emitter Assembly

- A. Single Outlet Emitter: Emitter assembly shall consist of a 1/2" Sch. 80 PVC Male adapter (gray), a Salco RA 125T Adapter or approved equal, and a Salco emitter or approved equal.
- B. Multiple Outlet Emitter: Emitter assembly shall consist of a 1/2" Sch. 40 PVC Male Adapter, a RA 125T, 1/2" adapter, a Salco PC6-1 Multi-Outlet Emitter, Salco Distribution Tubing #CT-125 PVC, Salco EOCV Emitter

Outlet Check Valves on Tips of Distribution Tubing and a Salco DAS-8 Emitter Access Sleeve, all products as specified or approved equal.

19-3 Preparation

19-3.1 Physical Layout

- A. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads.
- B. Coordinate drip, bubbler and spray system with approved plant layout prior to installation of any irrigation piping.
- C. All layout shall be approved by City prior to installation.

19-3.2 Water Supply

- A. Sprinkler irrigation system shall be connected to water supply points of connection as indicated on the drawings.
- B. Connections shall be made at approximate locations as shown on drawings. Contractor is responsible for minor changes caused by actual site conditions.

19-3.3 Electrical Supply

- A. Electrical connections for automatic controller wiring shall be made to electrical service points as indicated on the drawings.
- B. Connections shall be made at approximate locations as shown on drawings. Contractor is responsible for minor changes caused by actual site conditions.

19-4 Execution

19-4.1 General — Contractor is responsible for coordinating work with paving installations and/or removal and repair of all asphalt and/or concrete paving necessary to install the irrigation system as shown on the plans which are a part of these contract documents. Contractor shall coordinate all work within public right-of-ways with the appropriate agencies and City. Removal and repair of paving shall be completed under the direction and approval of the City and appropriate agencies and shall be installed in accordance with City/County Specifications and applicable codes.

19-4.2 Trenching — Trenching shall be in accordance with Section 18-1 of these Technical Provisions and as specified herein.

- A. Dig trenches straight and support pipe continuously on bottom of trench. Lay pipe to an even grade. Trenching excavation shall follow layout indicated on drawings and as noted.
- B. Where it is necessary to excavate adjacent to existing trees, the Contractor shall use all possible care to avoid injury to trees and tree roots. Excavation in areas where two (2) inch and larger roots occur shall be done by hand. All roots two (2) inches and larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and heavily wrapped with burlap and kept damp, to prevent scarring or excessive drying. Where a ditching machine is run close to trees having roots smaller than two (2) inches in diameter, the wall of the trench adjacent to the tree shall be hand trimmed, making clean cuts through. Roots one (1) inch and larger in diameter shall be painted with two coats of Tree Seal, or equal. Trenches adjacent to trees should be closed within twenty four (24) hours; and where this is not possible, the side of the trench adjacent to the tree shall be kept shaded with damp burlap or canvas.
- C. Subgrade of all trenches shall be flush with the adjoining subgrade. The sprinkler irrigation contractor shall set in place, cap and pressure test all piping to be under paving prior to the paving work.
- D. Generally, piping under existing walks is to be done by jacking, boring or hydraulic driving, but where any cutting or breaking of sidewalks and/or concrete is necessary, it shall be done and replaced by the Contractor as part of the contract cost. Permission to cut or break sidewalks and/or concrete shall be obtained from the City. No hydraulic driving will be permitted under concrete paving. When pavement removal is approved by the City, removal and replacement shall be in accordance with other applicable provisions of these Technical Provisions.

Minimum cover requirements over:

- 1. Non pressure lines: 18"
- 2. Pressure main lines: 24"
- 3. Control wiring: 24"
- 4. All pipe and conduit under asphalt roadways: 36"
- 5. All pipe and conduit under concrete roadways or asphalt pedestrian or bike paths 24"

19-4.3 Backfilling — Backfilling shall conform to Section 18-2 and 18-5 of these Technical Provisions and as specified herein.

- A. The trenches shall not be backfilled until all required tests are performed.
- B. A 6" layer fine granular material backfill will be initially placed on all lines. No foreign matter larger than one-half (1/2) inch in size will be permitted in the initial backfill. Remainder of backfill shall be excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, or other approved materials, free from large clods of earth or stones. Backfill shall be mechanically compacted according to Section 18. Backfill will conform to adjacent grades without dips, sunken areas, humps or other surface irregularities.
- C. Flooding of trenches will be permitted only with approval of the City.
- D. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments without cost to the City.

19-4.4 Assemblies

- A. Routing of sprinkler irrigation lines as indicated on the drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to conform with the details and plans.
- B. Install NO multiple assemblies from PVC mainlines. Provide each assembly with its own outlet.
- C. Install all assemblies specified herein in accordance with the respective details. In absence of details or specs pertaining to specific items required to complete work, perform such work in accordance with best standard practice and with prior approval of the City.
- D. On PVC to metal connections, the Contractor shall work the metal connections first. Permatex 51 pipe joint compound or approved equal, shall be used on all threaded PVC to PVC, and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Use no pipe joint compound on threaded connections at sprinkler inlets.

19-4.5 Line Clearance — All lines shall have a minimum clearance of six (6) inches from each other and from lines of other trades. Parallel lines shall not be installed directly over one another.

19-4.6 Pipe

A. PVC:

1. Pipe shall be cut with a fine tooth hacksaw or approved PVC cutting tool and any burrs shall be removed. The outside surface of the pipe and the inside surface of the fittings shall be wiped with a clean cloth saturated with methyl isobutyl ketone (MIBK) to remove all dirt and moisture before the cement solution is applied. The cement solution shall be applied to the pipe and fitting socket with a brush having a width approximately three-quarters the depth of the socket. The cement solution shall be applied freely with a light wiping action to spread the cement uniformly over the surfaces. The pipe surface of fitting socket shall not be rubbed with a brush any more than is necessary to spread the cement. If the cement thickens, it shall be discarded.
2. Immediately after the cement has been applied to the surface to be joined, the pipe shall be inserted into the fitting with a twisting motion to the full depth of the fitting socket. Immediately after joining is completed, any excess cement shall be thoroughly wiped from the pipe and fitting. The joined members shall be allowed to cure for at least 5 minutes before they are handled. In cold or damp weather, the curing period shall be increased due to slower evaporation of the solvent. An additional fitting or pipe section may be added to the completed joint within 3 minutes if care is exercised in handling so that a strain is not placed on the previous joint. The male pipe threads of all threaded connections on PVC plastic pipe shall be coated with Permatex #51 pipe joint compound or a joint compound suitable for use with plastic pipe.
3. Except as shown on the plans, PVC plastic pipe placed in a trench shall be laid on level, undisturbed, or well-compacted earth and solvent-weld pipe shall be snaked from side to side in the trench at intervals of approximately 50 feet. Pipe shall be held down between joints with small mounds of earth to prevent movement. After completing the pressure tests on the pipelines and before any backfill is placed, water shall be run through the entire line until the pipe has been cooled to the supply water temperature. The trench shall be immediately backfilled, covering the pipe with soft earth to prevent damage to the pipe from rocks or clods.
4. There shall be no ring tite couplings inside of sleeves.
5. Where length of sleeve exceeds 15' in length and where ring tite

pipe is designated to be installed at sleeve location, substitute class 315 solvent weld pipe and Schedule 40 solvent weld fittings inside sleeve.

B. Thrust Blocks:

1. Thrust blocks shall be provided where necessary to resist system pressure on ring-tite gasketed pipe and fittings. Blocks shall be concrete and the size shall be based on an average soil safe bearing load of 2,000 lbs/s.f.
2. Form thrust blocks in such a manner that concrete comes in contact only with the fittings. Thrust blocks shall be between solid undisturbed soil and the fittings.

19-4.7 Remote Control Valves

- A. Install where shown on drawings and details and in accordance with manufacturer's specifications. When grouped together, allow at least eighteen (18) inches between valves. Install each remote control valve in a separate valve box.
- B. Provide each assembly with its own outlet; no multiple assemblies will be allowed.
- C. Remote control valves shall be adjusted so the sprinkler heads operate at the pressure recommended by the head manufacturer and so a uniform distribution of water is applied by the sprinkler heads to the planting area for each individual valve system.
- D. Label control line wire at each valve with a 2-1/4" X 2-3/4" polyurethane I.D. tag, indicating identification number of valve (controller and station number). Attach label to control wire.

19-4.8 Quick Coupling Valves

- A. Install as detailed on the drawings.

19-4.9 Hose Bib

- A. Install as detailed on the drawings.

19-4.10 Valve Boxes

- A. All valve boxes shall be set to finish grade in lawn areas and 2 inches above finish grade in ground cover areas.
- B. Valve boxes located near walks, curbs, and header boards, shall be installed in such a way as to align with those items, squarely if rectangular in shape, and with top surface matching plane as items listed above.
- C. Install boxes 12" away from and perpendicular to adjacent improvements. At multiple valve box groups, install boxes 6" apart, measured at finish grade surface. Short side of box shall be parallel to adjacent improvement.

19-4.11 Flushing of System

- A. After all new sprinkler pipe lines and risers are in place and connected, all necessary diversion work has been completed, and prior to installation of sprinkler heads, the control valves shall be opened and a full head of water used to flush out the system.
- B. Sprinkler heads shall be installed only after flushing of the system has been accomplished to the complete satisfaction of the City.

19-4.12 Automatic Controller

- A. Install as per the plans and details and manufacturer's instructions. Remote control valves shall be connected to controller in numerical sequence as shown on the drawings.
- B. Label each new control line wire at controller with a permanent non-fading label indicating station number of valve controlled. Attach label to control wire.

19-4.13 Low Voltage Control Wiring

- A. A single common wire as previously described in these specifications, shall be installed from the controller to the control valves in series.
- B. For each control valve, install separate control wires as previously described in these specifications, from the Controller to each control valve serviced by the controller.
- C. A single spare wire as previously described in these specifications, shall be installed from the controller and stubbed into each valve box in series. The spare wire is not to be connected to any equipment at the time of

installation.

19-4.14 High Voltage Wiring for Automatic Controller

- A. A 120 volt power source and service switch for the automatic controller shall be provided by the electrical subcontractor. The irrigation subcontractor shall install the wires from the 120 volt power service switch to the controller.
- B. All electrical work shall conform to local codes, ordinances and union authorities having jurisdiction.
- C. The Contractor shall provide and install the service unit and meter socket and make the connection between the power source and the controller.
- D. Adequate coverage and protection of the 24 volt service wire leading from the controller shall be maintained from the bottom of the controller.

19-4.15 Testing — After the entire sprinkler system has been completely installed, a complete test of the entire installation shall be made by the Contractor in the presence of the City before final acceptance of the system by the City.

- A. Testing of Service Lines:
 - 1. After the pipe has been backfilled to 12 inches over the top, each section of the pipe to be tested shall be slowly filled with water and all air shall be expelled from the pipe. The valves controlling the admission of water into the section of pipe to be tested should be opened wide before shutting hydrants or blow-offs. After the system has been filled with water and all air expelled, all valves controlling the section to be tested shall be closed and the line be allowed to set for a period of not less than 24 hours.
 - 2. The pipe shall then be refilled, if necessary, and subjected to a pressure of not less than 150 lbs per square inch or the service pressure plus 50 pounds, whichever is greater for a period of four hours.
 - 3. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test. Any cracked or defective pipe, fittings, or valves discovered during the test shall be removed and replaced with sound material and the test repeated until the system is proved satisfactory by the City.
 - 4. For a 4 hour hydrostatic test, the allowable leakage in gallons is

equal to diameter (inches) x length (feet) x 0.00158.

5. The test water shall be left in the mains until backfilling operations are completed.
6. After backfilling is completed, and before pavement sections are installed, the test shall be run again and no section shall be allowed a leakage greater than that of the 4 hour hydrostatic test.

B. Testing Plastic Pipe:

After all new sprinkler piping and risers are in place and connected, and all necessary division work has been completed and prior to the installation of sprinkler heads, control valves shall be opened and a full head of water used to flush out the system. After the system is thoroughly flushed, risers shall be capped off and the system pressure tested. At drip system, cap tees before flexible riser is installed. Request the presence of the City in writing at least 72 hours in advance of testing. All testing shall be done in the presence of the City or the City's authorized representative. Apply a continuous static water pressure of 120 p.s.i. on main lines and 60 p.s.i. on lateral lines when welded plastic joints have cured at least 24 hours and with the risers capped as follows:

1. Test main lines and submains for 4 hours.
2. Test lateral lines for 2 hours.
3. Repair leaks resulting from tests. Pressure testing shall continue until no leakage or loss of pressure is shown over the entire prescribed test period. At the conclusion of the pressure test, the heads, flexible risers and emitters shall be installed and tested for operation in accordance with design requirements under normal operating pressure.

19-4.16 Testing of Electrical System — Prior to acceptance of the work, the Contractor shall cause the following tests to be made:

- A. For continuity of each circuit.
- B. For grounds in each circuit.
- C. A megger test on each circuit.
- D. A functional test in which it is demonstrated that each and every part of the system functions as specified or intended herein.

19-4.17 Sprinkler Heads

- A. Install the sprinkler heads as designated on the drawings. Sprinkler heads to be installed in this work shall be equivalent in all respects to those itemized.
- B. Spacing of heads shall not exceed the maximum indicated on the drawings. In no case shall the spacing exceed the maximum recommended by the manufacturer.
- C. Nozzles on stationary sprinklers shall be tightened after installation and sprinklers having an adjustment stem shall be adjusted on a lateral line for the proper radius, diameter and/or gallonage. They shall be set perpendicular to finish grade.
- D. Trim sprinkler heads around existing utility company boxes and other obstructions.

19-4.18 Adjustment of the System

- A. The Contractor shall flush and adjust all sprinkler heads for optimum performance and to prevent over-spray onto walks, roadways, and buildings as much as possible.
- B. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments after approval by the City, prior to planting. Adjustments may also include changes in nozzle or screen sizes and degrees of arc as required. Contractor is responsible for providing full coverage of all planted areas, with no flooding or dry spots.
- C. Lowering raised sprinkler heads by the Contractor shall be accomplished within ten (10) days after notification by the City.
- D. The irrigation system shall also be tested at the time of final inspection for planting. If in the opinion of the City, any portion of the irrigation system is found to be defective or damaged the Contractor shall make all required repairs or replacement to meet the requirements of the irrigation specifications at no additional cost to the City. The Contractor shall make repairs within two weeks after planting final inspection.

19-5 Maintenance

- A. Plant maintenance following project installation is included in the contract and it shall begin on the date the work is accepted by the Director of

Public Works as complete.

- B. The plant maintenance period shall be as specified in the Special Provisions. If not specified, the minimum period shall be 180 days.
- C. The irrigation system shall be maintained, repaired and adjusted as required by the Contractor during the plant maintenance period. Soil moisture at the plant root balls in each watering zone shall be checked prior to watering. The Contractor shall be responsible for adjusting watering cycles so that plants receive sufficient water to ensure vigorous growth without allowing soil to become oversaturated with water.

19-6 Measurement — The work performed under these specifications will be measured by the unit or lump sum as designated in the contract items of work.

19-7 Payment — Payment will be made at the lump sum or unit price for sprinklers, sprinkler heads, bubbler heads, quick coupling valves, backflow preventers, control valves, control assemblies, turning unions, or garden valves; and the contract prices per linear foot for the various sizes and types of pipe.

Full compensation for furnishing and installing swing joints and pipe used for risers shall be considered as included in the price paid for the contract item requiring the swing joint and riser and no additional payment will be made therefore.

When there are no separate contract items for materials necessary to complete the irrigation system, such materials shall be furnished and installed. Full compensation for this work and materials shall be considered as included in the prices paid for the various contract items of the irrigation system and no additional payment will be made therefore.

The contract prices and payments shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals; and for doing all the work involved in installing the irrigation systems, complete in place, as shown on the plans, and specified in these specifications and the special conditions and as directed by the City, including any excavation, backfill, testing and water involved.