

SECTION 32 84 00

PLANTING IRRIGATION

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for furnishing and installing modifications to an existing automatically-controlled irrigation system, and all other appurtenances necessary to irrigate landscape areas indicated on the drawings.

1.2 DEFINITIONS

- A. Mainline Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under constant system pressure.
- B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 volts or for remote-control, signaling power-limited circuits.

1.3 ABBREVIATIONS

- A. FPT: Female pipe thread
- B. NPT: National pipe thread
- C. PVC: Polyvinyl chloride plastic

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be under automatic operation with controller, automatic control valves and hydrometer.
- B. Minimum Working Pressures: The following are minimum pressure requirements for piping unless otherwise indicated.
1. Mainline Piping: 100 psi (640 kPa).

1.5 QUALITY ASSURANCE:

- A. Products Criteria:
1. Assembled Units: Components are compatible with each other and with the total assembly for the intended service.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Installer Qualifications:

1. Irrigation Contractor must be a licensed landscape contractor in the State of Oregon.
2. Must have demonstrated, using persons directly employed by the Contractor, experience with the installation of at least five (5) irrigation systems having large diameter gasketed pipe (3-inch and larger), electrically operated remote-control valves and has previous experience with installation of two-wire decoder based irrigation control systems.

C. System Requirements:

1. Layout work as closely as possible to drawings. Drawings are diagrammatic to the extent that offsets and all fittings are not shown. Diagrammatic also refers to the location of the pipelines and valves, which may have been adjusted for clarity of the drawings.
2. Determine the exact location for the assemblies by verifying actual field conditions. The locations shall be staked in the field and coordinated with the Contracting Officer's Representative (COR) before installation. Construction cannot proceed unless staking of mainline, isolation valve locations, hydrometer, and pressure regulator are reviewed and accepted by the COR.
3. Follow manufacturer's printed instructions for installation.

1.6 SUBMITTALS

- A. Submit product data as one package for each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Highlight items being supplied on the catalog cut sheets
- B. Provide qualification data for:
 1. A qualified irrigation installer.
- C. As-Built Record Drawings: Maintain a complete set of as-built drawings which shall be corrected daily to show changes in locations of all pipe, two-wire path when not located next to mainline, valves, and related irrigation equipment. Valves shall be shown with dimensions to reference points.

1.7 SUBSTITUTIONS

- A. COR must approve equipment prior to construction. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility. "As-Built" information shall show the sizes installed.

- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

1.8 TESTING

- A. Notify the COR three days in advance of testing.
- B. Newly installed irrigation pipelines jointed with rubber gaskets or threaded connections shall be subject to pressure and leakage testing after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints will be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the COR.
- D. Furnish clean, clear water, pumps, labor, fittings, power, and equipment necessary to conduct tests or retests.
- E. Volumetric Leakage Test - Gasketed Mainline Pipe:
 - 1. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - 2. Purge all air from the pipeline before test.
 - 3. Provide all necessary pumps, bypass piping, storage tanks, meters, 75 mm (3-inch) test gauge, supply piping, and fittings in order to properly perform testing. Testing pump must provide a continuous 700 kPa (100 psi) pressure to the mainline pipe. Where main lines are installed with significant elevation change, perform the test at the mid elevation of the segment being tested. Main lines may be tested in segments where the terrain makes it difficult to maintain the test pressure throughout. The test pressure is the minimum pressure on the line at the highest point of the line segment being tested.
 - 4. Allowable deviation in test pressure is 35 kPa (5 psi) during test period. Average pressure during the test shall be 700 kPa (100 psi) therefore the pressure shall start at 5 psi above and be re-pressurized when the pressure is 5 psi below the test pressure. Restore test pressure to 700 kPa (100 psi) at end of test. Water added to mainline pipe must be measured volumetrically to nearest 10 ml (0.025 gallons).
 - 5. Subject mainline pipe to the anticipated operating pressure of 700 kPa (100 psi) for two hours. The amount of additional water pumped in during the test will not exceed the value in the table, or the

calculated value using the formula below, based upon differing number of joints, duration, or pressure of the test:

Leakage Allowable (Gallons per (100 Joints) / Hour)

PIPE SIZE mm (INCHES)	Test Pressure (PSI)								
	60	70	80	90	100	110	120	130	140
63mm (2 ½")	0.26	0.28	0.30	0.32	0.34	0.35	0.37	0.39	0.40
75mm (3")	0.31	0.34	0.36	0.38	0.41	0.43	0.44	0.46	0.48
100 mm (4")	0.42	0.45	0.48	0.51	0.54	0.57	0.59	0.62	0.64
150 mm (6")	0.63	0.68	0.73	0.77	0.81	0.85	0.89	0.92	0.96
200 mm (8")	0.84	0.90	0.97	1.03	1.08	1.13	1.18	1.23	1.28
250 mm (10")	1.05	1.13	1.21	1.28	1.35	1.42	1.48	1.54	1.60
300 mm (12")	1.26	1.36	1.45	1.54	1.62	1.70	1.78	1.85	1.92

Note: Allowable Leakage calculated using $L = (NDVP) / 7400$

Where: L = Allowable Leakage (gph)

N = Number of Joints

D = Nominal Diameter of Pipe (inches)

P = Average Test Pressure (psi)

The following are the values for a 2-hour duration test at 100 psi for pipe length containing 100 joints.

- a. 3.10 liters (0.82 gallons) per 100 joints of 75 mm (3-inch) diameter pipe
- b. 4.09 liters (1.08 gallons) per 100 joints of 100 mm (4-inch) diameter pipe
- c. 6.13 liters (1.62 gallons) per 100 joints of 150 mm (6-inch) diameter pipe
- d. 8.18 liters (2.16 gallons) per 100 joints of 200 mm (8-inch) diameter pipe
- e. 10.22 liters (2.70 gallons) per 100 joints of 250 mm (10-inch) diameter pipe
- f. 12.26 liters (3.24 gallons) per 100 joints of 300 mm (12-inch) diameter pipe

Volumetric leakage exceeding the amounts indicated above, adjusted for system test pressure, number of joints and shall be a failure of the test. Replace defective pipe, fittings, joints, valves, or other appurtenances. Repeat the test until the pipe passes test.

6. Cement or caulking to seal leaks is prohibited.
7. Contractor may sub-contract testing to pipeline testing company approved by COR.

1.9 CONSTRUCTION REVIEWS

- A. The purpose of on-site reviews by the Contracting Officer's Representative (COR) is to periodically observe the work in progress, the Contractor's interpretation of the construction documents, and to address questions regarding the installation.
 1. Schedule reviews for irrigation system layout or testing with the COR as required by these specifications.
 2. Impromptu reviews may occur at any time during the project.
 3. A Final Inspection will occur at the completion of the irrigation Acceptance Test. The intent of the Final Inspection is to verify that all installation; testing; maintenance and operation submittals; and project record drawing submittals are completed prior to the start of the Maintenance and Warranty periods.

1.10 WARRANTY

- A. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of one year from date of final acceptance.
- B. Contractor will provide all manufacturers' and supplier's written guarantees and warranties covering materials and equipment furnished under this Contract.
- C. Make repairs within 24 hours of notification from COR. Fill and repair depressions. Restore landscape, utilities, structures, or site features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by construction or a defective item.
- D. Replace damaged items with identical materials and methods per contract documents or applicable codes. Make replacements at no additional cost to the contract price.
- E. Warranty applies to originally installed materials and equipment and replacements made during the Warranty period.

1.12 GENERAL CONSTRUCTION REQUIREMENTS

- A. Coordinate construction of irrigation system with COR. Coordinate temporary shut-down of existing system with COR prior to construction. Disturbance to cemetery operations must be minimized. See irrigation plans and installation details and Specifications Sections for required

coordination efforts related to the installation of specific irrigation components.

- B. Connections to the existing mainline must be approved by the COR while minimizing the impact on the operation of the existing irrigation system.
- C. Install irrigation components in landscaped areas unless specifically indicated otherwise.

1.11 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American Society of Mechanical Engineers (ASME):

C. American Society for Testing and Materials (ASTM):

A242/A242M-04 (2009)....High Strength Low-Alloy Structural Steel

A536-84 (2009).....Ductile Iron Castings

B61-08.....Steam or Valve Bronze Castings

B62-09.....Composition Bronze or Ounce Metal Castings

D1784-08.....Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds

D1785-06.....Poly Vinyl Chloride (PVC) Plastic Pipe, Schedule 40, 80, and 120

D1894-08.....Standard Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting

D2241-09.....Poly Vinyl Chloride (PVC) Pressure Rated Pipe (SDR Series)

D2464-06.....Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D2466-06.....Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

D2467-06.....Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

D2564-04(2009)e1.....Solvent Cements for Poly Vinyl Chloride (PVC)
Plastic Piping Systems

D2855-96(2010).....Making Solvent Cemented Joints with Poly Vinyl
Chloride (PVC) Pipe and Fittings

D3139-98 (2005).....Joints for Plastic Pressure Pipes Using
Flexible Elastomeric Seals

F477-08.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe

F656-10.....Primers for Use in Solvent Cement Joints of
Poly Vinyl Chloride (PVC) Plastic Pipe and
Fittings

D. American Water Works Association (AWWA):

C110/A21.10-08.....Ductile-Iron and Gray-Iron Fittings, 3-Inch
Through 48-Inch for Water

C111/A21.11-06.....Rubber-Gasket Joints for Ductile-Iron Pressure
Pipe and Fittings.

C115/A21.15-05.....Flanged Ductile-Iron Pipe with Ductile-Iron or
Gray-Iron Threaded Flanges

C151/A21.51-09.....Ductile-Iron Pipe, Centrifugally Cast, for
Water

C153/A21.53-00.....Ductile-Iron Compact Fittings for Water Service

C509-09.....Resilient-Seated Gate Valves for Water Supply
Service

E. Manufacturers Standardization Society (MSS):

SP70-2006.....Cast Iron Gate Valves, Flanged and Thread Ends

PART 2 - PRODUCTS

2.1 AUTOMATIC-CONTROL SYSTEM

A. Decoders for Two-Wire Operation:

1. The decoders shall be of solid-state design and housed in a watertight molded plastic housing. The decoder leads shall be 18-gauge, insulated, stranded copper conductors of colors as indicated below.

Wire leads shall be not less than 12" long. All decoder wire connections shall be made using watertight electrical connections suitable for the wire type being connected, as recommended by the manufacturer.

2. Decoders shall have addresses pre-coded from the factory of manufacture.
3. Provide manufacturer's optional barcode scanner-based decoder programming unit to input decoder addresses. Programs shall be capable of being backed up and restored with the programming unit. Acceptable Manufacturer and Model: Rain Bird DPU210.
4. Decoders shall be as manufactured and furnished by Rain Bird; as indicated in the irrigation controller manufacturer's printed instructions.
 - a. Field Decoder: FD-101.
 - b. Sensor Decoder: SD-210.

B. Decoder Cable:

1. 2-conductor control cable design consisting of tin coated copper conductors, insulated with PVC and having a high-density polyethylene direct burial jacket. Conductors are listed as Type UF by UL or ETL or CSA.
2. Conductor: Minimum conductor size 14 AWG; soft annealed tin coated solid copper conforming to ASTM B-33.
3. Insulation: Polyvinyl Chloride conforming to UL Standard 493 for TYPE UF rated 60°C.
4. Cable Assembly: Insulated conductors are laid parallel.
5. Outer Jacket: Pressure Extruded High Density PE conforming to ICEA S-61-402, and NEMA WC5 Jacket Thickness 3/64" minimum jacket material to completely fill interstices between the two insulated conductors.
6. Color Coding: Black, Red.
7. Size No. 14 gauge; 600V sunlight-resistant direct-burial for Rain Bird two-wire control systems; as indicated in the irrigation controller manufacturer's printed instructions, or approved equal.
8. Use red jacket for lead-in wires to control valves
9. Decoder-to-Solenoid (DTS) Cables 14 AWG, solid copper; 2-conductor; Paige Electric P7351D.
10. Decoder Cable Connectors: 3M/ DBY and DBR connectors, or equal.

2.2 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Mainline Pipe [75 mm(3-inch) and larger]: Polyvinyl Chloride (PVC), AWWA C900, PVC 1120, minimum working pressure 1025 kPa (150 psi) rubber-gasketed pipe equipped with factory installed reinforced gaskets. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139.
- C. Threaded Pipe:
 - 1. Polyvinyl Chloride, ASTM D1785, PVC 1120, Schedule 80, for threaded connections, risers, and swing joints.
- D. Fittings:
 - 1. Mainline Pipe [75 mm(3-inch) and larger]:
 - a. Ductile Iron and PVC Pipe: Use mechanical joints conforming to ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 850 kPa (125#). All fittings shall be installed with retainer glands designed for the pipe material, and shall be manufactured with twist off screws that shear off at the proper force to anchor the retainer gland to the pipe at the pressure rating for the pipe, or at the test pressure for the pipe, whichever is higher, without causing damage to the pipe.
 - b. PVC Pipe: Push-on rubber-gasketed ductile iron fittings with gasketed joints conforming to ASTM A536 and ASTM F477. Acceptable manufacturer for ductile iron fittings is 'Leemco' or approved equal.

2.3 PIPE JOINING MATERIALS

- A. Mainline Pipe [75 mm (3-inch) and larger]: Rubber gaskets, AWWA C111.
- B. Threaded pipes: Use only Teflon-type tape or Teflon based paste pipe joint sealant on plastic threads. Use non-hardening, non-toxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

2.4 PIPE AND FITTING RESTRAINTS

- A. Joint Restraints:

1. Mechanical joints conforming to ANSI A21.10 (AWWA C110) and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).

B. Joint Restraint Harness:

1. Provide a joint restraint harness wherever joints are not positively restrained by flanged fittings.
2. Provide a joint restraint harness with transition fittings between metal and PVC pipe.
3. Provide bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials that are stainless steel. Provide retainer conforming to ASTM A536. Provide high strength, low alloy steel bolts and connecting hardware conforming to ANSI/AWWA C111/A21.11.
4. Acceptable manufacturer is 'Leemco', or approved equal.

2.5 VALVES

A. Underground Shut-Off Valves:

1. Isolation Valves, [75 mm (3-inch) and larger]: Cast-Iron Gate Valves AWWA C-515, resilient-wedge, non-rising stem, ductile-iron body and bonnet, with stainless steel stem and bronze stem nut, and with restrained ends to mechanically attach to a fitting or PVC pipe; minimum Working Pressure: 250 PSI; End Connections: Mechanical joint or Flanged (as required by condition); Interior Coating: 14-16 mil fusion bonded epoxy complying with AWWA C550. Provide "T" handle socket wrenches of 15 mm (5/8 inch) round stock with sufficient length to extend 600 mm (2 feet) above top of deepest valve box cover. Acceptable Manufacturer: 'CLOW Valve Co.' Model 2639/2640 or approved equal.
2. Valve ends shall accommodate the type of main pipe adjacent to valve.

2.6 VALVE BOXES

A. Mainline Shut-off Valves:

1. In turf and planter areas valve boxes shall be HDPE structural foam Type A, Class III, black in color. Box shall be minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with black "T"-style lid.
2. Box shall be of such length to be adapted to depth of cover required over pipe at valve location. Set flush with finished grade.

B. Valve Box Accessories:

1. Galvanized steel wire mesh fabric; 16 gauge with 1/2-inch openings.

2. Filter Fabric: Spunbond polyester 3.5 oz. per square yard landscape fabric.
3. Support Blocks: precast concrete pavers, or bricks.
4. Drainage Backfill: Clean gravel or crushed stone, graded from 1/4-inch (6 mm) minimum to 3/4-inch (19 mm) maximum.
5. Valve I.D. Tags: Standard I.D. tags with hot-stamped black letters on a yellow background designating controller letter and valve station number in 1-inch minimum tall letters; 'Christy' or equal.

2.7 WIRE SPLICING MATERIALS

- A. Waterproof Wire Connectors. '3M' DBY or DBR.

2.8 WARNING TAPE

1. Standard, 4-Mil polyethylene 76 mm (3-inch) wide tape, detectable type yellow with black letters, and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW".

2.9 TRACER WIRES

1. No. 14, Green, Type TW plastic-coated copper tracer wire shall be installed with non-metallic irrigation main lines.

2.10 OTHER COMPONENTS

- A. Tools and Spare Parts: Provide operating keys, servicing tools, spare parts and other items indicated in the General Notes of the drawings.
- B. Pipe Bedding and Initial Backfill: Clean plaster sand, ASTM C-33.
- C. Other Materials: Provide other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

PART 3 - EXECUTION

3.1 INSPECTIONS AND REVIEWS

- A. Site Inspections:
 1. The Contractor shall verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the COR prior to beginning work.
- B. Utility Locates ("Call Before You Dig"):
 1. Arrange for and coordinate with local authorities the location of all underground utilities, and with cemetery maintenance personnel.
 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.

C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking has been completed. Notify the COR one week in advance of review. The COR will identify and approve modifications during this review.

3.2 LAYOUT OF WORK

- A. Stake out the irrigation system. Items staked include: mainline pipe and isolation valves.
- B. If staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with the COR.
- C. Connect new system to existing mainline.

3.3 EXCAVATION, TRENCHING, AND BACKFILLING

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit workspace for installing connections and fittings.
- B. Do not lay pipe on unstable material, in wet trench or when, in the opinion of the COR, trench or weather conditions are unsuitable for the work.
- C. Allow a minimum of 80 mm (3 inches) between parallel pipes in the same trench.
- D. Hold pipe securely in place while joint is being made.
- E. Do not work over, or walk on, pipe in trenches until covered by layers of earth well tamped in place to a depth of 300 mm (12 inches) over pipe.
- F. Full length of each section of pipe shall rest upon the pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipe on wood blocking.
- G. Install sprinkler lines to avoid electric ducts, storm and sanitary sewer lines, water and gas lines, all of which have right of way.
- H. Clean interior of pipe of foreign matter before installation. Keep pipe clean during laying operations by means of plugs or other methods. When work is not in progress, securely close open ends of pipe and fittings to prevent water, earth, or other substances from entering.
- I. Minimum cover:
 - 1. 900 mm (36-inches) or to match existing over mainline pipe in landscaped areas and to bottom of road base. (distance from top of pipe to finish grade)

2. 75 mm (3-inches) minimum horizontal separation between pipes and wiring in a common trench.
- J. Install and maintain safety fencing around all unattended excavation. Place safety signs adjacent to construction area roadway to the satisfaction of the COR.
- K. All excavations must be backfilled by the end of each workday. Do not leave any open trenches overnight, on weekends or on holidays.
- L. Excavated material is generally satisfactory for backfill. Backfill will be free from rubbish, vegetable matter, frozen materials, and stones larger than 2-inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe will be free of sharp objects that may damage the pipe.
- M. Backfill mainline pipe, lateral pipe and wiring in turf areas in the following manner:
 1. Backfill the trench by depositing the backfill material equally on both sides of the pipe or wire in 150 mm (6-inch) layers and compacting to the density of surrounding soil.
- N. Dress backfilled areas to original grade. Remove excess backfill to on-site location as directed by the COR.
- O. Where utilities conflict with irrigation trenching and pipe work, contact the COR for trench depth adjustments.
- P. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials, and equipment.
- Q. Warning tape shall be continuously placed above sprinkler system water mainlines at a depth of 200-250 mm (8-10 inches) below finish grade. Tape shall be purple with black letters for reclaimed water and imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW."

3.4 ASSEMBLING PIPE AND FITTINGS

- A. General:
 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and deburr. Clean pipe ends.
 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Maximum radius of

curvature and offset per 6 meters (20-foot) length of mainline and lateral pipe by pipe size are shown in the following table. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

SIZE	RADIUS	OFFSET PER 6 m (20') LENGTH
38 mm (1 ½")	7.5 m (25')	2.3 m (7'-8")
50 mm (2")	7.5 m (25')	2.3 m (7'-8")
63 mm (2 ½")	30 m (100')	575 mm (1'-11")
75 mm (3")	30 m (100')	575 mm (1'-11")
100 mm (4")	30 m (100')	575 mm (1'-11")
150 mm (6")	45 m (150')	400 mm (1'-4")
200 mm (8")	60 m (200')	300 mm (1'-0")
250 mm (10")	75 m (250')	225 mm (9")
300 mm (12")	90 m (300')	200 mm (8")

B. Mainline Pipe and Fittings:

1. Plastic pipe:

a. Shall be snaked in trench at least 1 meter to 100 meters (1 foot per 100 feet) to allow for thermal construction and expansion and to reduce strain on connections.

b. Joints

1) Solvent Welded Socket Type: ASTM D2855.

2) Threaded Type: Apply liquid Teflon thread lubricant of Teflon thread type. After joint is made hand tight (hard), a strap wrench should be used to make up to two additional full turns.

3) Elastomeric Gasket: ASTM F477.

- a) Immediately before joining two lengths of PVC pipe, the inside of the bell or coupling, the outside of the spigot and the elastomeric gasket shall be thoroughly cleaned to remove all foreign material.
- b) Bevel ends of PVC pipe per pipe manufacturer's printed instructions.
- c) Lubrication of the joint and rubber gasket shall be done in accordance with the pipe manufacturer's specifications.
- d) Care shall be taken that only the correct elastomeric gasket, compatible with the annular groove of the bell, is used. Insertion of the elastomeric gasket in the annular groove of the bell or coupling shall be in accordance with the manufacturer's printed instructions. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint.
- e) The spigot and bell or coupling shall be aligned and pushed until the reference line on the spigot is flush with the end of the bell or coupling. Pushing shall be done in a smooth, steady motion.

C. Specialized Pipe and Fittings:

1. Mechanical joint connections: Install fittings, fasteners, and gaskets per manufacturer's printed instructions and in accordance with accepted industry practices.
2. PVC Threaded Connections:
 - a. Use only factory-formed threads. Field-cut threads are not permitted.
 - b. Apply thread sealant in manner recommended by component, pipe, and sealant manufacturers and in accordance with accepted industry practices.
 - c. Use plastic components with male threads and metal components with female threads where connection is plastic-to-metal.

D. Joint Restraint Harness:

1. Install harness per manufacturer's printed instructions and in accordance with accepted industry practices.

2. Use restrained casing spacers for gasketed pipe routed through sleeves. Install harness per manufacturer's printed instructions and in accordance with accepted industry practices. Install self-restraining casing spacers at all gasketed pipe bell joints and every 10-feet along the gasketed mainline pipe installed through sleeves. Provide correct number and type of restraints per manufacturer's requirements.

3.5 INSTALLATION OF MAINLINE COMPONENTS

A. Isolation Valves:

1. No valves shall be set under roads, pavement, or walks.
2. Clean interior of valves of foreign matter before installation.
3. Set valve box cover flush with finished grade.
4. Install as indicated in the installation details, per manufacturer's printed instructions.
5. Install where indicated on the irrigation plans.
6. Brand or cast "GV" in 50 mm (2-inch) high by 5 mm (3/16-inch) deep letters on valve box lid.
7. Brand "AV" in 2-inch high by 3/16-inch deep letters on valve box lid.

3.6 VALVE BOX INSTALLATION

1. As presented in the installation details, per manufacturer's instructions.
2. Install flush with finish grade in to 1/2 inch above finish grade in lawns areas; and 1-inch above finish grade in mulched areas.

3.7 CONTROL WIRING

- A. All wire splicing shall occur only at the valves, at the controller, or at splits in the two-wire cable path. Install Decoder Cable Fuse Devices at each split in the two-wire cable path as show in the Drawings and per the manufacturer's printed instructions.
- B. Provide 1 spare wire, 2-conductor DTC cable, yellow in color, making a circuit from each decoder to all valves served by that decoder. Coil 24 inches length neatly in each box.
- C. Lay wire in trenches adjacent to mainline or lateral lines for maximum protection.
- D. Two-conductor DTC control cable from decoders to each solenoid shall have a colored jacket matching the wire jacket color on the decoder. Wire the cables from the decoders to the solenoids per manufacturer's printed instructions and as indicated in the Drawings.

- E. Bundle and tape wires in common runs from decoders to valves together at 10-foot intervals.
- F. Provide 24 inches expansion loops in control wire at connection to valve solenoids. Provide expansion loops in neat 1-inch expansion loops.
- G. Provide 24 inches expansion loops in decoder cable at least every 100 feet in runs of more than 100 feet in length, at changes in direction along the mainline, and at entrance and exits to all sleeves under paving. Provide 24-inch expansion coils at connection to decoders. Provide expansion loops in neat expansion loops.

3.8 DECODER-TO-SOLENOID CABLES:

- A. Provide decoder-to-solenoid (DTS) cable from decoders to solenoids on remote control valves.
- B. Two-conductor DTS control cable from decoders to each solenoid shall have a colored jacket matching the wire jacket color on the decoder for ease of installation and repair. Wire the cables from the decoders to the solenoids per manufacturer's printed instructions and as indicated in the Drawings.
- C. Install DTS cable in sleeves under paving.
- D. Provide 1 spare wire, 2-conductor decoder-to-solenoid (DTS) cable, yellow in color, making a circuit from each decoder to all valves served by that decoder. Coil 24 inches length neatly in each box.

3.9 DECODERS:

- A. Decoders for two-wire systems shall be placed in valve box with remote control valve wherever practicable.
- B. Program decoder two-wire interface modules per manufacturer's printed instructions using the decoder field programmer. Assign unique station numbers to each decoder before installing decoders in the field at the valve locations.
- C. Test the decoders by validating that the station numbers have been correctly accepted into the decoder.
- D. Write down the decoder number and the station(s) assigned to it onto the irrigation as-built drawing in the blank chart provided with the irrigation plans.

3.10 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed on bottom of trench, adjacent to vertical pipe projections, carefully installed to avoid stress from backfilling,

and shall be continuous throughout length of pipe with spliced joints soldered and covered with insulation type tape.

- B. Tracer wire shall follow main line pipe and branch lines and terminate in yard box with gate valve controlling these main irrigation lines. Provide sufficient length of wire to reach finish grade, bend back end of wire to make a loop and attach a Dymo-Tape type plastic label with designation "Tracer Wire."
- C. Record locations of tracer wires and their terminations on project record documents.

3.11 INSTALLATION OF OTHER COMPONENTS

A. Tools and Spare Parts:

- 1. Prior to the Review at completion of construction, provide operating keys, servicing tools, spare parts, and any other items indicated on the drawings.

- B. Other Materials: Install other materials or equipment shown on the drawings or installation details that are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.12 MAINTENANCE AND OPERATION INSTRUCTIONS

A. Maintenance and Operating Instructions: Provide Maintenance and Operating Instructions for the provided irrigation system in the form of manual(s) as follows:

- 1. Unless otherwise noted, provide irrigation operation and maintenance information in a 3-ring binder with table of contents and index sheet. Provide sections that are indexed and labeled. Provide the following information:
 - 2. Manufacturer's Operation and Maintenance manuals.
 - 3. Manufacturer's Technical Service Bulletins.
 - 4. Manufacturer's Warranty Documentation.
- 5. Operation and maintenance submittal package must be complete prior to being reviewed by the COR. Incomplete submittals will be returned without review.

3.13 TESTING, OPERATIONAL PERFORMANCE AND ACCEPTANCE

- A. Provide the testing as indicated in previous sections of the specifications.
- B. Demonstrate the operations of the systems as indicated in the project specifications.

C. Acceptance shall be predicated upon a successful demonstration of the operation of the systems, as described, or demonstrating a fully functional system in automatic operation for a period of 7 days, whichever is more stringent.

3.14 ADJUSTMENTS

A. Adjust pressure regulator to provide operating pressure of 90 psi.

3.15 CLEANUP

A. Upon completion of work, remove from site all machinery, tools, excess materials, and rubbish. Restore site to normal or original condition.

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