

**SECTION 32 84 00  
PLANTING IRRIGATION**

SPEC WRITER NOTES:

1. Use this section only for NCA projects. Delete text between // \_\_\_\_\_ // not applicable to project. Edit remaining text to suit project.
2. Modify paragraph 1.1 according to project requirements, indicate whether irrigation system is part of an existing system being modified, or whether system is new.
4. Remove references to automatic operation, when system being installed is manually operated.

**PART 1 - GENERAL**

**1.1 SUMMARY**

A. Section Includes:

1. // Manually controlled // Stand-alone programmable // Programmable fully automatic // irrigation system with full and complete 100 percent coverage within areas indicated on drawings.

SPEC WRITER NOTE: Add or delete items required to cover work for specific project.

2. Sleeving irrigation pipes and wires as indicated, and beneath hardscape surfaces.

SPEC WRITER NOTE:

Modify following statement that proposed irrigation equipment is to match or be compatible with the existing irrigation equipment and control system.

3. // Manufacturer of primary irrigation equipment including but not limited to sprinklers, controllers, control valves, // weather station // // and decoders // shall be compatible with the existing components on the cemetery //.

## 1.2 RELATED REQUIREMENTS

SPEC WRITER NOTE: Update and retain references only when specified elsewhere in this section.

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. As-Built Drawings: Section 01 00 00, GENERAL REQUIREMENTS.
- C. Availability and Use of Utility Services: Section 01 00 00, GENERAL REQUIREMENTS.
- D. Submittals: Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- E. Concrete: Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
- F. Excavation, Backfill: Section 31 20 00, EARTH MOVING.
- G. Electrical supply and connection to irrigation controller // and irrigation pumps //: Section 26 05 00, COMMON WORK RESULTS FOR ELECTRICAL.
- H. Spigot: Section 323000, SITE FURNISHINGS.
- I. Water Distribution Systems: Section 33 10 00, WATER UTILITIES.
- J. Irrigation Pressure Booster System: Section 32 82 00, IRRIGATION PUMPS.
- K. Plants, Turf, and Grasses: Section 32 90 00, PLANTING.

SPEC WRITER NOTE: Modify following paragraph based upon project conditions. Retain applicable definitions after editing.

## 1.3 DEFINITIONS

- A. Lateral Piping: Piping located downstream from control valves to sprinklers, specialties, // and lateral line drain valves //. Piping is under pressure during flow.
- B. Mainline Piping: Located downstream from point of connection to water distribution piping to, and including, control valves. Piping is under system pressure.
- C. 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.
- D. Hardscape: Site roads, walks, walls, or any other surface improvements for which removal for excavation to perform maintenance or replacement of the irrigation system pipes, or wires will require disturbance of other than landscape materials.

- E. RE: Contracting Officer's Representative (COR).
- F. COR: Contracting Officer's Technical Representative.

#### 1.4 APPLICABLE PUBLICATIONS

- A. Comply with references to extent specified in this section.
- B. American National Standard Institute (ANSI).
  - 1. B40.1-05 - Gauges-Pressure Indicating Dial Type-Elastic Element.
- C. American Society of Sanitary Engineers (ASSE).
  - 1. 1013-2005 - Reduced Pressure Principle Backflow Preventers.
- D. ASTM International (ASTM).
  - 1. A36/A36M-14 - Carbon Structural Steel.
  - 2. A53/A53M-12 - Pipe, Steel, Black and Hot-Dipped, Zin-Coated, Welded and Seamless.
  - 3. A242/A242M-04 (2009) - High Strength Low-Alloy Structural Steel.
  - 4. A307-14 - Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
  - 5. A536-84 (2009) - Ductile Iron Castings.
  - 6. B33-10(2014) - Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes.
  - 7. B61-08 - Steam or Valve Bronze Castings.
  - 8. B62-09 - Composition Bronze or Ounce Metal Castings.
  - 9. B584-14 - Copper Alloy Sand Casting for General Applications.
  - 10. D1785-15 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.
  - 11. D1238-04c - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
  - 12. D1784-11 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
  - 13. D1785-06 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, 120.
  - 14. D2241-15 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
  - 15. D2464-15 - Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  - 16. D2466-15 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  - 17. D2564-12 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

18. D3139-98 (2005) - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
19. D3261-15 - Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
20. D3350-10 - PE Pipe & Fittings Materials.
21. F477-14 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
22. F656-15 - Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

E. American Water Works Association (AWWA).

1. C110/A21.10-08 - Ductile-Iron and Gray-Iron Fittings, 3 inch Through 48 inch for Water.
2. C111/A21.11-06 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. C115/A21.15-05 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
4. C151/A21.51-09 - Ductile-Iron Pipe, Centrifugally Cast.  
C153/A21.53-00 - Ductile-Iron Compact Fittings for Water Service.
5. C504-15 - Rubber Seated Butterfly Valves.
6. C509-09 - Resilient-Seated Gate Valves for Water Supply Service.
7. C600-10 - Installation of Ductile Iron Water Mains and Their Appurtenances.
8. C900-07 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fitting, 100 mm and Through 300mm (4 In. Through 12 inches) for Water Transmission and Distribution.
9. C901-08 - Polyethylene (PE) Pressure Pipe and Tubing, 13 mm (1/2 inches) through 76 mm (3 inches), for Water Service.
10. C905-10 - Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 48 In. (350 Through 1,200 mm) for Water Transmission and Distribution.

F. Manufacturers Standardization Society (MSS).

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

G. National Electrical Manufacturers Association (NEMA).

1. 250-2008 - Enclosures for Electrical Equipment (1000 Volts Maximum).

**1.5 PREINSTALLATION MEETINGS**

- A. Conduct preinstallation meeting // at project site // minimum 30 days before beginning Work of this section.

SPEC WRITER NOTE: Edit participant list to ensure entities influencing outcome attend.

1. Required Participants:
  - a. COR (COR).
  - b. // Architect/Engineer. //
  - c. // Inspection and Testing Agency. //
  - d. Contractor.
  - e. Installer.
  - f. // Manufacturer's field representative. //
  - g. Other installers responsible for adjacent and intersecting work, including // \_\_\_\_\_ //.

SPEC WRITER NOTE: Edit meeting agenda to incorporate project specific topics.

2. Meeting Agenda: Distribute agenda to participants minimum 3 days before meeting.
  - a. Installation schedule.
  - b. Installation sequence.
  - c. Preparatory work.
  - d. Protection before, during, and after installation.
  - e. Installation.
  - f. Terminations.
  - g. Transitions and connections to other work.
  - h. Inspecting and testing.
  - i. Other items affecting successful completion.
3. Document and distribute meeting minutes to participants to record decisions affecting installation.

SPEC WRITER NOTES: Verify number of copies of irrigation information submittals with NCA/CFM Project Manager.

#### 1.6 SUBMITTALS

- A. Submittal Procedures: Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submittal Drawings:
  1. Shop Drawings: Show size, configuration, and fabrication and installation details.
  2. Controller Chart:

- a. Prepare map diagram showing valves, // decoders, // lateral lines, and control wires // and communication cables // route location. Identify valves size, station, number and type irrigation type. Submit approved "As-built" drawings before charts are prepared.
  - b. Provide one reduced drawing of actual "as-built" system controller chart, showing area covered by each automatic controller, supplied at maximum size controller door allows. When controller sequence is not legible when Drawing is reduced to door size, enlarge drawing to readable size and place folded in sealed plastic container, inside controller door.
  - c. Print chart with different color used to show area of coverage for each station. Charts must be completed and approved before final inspection of the irrigation system.
3. Irrigation point-of-connection showing pipe and valve sizes and lay lengths within specified vaults.
  4. Irrigation control panel showing all components of control system, location and layout within control cabinet.
  5. Show sizes of irrigation zones in GPM based on flow rates of actual irrigation outlets submitted and approved. Size valves for actual demand in GPM not exceeding manufacturer's recommendations for valves with pressure-regulating option.
  6. Flower Water Station Spigot Connection Assembly and Curb Stop Valve.
  7. Any other detailing through shop drawings indicated in the Drawings.
- C. Samples: // includes laboratory samples //.
1. // Product //: // size // // long // square //, each type and color //.
  - a. Submit quantity required to show full color // and texture // range.
  2. // Product //: Full sized, complete assembly.
  3. Approved samples may be incorporated into work.
- D. Manufacturer's Literature and Data:
1. Description of each product.
  2. Gear-driven rotor sprinkler heads indicating manufacturer recommendation for each application.
  - a. // Include Center for Irrigation Technology Space Pro Single Leg Profile showing Distribution Uniformity and Scheduling Coefficient for nozzles being used at specified spacing. //

- b. // Provide computer generated distribution uniformity and scheduling coefficient calculations for nozzles used at specified spacing. //
- 3. Controllers.
- 4. Valves.
- 5. Installation instructions.
- 6. Warranty.
- E. Materials List:
  - 1. Pipe and fittings.
  - 2. Valves.
  - 3. Mainline components.
  - 4. Water filtration components.
  - 5. Electrical components.
  - 6. Control system components.
- F. Test Reports: Certify // each product complies // products comply // with specifications.
- G. Operation and Maintenance Data:
  - 1. Care instructions for each exposed finish product.
  - 2. Start-up, maintenance, troubleshooting, emergency, and shut-down instructions for each operational product.

**1.7 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. Regularly manufactures specified products.
  - 2. Manufactured specified products with satisfactory service on five similar installations for minimum five years.
    - a. // Project Experience List: Provide contact names and addresses for completed projects. //
- B. Installer Qualifications: // Product manufacturer. // Manufacturer authorized installer //.
  - 1. Regularly installs specified products.
  - 2. Installed specified products with satisfactory service on five similar installations for minimum five years.
    - a. // Project Experience List: Provide contact names and addresses for completed projects. //.

SPEC WRITER NOTES: Provide requirements for welding certificates and welders' qualifications if required according to system installed for specific project.

- C. Welders and Welding Procedures Qualifications: // AWS D1.1/D1.1M. // AWS D1.2/D1.2M // AWS D1.3/D1.3M. //
- D. Products Criteria:
  - 1. Multiple Units: When two or more units, same type or class of materials or equipment required, provide compatible products from one manufacturer.
  - 2. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for final assembled product.
    - a. All components of assembled unit need not be products of same manufacturer but component parts which are alike are product of single manufacturer.
    - b. Components are compatible with each other and with total assembly for intended service.
- E. Codes and Regulations:
  - 1. Comply with latest edition of National Electrical Code, Uniform Plumbing Code, and applicable laws and regulations of governing authorities.

**1.8 WARRANTY**

SPEC WRITER NOTE: Always retain construction warranty. FAR includes Contractor's one year labor and material warranty.

- A. Construction Warranty: FAR clause 52.246-21, "Warranty of Construction."

SPEC WRITER NOTE: Specify extended manufacturer's warranties for materials only.

- B. Manufacturer's Warranty: Warrant irrigation materials against material and manufacturing defects.



SPEC WRITER NOTE: Specify customarily available warranty period for specified products.

1. Warranty Period: One year.

## **PART 2 - PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

#### **A. System Requirements:**

1. Full (head to head plus 10-percent) and complete coverage of irrigated areas. Adjust head locations as required to achieve full coverage of irrigated areas.
2. Layout work as shown on the drawings. Drawings are diagrammatic to the extent that swing joints, offsets and fittings are not shown. Diagrammatic also refers to the location of the pipelines and valves, which may have been adjusted for clarity of Drawings. Lines are to be common trenched wherever possible. Place irrigation heads shown along roadways between // \_\_\_\_\_cm (inches) // x cm (x inches) and x cm (x inches) from edge of pavement, unless otherwise specified.
3. Locations of remote control valves is schematic. Group remote control valves wherever possible and align at set dimension back of curb along roads // at the perimeter of burial sections //. Locate remote control valves individually or in groups of two. Where exact location for valves has not been set, or there are conflicts, coordinate location with COR before installation.
4. Run irrigation lines and control wire at boundaries of graves, thru designated utility lanes or beside roadways.
5. Run irrigation lines, control wires and power wires in trenches as indicated on Drawings or as typical for industry standards, when not indicated.
6. Connect new system to existing mains. // Disconnect and abandon existing irrigation system. // Connect to new mains //.
7. Unless noted otherwise, run irrigation lines, power wires and control wires in sleeves or conduit where installed beneath any site hardscape materials.

- #### **B. Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for

intended location and application. Run irrigation lines, cables, control wires, and high voltage conduits in separate sleeves.

SPEC WRITER NOTE:

1. Modify following paragraph to adjust coverage requirements when irrigation water quality causes staining hardscape materials due to water quality issues like high Iron.

2. Modify paragraph below as appropriate to indicate exactly what programming of central computer is required as well as programming for stand-alone programs and for any new satellite controllers.

3. Modify paragraph below when adding to existing irrigation system to address fully functional irrigation program, when all satellites and zone control valves are fully operational. Provide programming as required to perform temporary irrigation needed operate to establish new lawn and plants, before acceptance by the Government.

For central controls both existing and new controllers, provide or modify programming so system will operate existing and new controllers for fully operational irrigation system. In addition, require to provide any interim modifications to central controls to allow operation of existing system as well as all or portions of new, until the full system is operational.

- C. Completely program central controller // and satellite controllers // according to approved // master irrigation schedule //.
- D. Follow manufacturer's instructions for installation.
- E. Submit manufacturer's written certification that Control System is complete, including related components, and fully operational to COR.

SPEC WRITER NOTE:  
Update and specify only that which  
applies to the project.

## 2.2 SYSTEM PERFORMANCE

SPEC WRITER NOTE:  
1. Use article below only if irrigation  
system will be Designed/Build.  
2. Specify actual pressure when known for  
project.

- A. Design irrigation system complying with specified performance:
  - 1. Minimum Working Pressure // Program landscape irrigation pump station settings by the selected irrigation installer to maintain system pressure of minimum 90 psi dynamic while minimum two stations of similar water use volume are in simultaneous operation including stations at or near the furthest uphill interval from the irrigation system point of connection. Do not allow programming of control station to exceed 105 psig. // Station-specific pressure regulation shall occur at each control valve and shall be set by the selected irrigation installer to the optimum or manufacturer recommended operating pressure of the associated irrigation emission devices downstream of each control valve.
  - 2. Minimum Design Pressures:
    - a. Irrigation Mainline Piping: 1380 kPa (200 psig).
    - b. Lateral Piping: 1380 kPa (200 psig).
    - c. Valves: 1380 kPa (200psig) WOG.

## 2.3 MATERIALS

- A. Use new materials without flaws or defects.

## 2.4 PRODUCTS - GENERAL

- A. Provide each product from one manufacturer.

## 2.5 PIPE AND FITTINGS

- A. Irrigation Main Pipe:

## SPEC WRITER NOTE:

1. Retain pipe required.
2. Modify to 1375 kPa (200 psi) if working pressure exceeds the pipe pressure rating, or if the main is installed beneath pavement.

1. Ductile Iron Pipe: AWWA C151, minimum working pressure 1025 kPa (150 psi), cement lined, exterior bituminous coated.
  2. Polyvinyl Chloride (PVC) Pressure Pipe: ASTM D1784, PVC 1120, SDR 21 minimum working pressure 1375 kPa (200 psi), gasketing conforming to ASTM F477. Pipe outside diameters, comply with AWWA C151 cast iron pressure pipe to accommodate cast iron fittings.
  3. Polyvinyl Chloride (PVC) Pressure Pipe: ASTM D1784, Class 200, SDR-21, rated at 1375 kPa (200 psi), gasketing conforming to ASTM F477.
  4. High Density Polyethylene (HDPE) pipes: AWWA C901. Pipe and fittings PE 3408 HDPE resin compound meeting cell classification 345434C, ASTM D3350; and Type 111, Class C, Category 5, Grade P34, ASTM D1238.
  5. Mainline Pipe Within Sleeves: Provide restrained casing spacers for gasketed joints.
- B. Irrigation Main Fittings:
1. Ductile Iron Pipe Fittings:
    - a. Mechanical Joint Fittings: ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111).
    - b. Flanged Fittings: ANSI/AWWA C110 and ANSI B16.1 850 kPa(125 lbs.).
    - c. Push-On Joints: ASTM D3139 for Laboratory Qualifying Tests. Use push-on rubber-gasketed ductile iron fittings.
    - d. Gaskets: ASTM F477, rubber.
    - e. Joint Restraints: Class 350 Ductile Iron per ASTM A536.
  2. PVC Pipes Fittings:
    - a. Mechanical Joint Fittings: ANSI A 21.10 (AWWA C110) and ANSI A21.11 (AWWA C111).
    - b. Flanged Fittings: ANSI/AWWA C110 and ANSI B16.1 850 kPa(125 lbs.).
    - c. Gaskets: ASTM F477, rubber.
    - d. Joint Restraints: Class 350 Ductile Iron per ASTM A536.
  3. High Density Polyethylene (HDPE)Fittings:

a. Butt, Heat-Fusion Fittings: ASTM D3261.

C. Lateral Pipe:

1. PVC Pipe: ASTM D1784 Rigid, Unplasticized (PVC) 1120, Class 12454-A or 12454-B, with integral bell end suitable for solvent welding.
2. Pressure Rated PVC Pipe: ASTM D2241, Class 200, SDR-21, 1375 kPa(200 psi) pressure rating.
3. PVC Pipe: ASTM D2466 and D1784.
4. Threaded Pipe: ASTM D1785, PVC 1120, Schedule 80 threaded connections, risers and swing joints. Pipe Above Grade and in Concrete Structures: // Ductile Iron meeting AWWA C600, AWWA C115, flanged joints and fittings, working pressure 1025 kPa (150 psi) //.

D. Lateral Fittings:

1. Irrigation Laterals: ASTM D2466 PVC, Schedule 40, solvent welded socket type.
2. Threaded Pipe: ASTM D2464, PVC, Schedule 80.
3. Swing Joints: Manufacturer's standard with elastomeric seal, allows 360 degree rotation, minimum 1375 kPa (200 psig) working pressure.

E. Joining Materials:

1. Irrigation Mains: Rubber gaskets, AWWA C111.
2. Irrigation Laterals: ASTM D2466 and D1784 PVC Schedule 40, Type 1, solvent weld fittings.
  - a. Primer: ASTM F656.
  - b. Solvent Cement: ASTM D2564.
3. Threaded pipes: Teflon-type tape or Teflon based paste pipe joint sealant. Use non-hardening, non-toxic pipe joint sealant for water-carrying pipes on metal threaded connections.

SPEC WRITER NOTE:

1. Modify sleeves to reflect design conditions, following Facilities Design Guide for location of irrigation mains.
2. Select appropriate sleeves for locations, depth, soil conditions and loading.

**2.6 SLEEVES**

- A. Sleeves: ASTM D1784 Rigid, Unplasticized (PVC) 1120, Class 12454-A or 12454-B, with integral bell end.
  1. Pipes Larger than 300 mm (12 inch): AWWA C905, DR-18 rated at 1615 kPa (235 psi).

2. Pipes Smaller than 300 mm (12 inch): // ASTM D2241, Class 200, SDR-21 or AWWA C905, DR-25 rated at 1375 kPa (200 psi). // or // AWWA C900, rated at 1375 kPa (200 psi). //.
- B. Size: As indicated on Drawings or twice nominal pipe diameter when not shown. Wiring bundle area not exceeding 40 percent of sleeve cross sectional area, according to NEC recommendations.
- C. Restrained Casing Spacers: ASTM A536, Grade 65-45-12 high strength ductile iron.
1. Restraining Rods: ASTM A242 and ANSI/AWWA C111/A21.11, high strength low alloy material.
  2. Runners: ASTM D-1894, ultra-high molecular weight polymer, 175-350 Joules/cm (600-1200 ft-lbs./in.) tensile impact and coefficient of friction 0.14-0.17.

**SPEC WRITER NOTES:**

1. Provide self-restrained fittings or restraint harnesses for three inch or larger mainline piping.
2. Provide gasketed ends on main line piping three inches or larger.
3. Modify the following depending on size of main into which thrust block is attached. Use thrust blocks only when pipe size exceeds six inches.
4. For bends beneath hardscape for mains 150 mm (6 inch) or larger require plastic and rebar as indicated on the thrust block details.
5. Coordinate specifications with drawing details.

**2.7 RESTRAINTS**

- A. Self-Restrained Fittings: Meeting // ASTM A536 // ANSI/AWWA C153/A21.53 "Ductile-Iron Compact Fittings For Water Service" or ANSI/AWWA C110/A21.10 "Ductile-Iron and Gray-Iron Fittings, 76 mm through 1219 mm (3 inches through 48 inches), For Water" //.
1. Provide on rubber gasketed pipe pipes 75 mm (3 inch) diameter or larger.
  2. Size: As indicated on Drawings.
- B. Thrust Blocks: Concrete, 20 MPa (3,000 psi), 50 micrometers (2-mil) plastic and 12.7 mm (No. 4) rebar wrapped or painted with asphalt tar based mastic coating.
1. Provide on pipe fittings greater than or equal to 75 mm (3 inch) diameter or rubber gasketed pipe.

2. Size: As indicated on Drawings.
- C. Joint Restraint Harness: Provide joint restraint harness where joints not positively restrained by flanged fittings, threaded fittings, or retainer glands and thrust blocks.
1. Provide in ductile iron fittings 76 mm (3 inch) and larger, transition fittings between metal and PVC pipe, where thrust block is not allowed, or where extra support is required to retain fitting or joint.
  2. Provide joint restraint harness or retainer glands with preset torque shearing set screws on mainline gate valve assemblies 76 mm (3 inch) and larger.
  3. Provide stainless steel bolts, nuts, retaining clamps, all-thread, or other joint restraint harness materials retainer, ASTM A536, and high strength, low alloy steel bolts and connecting hardware, ANSI/AWWA C111/A21.11.

## 2.8 MAINLINE COMPONENTS

### SPEC WRITER NOTES:

1. Provide one or more of the following valve types based upon project specific conditions.
3. Coordinate specifications and drawing details.

- A. Valves (Except Remote Control Valves):
1. Underground Shut-Off Valves:
    - a. Gate Valves 50 mm (2 inches) and Larger: AWWA C509, iron body, bronze mounted, double disc with parallel or inclined seats, non-rising stem turning clockwise to close, // 1025 kPa (150 psi) // 1375 kPa (200 psi) // minimum working pressure.
    - b. Butterfly Valves 80 mm (3 inches) and Larger: AWWA C504, cast iron body with stainless steel shaft, ductile iron valve disc and resilient rubber coated, // 1025 kPa (150 psi) // 1375 kPa (200psi) // minimum pressure.
  2. Check Valves: Swing.
    - a. Smaller than 100 mm (4 inches): ASTM B61 or B62, bronze body and bonnet, 850 kPa (125 pound) WSP.
    - b. Larger than 100 mm (4 inches): Iron body, bronze trim, vertical or horizontal installation, flange connection, 1375 kPa (200 pound) WOG.

SPEC WRITER NOTE: Modify as required for project conditions and provide pressure setting for valve in specific location for installation.

3. Pressure Reducing Valve:
  - a. Cast steel body, renewable seats, stainless steel trim, high velocity components. // ASSE: Certified 1003-2027, Threaded Union inlet and outlet, Cast bronze valve body meeting ASTM B584, Stainless steel 300 Series Internal components and strainer screen //.
  - b. Adjustable to desired pressure, within range of operation specified.
  - c. Air-Vacuum Relief Valve: Epoxy-coated cast Iron body, polypropylene float, glass fiber reinforced nylon kinetic float, Buna-N seals and O-rings, stainless steel nuts and bolts, pressure range 14 kPa to 1580 kPa(2 psi to 230 psi). Continuous acting combination air and vacuum and air release valve. // Cast Bronze body meeting ASTM B584, 300 series Stainless Steel, internal components and springs, maximum working pressure 1200 kPa (175 psi). //
4. Bronze Ball Valve with Stainless Steel Handle:
  - a. Maximum Pressure: 4140 kPa (600 psi) CWP.
  - b. Federal Specification: WW-V-35C.
    - 1) Type II.
    - 2) Composition BZ.
    - 3) Style 3.
5. Master Control Valve:
  - a. Body and Cover: Polyester-coated.
  - b. Spring: Stainless steel.
  - c. Diaphragm: Nylon fabric reinforced with rugged insert.
  - d. Bolts, Studs, and Nuts: Zinc-cobalt coated steel.
  - e. Tubing and Fitting Control Accessories: Reinforced plastic and brass.
  - f. Solenoid: 24V AC.
  - g. Operation: // Normally opened // Normally closed // with automatic control globe valve with contamination-proof, self-flushing filter screen.
  - h. .Pressure Rating: 16 bar (232 psig).
  - i. Operating Pressure Range: 0.5 to 16 bar (7 to 232 psig).



6. Quick Coupling Valve Assembly:
- a. Description: Brass construction, 1 inch nominal size, operating pressure 35-860 kPa (5-125 psi), locking rubber or vinyl cover.
  - b. Swing Joints: Joint with offsets for flexible joints.
  - c. Quick Coupler Anchor: Bolt on anchor type.

SPEC WRITER NOTE: For new installations use high quality brass, bronze or stainless steel manufacturer's equipment for similar golf course or lite commercial applications.

- d. Valve Box: Acrylonitrile Butadiene Styrene (ABS) Plastic, 10 inch round valve box with // green // brown // black lid // color to match location //.
- e. Filter Fabric: Spunbonded polyester 3.5 oz per sq. yard (118.7 grams per sq. m.) landscape fabric.

SPEC WRITER NOTES:

1. Coordinate specifications with flower watering station facility type and spigot.
2. Revise specifications to provide water through service with isolation valve and pressure regulation valve connection to flower watering spigot.
3. Follow Facilities Design Guide for type of spigot for project location, of new facilities.
4. Revise specs to match existing facilities, unless otherwise noted, note required changes.

B. Flower Water Station Spigot Connection Assembly: As indicated on Drawings.

1. Flower Watering Station Spigot: As specified in Section 32 30 00, SITE FURNISHINGS.
2. Curb Stop Valve: ASTM B62, brass body, 2070 kPa (300 psi) minimum working pressure, female threaded connections, with stop and waste feature.
3. Inline pressure regulator: Low lead cast body conforming to ASTM B584, 2750 kPa (400 psi) maximum inlet pressure, with 105 to 515 kPa (15 to 75 psi) adjustable outlet pressure.
4. Copper Pipe: ASTM B88, type "M" soft tubing, wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint.

- a. Solder: 95-percent tin and 5-percent antimony.
- 5. Valve Box: Concrete curb valve box, cast iron lid, 200 mm ID x 300mm (8 inch ID by 12 inch), face anchored in concrete.

C. Valve Box:

1. Gate and Butterfly Valve:

a. Materials:

SPEC WRITER NOTES: Retain precast  
concrete valves box below for pavement  
areas; HDPE for turf and planter areas.

- 1) Precast Concrete: Precast concrete, 30 MPa (4000 psi) compressive strength.
- 2) HDPE: Structural foam Type A, Class III, // black // green // tan // in color, minimum 475 mm (19 inches) long by 350 mm (14 inches) wide, 305 mm (12 inches) deep, key-lockable hinged lid.

b. Cover: Mark box cover, differentiate between lawn irrigation system and domestic water supply system, set flush on finished grade.

c. Operations:

- 1) T-Handle Socket Wrench Operation: Underground valves 50 mm (2 inch) nut.
- 2) Handwheels: MSS SP70 Above ground and in pits.
- 3) Enclosed Gear Drive Operators: Butterfly valves 150 mm (6 inches) and above.

d. Accommodate end valves with type of pipe being installed. Provide mechanical joint ends with self-restrained joints on buried irrigation main valves.

2. Remote Control Valves:

a. Materials:

SPEC WRITER NOTES:  
1. Retain precast concrete valves box  
below for pavement areas; HDPE for turf  
and planter areas.  
2. Select polymer concrete boxes for  
boxes located where vehicular traffic is  
expected, or for boxes 432 mm (17 inches)  
or larger.

- 1) Precast Concrete: Precast concrete, 30 MPa (4000 psi) compressive strength.

- 2) Polymer Concrete: Fiberglass reinforced plastic with Plastic resin binder. Lid to have minimum loading capacity of 3630 kg (8,000 lbs.) per 254 mm by 254 mm (10 inch by 10 inch) square.
- 3) HDPE: Structural foam, Type A, Class III.
  - a) Color: // Black. // Green. // Tan. //.
  - b) Size: Minimum 475 mm (19 inches) long by 350 mm (14 inches) deep with key-lockable hinged lid.

SPEC WRITER NOTE: Select Stencil Paint required to match existing conditions, or as directed by Architect/Engineer during project design review.

- b. // After installation, hot brand valve box lid 75 mm (3 inch) // two 80 mm (3 inch) // high, 1 mm (3/16 inch) deep with permanent white epoxy paint, designating controller and circuit numbers. Place numbers in center of valve cover facing nearest main or service road. //.
  - c. Provide // \_\_\_\_\_ // 750 mm (30 inch) long valve adjustment keys.
  3. // Drip zone Lateral Flush Cap Assembly: HDPE round reinforced plastic valve box and lid, minimum 14.5 cm (5-3/4 inches) diameter top opening with lift-hole. Access box height, 23cm (9-1/16 inches) minimum. //.
  4. // Emitter Access Boxes: HDPE round plastic boxes and lid, color // green, // tan, // 13 cm (5 inches) minimum top diameter, height 26 cm (10-1/4 inches) minimum. //.
- D. Backflow Preventer: ASSE 1013, reduced pressure principle, except pressure drop, in each new connection to existing potable water distribution system.
1. Design Flow Rate: Maximum 70 kPa (10 psi).

SPEC WRITER NOTES:

1. Retain applicable Water Meter paragraph.
2. Modify as applicable to install water meter or meters to record all irrigation water sources. Designer to confirm the requirements of meter installation with water provider.
3. Add specifications for water meters to be used by the Government for record

keeping of all irrigation water sources  
for project.

E. Water Meter Assembly:

1. Water Meter:
  - a. // By Utility Company. //.
  - b. // Install Utility Company water meter. //.
  - c. // Provide meter approved by Utility Company. Submit approval before installation. //.
2. Water Meter Pit:
  - a. Reinforced poured in place concrete or approved precast concrete.
    - 1) Size: As indicated on Drawings.
    - 2) Rungs: Cast iron or aluminum, asphalt coated when in contact with concrete, free of sharp edges, burrs or projections with slip resistant finish.
      - a) Size: 25 mm (one inch) diameter, 300 mm (12 inches) wide, 175 mm (7 inches) clear space to wall, minimum 65 mm (2 1/2 inch) depth in wall.
    - 3) Reinforced Concrete: Same as above except, minimum 150 mm (6 inches) in wall.
    - 4) Vault Covers:
      - a) // Aluminum spring loaded access hatch. // Stainless Steel spring loaded access hatch. // Cast iron access cover. //

SPEC WRITER NOTES: Retain option for  
roadway application.

3. Frames and Covers: Cast-iron, // traffic rated // with cast-in identification symbol "WATER".

SPEC WRITER NOTES: Retain rungs for  
structure more than 1200 mm (4 feet) in  
depth.

4. Strainers: Brass strainer, basket or "Y" type.
  - a. Size:
    - 1) Body smaller than 70 mm (2-1/2 inch), brass or bronze.
  - b. Body 70 mm (2-1/2 inch) and larger, cast iron or semi-steel.
  - c. Cover: Provide blow-off connection and shut-off valve for 20 mm (3/4 inch) diameter hose connection.

5. Pressure Gages: ANSI B40 1, 114 mm (4-1/2 inch) diameter, metal case, oil filled bottom connected with shut-off cocks.
  - a. Dial: Either black or white lacquered throughout. Provide shut-off cocks.
  - b. Maximum graduations: 10 kPa (2 psi).
6. Pipe Supports: Corrosion-resistant, galvanized finish.
  - a. Plumbing and mechanical equipment supports for basket strainer, pressure reducing valve and master valve.
    - 1) Flange Cradle: ASTM A36.
    - 2) Collar/Base Cup: ASTM A53 D.O.M tubing.
    - 3) Threaded Stud: ASTM A36; rolled thread; Grade ASTM A307.
    - 4) Base Plate: Sheet steel, 6.5 mm (0.25 inch) plate; ASTM A36.
    - 5) Welds: 100 percent MIG. Electrode E70XX.
      - a) Cradle: Radiused to CL 125 flange diameter, 120 degree coverage.
7. Backflow Enclosure:
  - a. Construction: Vandal-resistant steel tube and wire with a smooth surface.
  - b. Coating: performance polymer alloy powder.
  - c. Locking Mechanism: Stainless Steel full release.
  - d. Warranty: One year.
  - e. Powder Coat Color: standard dark green.

## 2.9 SPRINKLER IRRIGATION COMPONENTS

- A. Remote Control Valve Assembly:
  1. Remote Control Valve: Globe type, heavy construction, manual shut-off and flow control adjustment for manual operation, minimum 1025 kPa (150 psi) working pressure; higher working pressure for systems that operates with working pressures above 140 psi.
    - a. Install underground, operated by a // 24-volt AC electric solenoid // 24-volt AC/DC direct drive thermal hydraulic motor. // Provide unions on both sides of valve. Provide assembly over gravel sump as indicated on Drawings.

SPEC WRITER NOTE: Retain valves below for normal water or water containing sand.

- b. Valves: Brass or plastic construction, straight or angle pattern type, or cast-iron body with brass bonnet, trim and renewable

seat, and two inlet tappings (furnished with one plugged) to allow straight or angle pattern valve installation.

SPEC WRITER NOTE: Retain valves below for sewage effluent or extremely dirty water.

- c. Valves: Diaphragm type, designed to operate water containing sand and debris, self-cleaning type with contamination filter. Incorporate non-adjustable type opening and closing speed control surge pressures protection, or operate by means of slow acting direct drive without ports, screens or diaphragms.

SPEC WRITER NOTE: Retain valve with pressure regulators when required for the project.

- d. Provide valves with pressure regulators.
- e. Valves Serviceability: From top without removing valve body from system. Provide // \_\_\_\_\_ // 750 mm (30 inch) long adjustment keys. Operate valves maximum 50 kPa (7 psi) pressure loss at manufacturers maximum recommended flow rate.
2. PVC Union: Schedule 80 threaded union with O-ring seal.
  3. Bronze Ball Valve with Stainless Steel Handle:
    - a. Maximum Pressure: 4140 kPa (600 psi) CWP.
    - b. Federal Specification: WW-V-35C.
      - 1) Type II.
      - 2) Composition BZ.
      - 3) Style 3.
  4. Filter Fabric: Spunbond polyester 3.5 oz. per square yard landscape fabric.
  5. Wire connectors: Direct burial 600 V maximum voltage. Wire combination size: (2 to 5) 18 AWG to (2) 12 AWG. UL approved. 3M DBY or DBR.
  6. Identification Tags: Christy I.D. tags. Standard Yellow, one sided. Tag Size: 57 mm by 69 mm (2.25 inch by 2.7 inch), hot stamped black letters on, yellow background. Hot stamp component number code as indicated.

SPEC WRITER NOTE: Modify specifications below to include all irrigation head and drip components being used in the project. Descriptions below are generic.

- B. Popup Gear Driven Rotary Sprinkler Assembly: Integral self-closing anti-drain valve, 3.0 m (10 feet) maximum head pressure with removable inlet debris screen.
1. Full Sprinklers:
    - a. Body: Corrosion resistant, impact resistant, heavy-duty ABS outer case.
    - b. Head Type: Dual or tri-nozzle combination positive gear assembly drive on stainless steel spindles in water lubricated sand proof case.
  2. Part Circle Sprinklers: Same as full sprinklers above, except variable arc type.
- C. Multi-Stream Rotary Nozzles:
1. Radius and arc as shown on Drawings.
- D. Spray Heads: High impact plastic or brass nozzle with adjusting screw to regulate radius and flow. Heavy-duty stainless steel retracting spring and ratcheting system for pattern alignment. Soft elastomer pressure-activated co-molded wiper seal.
1. Body: Heavy duty, ultraviolet resistant plastic sprinkler body, stem, nozzle, with non-clogging filter and pressure compensating screens (PCS).
  2. Head Type: Pop-up, matched precipitation rate nozzle as shown.
  3. Flow Rate: As indicated on Drawings.

SPEC WRITER NOTE: Modify above and below to include irrigation head and drip components required. Descriptions below are generic.

- E. Pressure Compensating Bubblers:
1. // 5 gph // 7 gph // 10 gph // as shown. 1.25 cm (1/2 inch) FPT threaded inlet.
- F. Drip Emitters:
1. Emitter Type: Pressure compensating, permanently assembled type, 1.25cm (1/2 inch) FPT inlet.
  2. Flow Rate: 1gpm at inlet pressures between 15 and 50 psi.
  3. Emitter Tubing: UV resistant vinyl, 6mm (0.22 inch) O.D. and 4 mm (0.16 inch) I.D., manufactured by same manufacturer as emitters.

## G. Low Voltage Control Valve Wire:

1. Wire: Solid copper wire, UL LLC approved for direct burial.
  - a. Size: According to manufacturer's instructions, but minimum AWG 14.
2. Splicing Materials: Epoxy waterproof sealing packet.
3. Low Voltage Controller Cable: Multi-strand, UL LLC approved for direct burial.
  - a. Number, Size and Type: According to manufacturer's instructions.
4. // Decoder-to-Solenoid (DTS) Cables 14 AWG, solid copper; 2-conductor; Use jacketed wire pairs with colors matching jacketed wires on decoders for connecting decoders to control valves. //

SPEC WRITER NOTE: Use non-detectable type  
at cemeteries only.

## H. Warning Tape: Polyethylene film warning tape, 0.1 mm (4 mils) thick, 75 mm (3 inches) wide, // detectable // non-detectable //, imprinted with "CAUTION BURIED IRRIGATION WATER LINE BELOW", colored as follows:

1. Blue with Black Letters: Potable water.
2. Purple with Black Letters: Reclaimed or untreated well water.

## I. Tracer Wires: Plastic-coated copper tracer wire, 1.8 mm (14 gage), green, Type TW. Install with non-metallic irrigation main lines.

## J. Decoders for Two-Wire Operation:

1. Decoder: Solid-state design, housed in a watertight molded plastic housing.
  - a. Decoder leads: 18-gauge, insulated, stranded copper.
  - b. Colors as indicated.
  - c. Wire Leads: Minimum of 305 mm (12 inches) long.
  - d. Wire Connections: Watertight electrical connections suitable for the wire type being connected.
2. Decoders: Mounted underground in separate 305 mm by 457 mm (12 inch by 18 inch) valve boxes, or with remote control valves. Fastened to inside of valve boxes with stainless steel self-tapping screws. Brand valve boxes containing decoders "SP" in 50 mm (2 inch) high letters, painted with permanent white epoxy paint. Place boxes on 457 mm (18 inch) deep bed of pea gravel.
  - a. 26VAC input service provided by the two-wire communication path.
3. Provide factory pre-coded decoders with 1, 2, or 4 addresses, each activating one remote valve solenoid.



4. Use 4 address decoders to extent. Include line surge protection.
  5. Provide manufacturer's optional barcode scanner-based decoder programming unit to input decoder addresses. Provide programming unit capable of backing up and restoring programs.
    - a. Field Decoders: TW-D-1 (One station decoder, includes dry splices); TW-D-2 (Two station decoder, includes dry splices); TW-D-4 (Four station decoder, includes dry splices).
  6. Decoder Cable Fuse Device: Paige Electric DCFD 2-way and DCFD3 3-way electrical isolation devices; or approved equal.
  7. Lightning Arrestor: Rain Master TW-LA-1, or approved equal.
  8. Grounding Rods: 16 mm by 2.5 meters (5/8 inch diameter by 8-foot long) copper ground rod, copper clamp and #6 bare copper wire; UL-approved; sized per manufacturer's instructions.
- K. Two-Wire Decoder Cable:
1. Two-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 B33.
  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 1.2 mm (3/64 inch) minimum jacket material to completely fill interstices between the two insulated conductors.
  6. Color Coding: Black, Red.
  7. Jacket Color: Blue. (Use a different jacket color for each controller on the project).
- L. Hard Wire Communication Cable: Direct burial, polymer-coated aluminum shielded, insulated, 1-pair multi-conductor, with polyethylene outer jacket for connecting satellite controllers with each other.
1. Provide two 20 AWG, full braid shield, 100 Ohm impedance. One copper conductor and one silver tinned conductor, black jacket, rated for direct burial shielded communication cable used for hardwire satellite serial link. Cable shall not exceed 5000 feet in length.
  2. All cable must be certified by Rain Master Irrigation systems.

- M. Flow Sensor Cable: Direct-burial, polymer-coated aluminum shielded, insulated, 1-pair multi-conductor, with polyethylene outer jacket for connecting flow sensors with satellite controllers.
1. Two 20 AWG foil shield w/drain, black jacket, rated for direct-burial BLK, WHT. Two conductor direct burial shielded cable used with all field sensor connections to satellites such as flow sensors. Cables not to exceed 609 meters (2000 feet) in length.
  2. Cables must be certified by Rain Master Irrigation systems.
- N. Communication Cable Splice and Cap: A three-part, rigid body closure that self-encapsulates two-and five-pair buried service wire. It has a built-in bonding system that bonds the buried service wire shield as the splice is put together. The special formulated sealant is a one-part, no-mix, non-urethane product containing no grease.
- O. Electrical Conduit and Fittings: High-impact Schedule 40 PVC C-2000 compound, UL approved, gray color, size as required. Solvent-weld fittings.
- P. Pull Rope for Empty Conduits: 1/4 inch diameter, 12-strand, 544 kg (1,200 lb) tensile strength braided polypropylene rope.
- Q. Drainage Backfill: Clean gravel or crushed stone, graded from 6 mm (1/4 inches) minimum to 19 mm (3/4 inch) maximum.
- R. Pipe Bedding and Initial Backfill: Clean sand per Section 31 20 00 EARTH MOVING for trenching and backfilling of utilities.

## 2.10 CONTROL SYSTEM COMPONENTS

### SPEC WRITER NOTE:

1. Retain below for projects having one or more field satellites.

- A. Automatic Central Control Equipment-Field Satellites:
1. Overall Control Concept: Central computer system; contains irrigation starting controls, capable of overriding field satellite units, and operating individual remote control valves according to timing schedules programmed into // central // field units //.
    - a. Number of Units and Locations: As indicated on Drawings.

### SPEC WRITER NOTE:

1. Modify as required to indicate components included in system for this project. Add additional equipment where required to provide communication between

water supply source equipment and irrigation equipment.

2. Central Computer Control System: Manufacturer's standard components; Central Computer, // Master Flow Meter, // Leak Detection Flow Meters, // Moisture Sensor, // ET Measurement Device, // Rain Measurement Device, // Wind Measurement Device, // Central Control Software, // Field Controller // and necessary components and software in standard package supplied by irrigation control manufacturer.

SPEC WRITER NOTES:

Listing in spec note following is only guideline. Manufacturer and models vary.

1. Modify performance criteria for Central Computer Control System, without indicating manufacturer. Accurately define functioning and operational components.
2. Modify where Central Computer Control System match existing system, clarify whether full system replacement of Central and satellites is acceptable instead of matching existing.
3. Modify to include function and performance information. Describe how system operates and provide desired leak detection performance. Describe causes of alarm conditions, specify system shut down level which occurs as a result of alarm conditions.
4. Specify exactly how new irrigation system components are to be integrated with existing and what modification, replacement, upgrading, etc. is required for the existing system.
5. Prepare performance based narrative. describing how system operates in normal automatic conditions; manual conditions; partial shutdown conditions and emergency shut down conditions.
6. Prepare performance-based narrative describing water supply source operates in conjunction with irrigation Central Computer equipment.

3. Central Computer Control System:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, Manufacturer and models vary.

Accurately define material and operational components.

1. Controller should be capable of reading flow meter and recording flow for each station. Logging reading for xx water days, including run times, water use, and operational characteristics.
2. Receiving and storing on-site, daily ET weather data and accumulated rainfall to automatically determine station run times in minutes.
3. Operating multiple master schedules to allow daily, weekly programming.
4. Comparing water budget proportionate to historical ET.
5. Operating Cycle and Soak watering.
6. Containing full, built-in English and Spanish operating manual.
7. Detecting electrical faults and bypass, and logging all alerts.
8. Programming rain shut down.
9. Activating/deactivating master valve control.
10. Optional integrated Radio Remote compatible.
11. Starting pump.
12. Monitoring flow within operator-set parameters.
13. Built-in transient protection and lightning protection.

a. Performance Criteria:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Identify housing materials.
2. Define pulse output, Voltage and pulse rate proportional to flow.
3. Fully compatible with internal interface of controller.
4. Powered by the controller.
5. Flow meter data can be accurately read by the controller up to X,XXX feet.
6. By the same manufacturer as the irrigation controller.
7. Define/describe unit features/sensing features.

4. Flow Meter:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Solid-state tensiometer type.
2. Include data transmission circuitry, which sends moisture level readings back to irrigation controller using valve field wires.
3. Entire unit encased in epoxy.
4. Require no calibration for life of the sensor.
5. Unaffected by temperature, salinity or changes in pH.
6. Accurately transmit moisture levels up to x,xxx ft.

5. Moisture Sensors:

SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Powered by field controller.
2. Measures ET directly in 0.01" increments and sends pulses directly to field controller.
3. Fully compatible with internal interface at field controller.
4. Mounted inside stainless steel, vandal-resistant enclosure specifically designed for the device.

6. ET Measurement Device:

## SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Accurately measures rainfall in 0.01" increments by means of a tipping and emptying device mounted below center of collection dish.
2. Fully compatible with internal interface at field controller.
3. Operate between 32 degrees F and 125 degrees F.
4. Be constructed of anodized aluminum.
5. Controller sets the following programming parameters for rain.
  - a. Stop Irrigation after x.xx inches.
  - b. Maximum Rain in One Hour is x.xx inches.
  - c. Maximum Rain in 24 Hours is x.xx inches.
  - d. Let Rain only build up to x.xx inches.

## 7. Rain Measurement Device:

## SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Accurately define material and operational components.
2. Powered by field controller.
3. Accurately measures wind in 0.1 mph increments.
4. Fully compatible with internal interface at field controller.
5. Operate between -50 degrees C and + 50 degrees C.
6. Be constructed of anodized aluminum.
7. Record wind speeds up to 140 MPH.
8. Controller sets the following programming parameters for wind:
  - a. Pause Irrigation when wind is at xx MPH for xx minutes.
  - b. Resume Irrigation when wind drops to xx MPH for xx minutes.

## 8. Wind Measurement Device:

## SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and

models vary. Accurately define material and operational components.

1. Operates on Windows compatible computer with minimum 16 MB memory.
2. Requires 300 megabytes hard disk space for program and files.
3. Functions on any combination of phone, or local radio, or hardware interface.
4. Allows uploading and downloading programs and log data by controller or groups of controllers.
5. Has real-time access to run stations and programs, check master valve operation, and operate controllers.
6. Capable of printing alerts based on operator-set data filters; automatically creating permanent files each time data is uploaded.
7. Allows program, log, summary and alert data for each controller to be printed selectively.
8. Capable of automatically uploading weather station, and Rain Bucket and redistributing to field units.
9. Capable to operate up to x,xxx controllers.
10. Capable of automatically retrieving water usage data and writing to text files monthly.
11. Capable of allowing user override changes.
12. Communication links or central control system failure cannot affect normal water management operation of field controllers.

#### 9. Central Computer Software.

##### SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. When using digital radio, radio shall be an internal packet-switched digital radio modem capable of two-way communication on Mobitex public network.
2. When using radio, radio modem and all interface boards shall be mounted inside the controller and powered by the same 24VAC internal transformer.
3. A vandal-resistant epoxy-filled dome antenna shall be used in any type of radio communication.

#### 10. Field Controllers with Central Communication:

- a. Conduct an on-site radio test with manufacturer to verify satisfactory operation before submitting a bid for radio control.

SPEC WRITER NOTE:

1. Equipment type in paragraph below is for addition to existing system, but is not VA preference.
2. For smaller projects with independent controllers, retain Electric or Solar Powered Controller as conditions permit.

B. Automatic Control Equipment-Independent Satellite Controllers:

1. Overall Control Concept. Electric automatic control system consists of independent satellite controllers operating individual remote control valves according to timing schedules programmed in each independent units. Number of units and location as indicated on Drawings.



## SPEC WRITER NOTES:

Listing in spec note following is only guideline, individual manufacturer and models vary. Accurately define material and operational components.

1. Multiple independent programs with multiple start times.
2. Station watering time can be set from one (x) minute to (x) hours and in one (1) minute increments.
3. Allow rapid programming for a block of stations with same watering time.
4. Programs allows independent seven-day a week or a skip-a-day routine.
5. Provide controller with a real time clock to retain the actual time during power outages.
6. Provide controller with a non-volatile memory to retain programs during power outages or seasonal shutdowns.
7. Run a single station for a select time in manual mode.
8. Provide controller with built-in remote control capability.
9. Provide controller with automatic field wire fault detection, report the fault, and move to the next programmed station.
10. Provide UL approved controller.
11. Provide controller with a percentage key to increase or decrease all station runtimes on a percentage basis.
12. Provide controller with ability to select cycle and soak.

2. Control System: System consists of Independent controller, and accessories necessary to operate irrigation system. Provide standard package containing these components and software.

## C. Automatic Control Equipment-Solar-powered:

## SPEC WRITER NOTES:

Listing in spec note following is only guideline individual manufacturer and models will vary. Accurately define material and operational components.

1. Solar powered control systems are typically highly proprietary ie. LEIT Control Systems, Irritrol, Aquarius base specification upon performance and technical criteria, avoid mentioning manufacturer by name.
2. Define Control System components - Independent controller, Rain Sensor, Moisture Sensor, Freeze sensor, and

accessories necessary to operate the irrigation system.

3. Define temperature range between x °F and x °F (x °C to x °C).
4. Define circuit protection from electrostatic discharge to xx,xxx Volts.
5. Define power source- powered by an internal photovoltaic module.
6. Define output to actuators: digital control pulses at x.xx Volts DC.
7. Define photovoltaic module shall be protection- Lexan polycarbonate, or other lens.

1. Overall Control Concept. Solar-powered automatic control system consists of one or more independent controllers operating individual remote control valves according to timing schedules programmed into the independent units. Number of units and location as indicated on Drawings.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Examine and verify substrate suitability for product installation.
- B. Protect existing construction and completed work from damage.
- C. Remove existing // item name // to permit new installation.
  1. Retain existing // item name // for reuse.
  2. Dispose of // other // removed materials.

#### **3.2 INSPECTIONS AND REVIEWS**

- A. Site Inspections:
  1. Verify site conditions and note irregularities affecting work. Report irregularities to COR before beginning work.
- B. Utility Location ("Call Before You Dig"):
  1. Arrange and coordinate underground utility locations with local authorities and cemetery maintenance personnel.
  2. Repair underground utilities damaged during construction with no increase in contract price.
- C. Irrigation System Layout Review: Stake locations of irrigation system components as defined below for COR's review. Notify the COR one week in advance of review. COR will identify and approve modifications during this review.

**3.3 INSTALLATION - GENERAL**

- A. Install products according to manufacturer's instructions // and approved submittal drawings //.
  - 1. When manufacturer's instructions deviate from specifications, submit proposed resolution for COR consideration.
- B. Perform excavation, trenching, and backfilling for sprinkler system as specified in Section 31 20 00, EARTHWORK and as indicated on Drawings.

**3.4 LAYOUT OF WORK**

- A. Stake alley and sprinklers locations in existing burial sections using a licensed surveyor. Use alleys as indicated on Drawings.
- B. Stake out irrigation system.
- C. When staked irrigation components conflict with utilities or other components or site features, coordinate rerouting of components with COR. To comply with requirements of the following conditions specified herein this specification section to obtain compliance of regulatory regulations.

**3.5 SLEEVING AND BORING**

- A. Provide and install sleeves where pipe and control wires pass under walks, paving, walls, and other similar areas.
- B. Extend sleeve minimum 300 mm (12 inches) beyond edge of paved surface, wall, etc. Cover pipe ends and mark edge of pavement.
- C. Verify sleeve sizing is adequate before installation. Note that sleeves required for pipe with restrained casing spacers are larger than twice the diameter of the pipe.
- D. Bed sleeves, minimum 100 mm (4 inches) sand backfill above top of sleeve.

**3.6 PIPE AND FITTING ASSEMBLY**

- A. General:
  - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur.
  - 2. Cap assembled pipe ends. Remove caps only to continue assembly.
  - 3. Curve trenches to change direction or avoid obstructions within limits of pipe curvature. No deflection allowed at pipe joint. Minimum radius of curvatures as follows:

SIZE	RADIUS	OFFSET PER 6 m (20 feet) LENGTH

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

B. Mainline Pipe and Fittings:

1. Plastic Pipe:

- a. // Lay pipe "snake fashion" in trench 1 meter to 100 meters (1 foot per 100 feet) to allow for thermal construction and expansion and to reduce strain on connections. //.
- b. Provide expansion joints every 1525 cm (50') o.c. Install per manufacturer's instructions.
  - 1) Acceptable manufacturer is Spears (S119-XX) or approved equal.
- c. Joints:
  - 1) Solvent Welded Socket Type, ASTM D2855.
  - 2) Threaded Type: Apply liquid Teflon, thread lubricant. Tighten joint with strap wrench up to two additional full turns after joint is hand tight (hard).
  - 3) Elastomeric Gasket: ASTM F477, compatible with bell annular groove.
    - a) Thoroughly clean inside of bell or coupling, outside of spigot, and elastomeric gasket immediately before joining two lengths of PVC pipe.
    - b) Lubricate joint and rubber gasket according to pipe manufacturer's instructions.
    - c) Insert elastomeric gasket in the annular groove of bell or coupling according to the manufacturer's instructions.

Mark pipe not furnished with depth mark before assembly and insert to full depth of joint.

- d) Align spigot and bell or coupling and push until spigot is fully inserted in bell or coupling. Push with smooth steady motion.

2. Ductile Iron Pipe: AWWA C600.

a. Joints:

- 1) Mechanical: AWWA C111. Provide bolts, nuts, glands and gaskets on pipe and fittings socket opening.
- 2) Push on: Apply thin film gasket lubricant and place in proper position in bell contour. Insert bevel end of joining pipe and make contact with gasket. Force pipe bevel end to bottom of bell without displacing gasket. Do not caulk. Use lubricant furnished by pipe manufacturer.
- 3) Flanges: AWWA C115. Install only in concrete pits. Make watertight and set minimum 150 mm (6 inches) from walls or floor.

C. Lateral Pipe and Fittings:

1. PVC Solvent Weld Pipe:

- a. Use primer and solvent cement. Join pipe according to manufacturer's instructions and accepted industry practices.
- b. Cure 30 minutes before handling and 24 hours before pressurizing or installing vibratory plow.
- c. Snake pipe from side to side within trench or install with expansion joints.
- d. In irrigation isles, coordinate location of monuments to avoid conflicts.

2. Fittings: Cross type fittings is not acceptable.

D. Emitter hose:

- 1. Use Type 1/11 solvent weld.
- 2. Use line size by 10 mm (3/8 inch) insert bushings to transition from PVC Schedule 40 fittings to flex-vinyl hose.

E. Specialized Pipe and Fittings:

- 1. Mechanical Joint Connections: Install fittings, fasteners and gaskets according to manufacturer's instructions and accepted industry practices.
- 2. PVC Threaded Connections:
  - a. Factory-formed threads. Field-cut threads are not acceptable.

- b. Apply thread sealant according to manufacturer's instructions and accepted industry practices.
- c. Use plastic components male threads and metal components female threads for plastic-to-metal connection.

F. Thrust Blocks:

- 1. Use cast-in-place concrete bearing against undisturbed soil.
- 2. Size, orientation and placement as indicated in installation details on Drawings.
- 3. Wrap fitting with plastic protecting bolts, joint, and fitting from concrete.
- 4. Install rebar with mastic coating as indicated on Drawings.

G. Joint Restraint Harness:

- 1. Install harness according to manufacturer's instructions and accepted industry practices.
- 2. Use restrained casing spacers for gasketed pipe routed through sleeving. Install self-restraining casing spacers at gasketed pipe bell joints and every 10-feet along gasketed mainline pipe installed through sleeving. Provide correct number and type of restraints per manufacturer's instructions.

SPEC WRITER NOTES:

- 1. Modify following paragraph to correspond to indicated valve installations. Main irrigation line valves, 150 mm (6 inches) or larger can be located in roadways, refer to Facilities Design Guide for details.
- 2. Modify to indicate minimum depth irrigation main lines where located beneath roads, pavement or walks.

**3.7 INSTALLATION OF MAINLINE COMPONENTS**

- A. General: Install as indicated on Drawings.
- B. Valve for Existing Facilities: Match existing of the same type, unless specifically noted otherwise.
- C. All valves meet or exceed specified parameters identified herein, or parameters for existing valves being matched, whichever provide higher quality product.
- D. Valves Setting:
  - 1. Install as indicated on Drawings and according to manufacturer's instructions.
  - 2. Do not set valves under roads, pavement or walks.

3. Clean valve interior before installation.
4. Place valves in same valve box where pressure control valves are installed adjacent to remote control valve.
5. Set valve box cover flush with finished grade.
6. Brand or cast "GV" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.

E. Air/Vacuum Relief Valve Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Brand "AV" in 2 inch high by 3/16 inch deep letters on valve box lid.

F. Quick Coupling Valve Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Brand "QC" in 2 inch high by 3/16 inch deep letters on valve box lid.

G. Flower Watering Station Hydrant Connection Assembly:

1. Install as indicated on Drawings and according to manufacturer's instructions.
2. Sequence of Construction:
  - a. Coordinate exact location with COR.
  - b. Install components before concrete pad. Coordinate installation with Section 03 30 53, CAST-IN-PLACE CONCRETE (SHORT FORM).
3. Location:
  - a. Install stations at locations indicated on Drawings, centered between adjacent sprinkler locations.
  - b. Route adjacent piping around stations. Do not install mainline or lateral pipe under Flower Watering Stations.
4. Paint "FW" in 2 inch high by 3/16 inch deep letters on valve box lid.

### 3.8 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS AND QUICK COUPLERS

A. Remote Control Valve Assembly: Install as indicated on Drawings and according to manufacturer's instructions.

1. Mainline Flushing:
  - a. Flush mainline before installation of Remote Control Valve Assemblies.
  - b. Identify remote control valve service tees for mainline flushing. Plug service tees not used for flushing.

- c. Connect 50 mm (2 inch) pipe to flushing service tees, to direct water away from trench and into drainage swale, curb section or storm sewer, away from work area and not disrupt cemetery operations.
  - d. Use water volume 0.9 m/s (3 FPS) velocity in largest pipe flushing.
  - e. Flush multiple points simultaneously.
  - f. Flush minimum 20 minutes. Continue flushing until water is clear of debris.
  - g. COR will review flushing operation and water clarity before stopping flushing operation.
  - h. Disconnect pipe from service tees and install remote control valves.
2. Adjust valve to regulate downstream operating pressure as follows:
    - a. Rotor Sprinklers: 480 kPa (70 psi).
    - b. Rotating Stream Nozzles: 310 kPa (45 psi).
    - c. Spray Sprinklers: 240 kPa (35 psi).
  3. Connect control wires to solenoid wires with wire connectors and waterproof sealant. Install connectors and sealant according to manufacturer's instructions.
  4. Install only one remote control valve to valve box. Locate valve box 1.5m (5-feet) from and align square from adjacent edges of paved areas.
  5. Attach ID tag to solenoid with controller station number to control wiring.
  6. Brand controller and station number in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
- B. PopUp Gear-Driven Rotary Sprinkler Assembly:
1. Flush lateral pipe before installing sprinkler assembly. Clear water of debris before flushing operation stops.
  2. Install at locations indicated on drawings.

SPEC WRITER NOTE: Adjust below based on project conditions.

3. Locate rotary sprinklers // 75 mm (3 inches) // 150 mm (6 inches) // from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to finish grade.
5. Install swing joint as indicated on Drawings.



6. Supply appropriate nozzle or adjust arc coverage of each sprinkler.
7. Adjust each sprinkler throw radius.
8. Install sod 600 mm (2-foot) square around rotary sprinklers in seeded areas.

C. Spray Sprinkler Assembly:

1. Flush lateral pipe before installing sprinkler assembly. Clear water of debris before flushing operation stops.
2. Install at locations indicated on drawings.

SPEC WRITER NOTE: Adjust below based on project conditions.

3. Locate rotary sprinklers // 75 mm (3 inches) // 150 mm (6 inches) // from adjacent edges of paved areas, walls or fences.
4. Install sprinklers perpendicular to and flush with finish grade.
5. Install swing joint as indicated on Drawings.
6. Supply appropriate nozzle or adjust each sprinkler arc coverage.
7. Adjust each sprinkler throw radius.

D. Sprinkler Heads and Quick Couplers:

1. Place on temporary nipples extending at least 80 mm (3 inches) above finished grade. After turf is established, remove temporary nipples and install sprinkler heads and quick couplers at flush with ground surface ensuring no dirt or foreign matter enters outlet.
2. Place part-circle rotary sprinkler heads maximum 150 mm (6 inches) from edge, of and flush with top adjacent walks, header boards, curbs, and mowing aprons, or paved areas at time of installation.
3. Install shrub sprays, sprinklers, and quick couplers on swing joints as detailed on Drawings.
4. Set shrub heads 200 mm (8 inches) above grade and 300 mm (1 foot) from curb or pavement edges. Place adjacent to walls. Stake heads parallel to riser before backfilling trenches.

### 3.9 INSTALLATION OF CONTROL SYSTEM COMPONENTS

A. Control Units:

1. Install control units at locations indicated on Drawings.
2. Install electrical connections according to manufacturer's instructions and as indicated on Drawings.

SPEC WRITER NOTE:  
1. Modify following paragraph to coordinate with grounding requirements

other than lightning protection where specific resistance values are required for grounding system.

2. Follow manufacturer's instructions regarding lightning protection.

3. Lightning Protection: Drive full length grounding rods into soil. Provide and install grounding plates as indicated on Drawings or as required to create grounding connection with field-tested resistance value equal to or lower than specified values identified in this specification. Connect 4mm diameter (#6 AWG) copper grounding wire to rod and plate using CADWELD style connections. Brand "GR" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
4. Attach wire markers to control wire ends inside controller unit housing. Label remote control valve wires with identification number indicated on Drawings, where control wire is connected.
5. Connect control wire to corresponding control unit terminal.
6. Install permanent receiver for hand held radio when not factory installed.
7. Install rain sensor and complete electrical connections control unit according to manufacturer's instructions.

B. Power Wire:

1. Route power wire as indicated on Drawings. Install minimum number field splices. When power wire is spliced, make splice with recommended connector. Place splices in separate 300 mm (12 inch) standard valve box. Coil 600 mm (2 feet) wire in valve box. Brand "WS" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
2. Lay power wire in trenches. Do not use vibratory plow.
3. Wire: NEC code compliant, green wire as common ground wire from power source to satellites and white for common (neutral) wire.
4. Carefully backfill around power wire, avoid wire insulation or wire connector damage.
5. Unless noted on Drawings, install wire parallel with and below mainline pipe. Install wire minimum 50 mm (2 inches) below bottom of PVC mainline pipe.
6. Encase wire in electrical conduit not installed with PVC mainline pipe, with continuous run of warning tape placed in backfill, 200 to 250mm (8 to 10 inches) below ground surface, directly over wiring.

7. Surface mount wire installed above grade in a professional manner, routing approved by COR.
8. Connect wire to power source.

C. Control Wire:

1. Bundle two or more control wires in the same trench. Bundle with pipe wrapping tape spaced 3 m (10-foot) intervals.
2. Chisel control wiring into soil utilizing vibratory plow device manufactured for pipe pulling and wire installation. Use appropriate chisel with wire, fed into chute on chisel, and not subject to pulling tension. Minimum burial depth equal minimum cover previously listed.
3. Provide 600 mm (24 inch) excess wire length in 200mm (8 inch) diameter loop at each 90 degree change in direction, at both ends of sleeves, and at 30 m (100-foot) intervals along continuous wire runs. Do not tie wiring loop. Coil 600mm (24 inch) wire length within each remote control valve box.
4. Install common ground wire and one control wire for each remote control valve. Multiple valves on single control wire are not acceptable.
5. Install spare control and common wires as indicated on Drawings.
6. Use wire connectors and waterproof sealant to splice wire according to manufacturer's instructions. Locate splices in valve box containing irrigation valve assembly, or in separate valve box. Use same procedure for valve connection and in-line splices. When separate valve box is used for wire splices, brand "WS" in 50 mm (2 inch) high by 5 mm (3/16 inch) deep letters on valve box lid.
7. Install wire parallel with and below mainline pipe, unless indicated on Drawings.
8. Protect wire not installed with PVC mainline pipe with continuous run of warning tape place in backfill 150 mm (6 inches) above wiring.
9. Cap exposed wire ends with waterproof wire splices.
10. Locate wiring in trench from master controllers to satellites and stub-cuts for future extension, with new mains or in separate trench at back of curb, unless cross-country route is indicated on Drawings. Locate in trench with mains when possible on cross-country routes.

11. Set wiring bundles located with piping, below bottom of pipe. No two wires of same colors in any bundle. Bundle and tie or taped wires at 3 m (10 foot) intervals. Provide same numbered tag at each wire end, i.e., at valve, at field located controllers and at master controller.
12. Minimize splicing. Provide pull box at each splice. No splice will be allowed between field located controllers and remote control valves.
13. Provide 300 mm (12 inch) expansion loops in wiring at each wire connection or change in wire direction. Provide 600 mm (24 inch) loop at remote control valves.
14. Do not place irrigation system power wiring in same conduit as control wiring.

D. Instrumentation:

1. Install according to manufacturer's instructions at location indicated on drawings.
2. Provide electrical connections between central control system hardware and weather station under direction and observation of central control system manufacturer's personnel.

### 3.10 TRACER WIRE INSTALLATION

- A. Install tracer wire on trench bottom, adjacent to vertical pipe projections, continuous throughout pipe length, with spliced connections soldered and wrap with insulation tape.
- B. Install tracer wire following main line pipe and branch lines and terminate in yard box with gate valve controlling main irrigation lines. Provide sufficient wire length to reach finish grade, bend back wire end making loop and attach Dymo-Tape type plastic label with designation "Tracer Wire."
- C. Record tracer wire locations and terminations on project record documents.

### 3.11 INSTALLATION OF OTHER COMPONENTS

- A. Tools and Spare Parts:
  1. Before punch list review, provide operating keys, servicing tools, spare parts, and other items indicated on Drawings.
- B. Other Materials: Install other materials or equipment indicated on Drawings or installation details that are part of irrigation system.

**3.12 FIELD QUALITY CONTROL**

A. Special Inspections and Tests:

1. On-Site Radio Test: Conduct on-site radio test before submitting bid for type of radio control.

B. Field Inspections:

SPEC WRITER NOTE: Section 01 45 29,  
TESTING LABORATORY SERVICES includes  
VA provided testing for large projects  
and contractor provided testing for small  
projects. Coordinate testing  
responsibility.

C. Field Tests: Performed by testing laboratory specified in Section 01 45 29, TESTING LABORATORY SERVICES.

1. Test irrigation system per procedures listed in section 1.10.
2. Notify the COR three days in advance of testing.
3. 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.
4. Subsections of mainline pipe may be tested independently, subject to the review of the COR.
5. Provide clean, clear water, pumps, labor, fittings, power and equipment necessary to conduct tests or retests.
6. Volumetric Leakage Test - Gasketed Mainline Pipe:
  - a. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
  - b. Purge all air from the pipeline before test.

SPEC WRITER NOTES:

1. Modify the following paragraphs where 700 kPa (100 psi) is indicated as the test pressure, if the irrigation lines are to be operated at a normal pressure higher than 450-500 kPa (65-70 psi). The test pressure should be performed at a minimum of 150% of the normal operation pressure for the line, without exceeding the pressure rating for the pipe.
2. Adjust the allowable leakage as proportional to the actual test pressure as compared to the 700 kPa (100 psi) indicated.

- c. 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.
- d. Allowable deviation in test pressure, 35 kPa (5 psi) during test period; average pressure during test, 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. Measure water added to mainline pipe volumetrically to nearest 10 ml (0.025 gallons).
- e. Subject mainline pipe to the anticipated operating pressure of 700 kPa (100 psi) for two hours. Amount of additional water pumped in during test not exceeding the value in table, or the calculated value using the formula below, based on differing number of joints, duration or pressure of the test:
  - 1) 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 1/2")	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  $L = (ND\sqrt{P})/7400$ .

Where: L = Allowable Leakage (gph).

N = Number of Joints.

D = Nominal Diameter of Pipe (inches).

P = Average Test Pressure (psi).

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

a) 3.10 L (0.82 gallons) per 100 joints of 75 mm (3 inch) diameter pipe.

b) 4.09 L (1.08 gallons) per 100 joints of 100 mm (4 inch) diameter pipe.

c) 6.13 L (1.62 gallons) per 100 joints of 150 mm (6 inch) diameter pipe.

d) 8.18 L (2.16 gallons) per 100 joints of 200 mm (8 inch) diameter pipe.

e) 10.22 L (2.70 gallons) per 100 joints of 250 mm (10 inch) diameter pipe.

f) 12.26 L (3.24 gallons) per 100 joints of 300 mm (12 inch) diameter pipe.

g) 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, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

f. Cement or caulking to seal leaks is prohibited.

g. Contractor may sub-contract testing to pipeline testing company approved by RE/COTR.

7. Hydrostatic Pressure Test - Solvent Weld Lateral Pipe:

- a. Subject lateral pipe to a hydrostatic pressure equal to the anticipated operating pressure of 550 kPa (80 psi) for 30 minutes.
  - b. Cap all sprinkler risers.
  - c. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
  - d. Leakage will be detected by visual inspection. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.
  - e. Cement or caulking to seal leaks is prohibited.
  - f. After lateral passes test and before operational test, install sprinklers and backfill and compact all pipe, fittings, joints, or appurtenance.
8. Operational Test - Remote Control Valves, Lateral Piping and Sprinklers:
- a. Activate each remote control valve in sequence from each new satellite controller manually at the controller, automatically from the Central Computer, and via any handheld units // through central controller // through standalone communication system //. Manual operation on the valves from the bleed valve on the remote control valve is not an acceptable method of activation. COR will visually observe operation, water application patterns, and leakage.
  - b. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
  - c. Replace, adjust, add, or move water emission devices to correct operational or coverage deficiencies.
  - d. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
  - e. Repeat tests until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.
  - f. // Test backflow prevention device with certified tester before project acceptance. //
9. Distribution Uniformity (DU):
- a. Perform DU Test on one zone of burial section rotors and one zone of tree lawn rotors per satellite controller.



- b. Select the zones of sprinklers representative of area being irrigated by satellite controller in the presence of the COR.
- c. Perform catch can test using procedures recommended by Irrigation Association.
- d. Where DU test fails, adjust zone pressures // and // or // nozzle sizes to meet required Distribution Uniformity.
- e. Calculate and provide written documentation of DU for each zone tested.
- f. Irrigation Association Certified Landscape Irrigation Auditor must perform the test. Provide written evidence of certification before conducting test.

SPEC WRITER NOTES:

1. Grounding for satellites is very site specific and is dependent on the site soil conditions and methods being utilized to construct earth grounding. To achieve desired resistance value for grounding of less than 15 ohms, recommended maximum allowable value, and recommended value of 5 ohms or below, adjustment to number and type of grounding facilities installed is required.
2. When testing of field installed grounding installations produce resistance values that are higher than those recommended above, the only way to lower resistance level is to add more grounding equipment. Refer to Facilities Design Guide for information on what to include for grounding to protect the irrigation equipment, and procedures to follow to achieve desired grounding without incurring cost increases due to change orders.
3. Modify the following to include sufficient information that will result in providing fully functional grounding system for irrigation system equipment that will result in test results grounding at or below readings specified herein.
4. Modify values for grounding test readings when required to be at levels recommended by manufacturer for protection of equipment, or as indicated herein, whichever is lower.

10. Control System Grounding:

- a. Test all new satellite controllers for proper grounding of control system with installed grounding equipment that creates grounding resistance readings of 5 ohms or less or higher levels not to exceed 15 ohms, when acceptable by equipment manufacturer without equipment warranty invalidation. Test results meet or exceed control system manufacturer's instructions for acceptance, while maintaining equipment warranty.
- b. Replace defective wire, grounding rod or appurtenances. Repeat test until manufacturer's instructions are met. Add grounding rods as needed, bond all rods together.
- c. When test is acceptable, document results of grounding test on inside of each satellite controller pedestal door and via written report submitted to the COR. Documentation includes satellite name or number, date of test, name or initials of the individual completing the test, and the ohms resistance to ground. Mark test results on the inside of each satellite controller pedestal door using a permanent marker.
- d. Submit to the COR, written report of test data listing satellite name or number, date of test, name of the individual completing the test, name of the company completing the test and the ohms resistance to the local ground for each satellite.

SPEC WRITER NOTES:

1. Modify following paragraph to reflect testing of the entire irrigation system, when there are portions already exist, or just operating new portion installed as part of this project. Having existing irrigation components as well as new complicates the testing process and faults, as there can be situations where the existing system problems may cause the failure during automatic operations. Clarify exactly what has to be done to adjust the programming, so known problem zones in the existing system can be removed from the scheduling program to prevent faults.

2. The irrigation system as well as the water supply source providing water to the irrigation system, when other than a connection to a municipal water supply connection, both need to be demonstrated as well as any equipment and or facilities that have been installed to insure that the two systems operate

together as designed, with any safe guards that were designed to be fully functional. Modify as required to clearly require full acceptance testing for the applicable systems.

11. Irrigation System Acceptance Test (Burn inches) before Final Inspection:

- a. Upon completion of construction and before Final Inspection, an Acceptance Test (Burn inches) must be passed.
- b. Coordinate start of Test with COR.
- c. During Test, irrigation system must be fully operational from // central control system // standalone programs at the individual satellites // for the system //. Operate irrigation system, with no faults for 14 consecutive days. When at any time during the 14 day test period, system fault occurs, determine source of the fault and correct, and restart 14 day evaluation period. When system fault occurs, make repairs within 24 hours of notification from COR. Document any faults of test report listing date, fault, cause of fault and corrective action taken.
- d. When system has operated for 14 days without fault, contact the COR to schedule Final Inspection.
- e. When system is designed to detect flow and shut down and this condition happens during test, this is considered a success and test continues; when does not shut down, test starts over.

## SPEC WRITER NOTES:

1. The following may be applicable when there is water supply source control system that operates with interconnection to irrigation computer control software. Modify as appropriate for the project conditions.
2. Delete SCADA Paragraph below, when water supply source system operates totally off pressure in irrigation system, performing pressure maintenance, and no separate computer operated system safeguards and there is no SCADA system.
3. Modify Paragraph describe the intercommunication being tested between SCADA system and Irrigation Central Computer systems.
4. Delete below when no SCADA system is present.

12. Flushing: After testing, flush system beginning with larger mains and continuing through smaller mains in sequence. Flush lines before installing sprinkler heads and quick couplers.
13. Operation Test: Upon completion of the final adjustment of sprinkler heads to permanent level at ground surface, test each sprinkler section by pan test and visual test to indicate uniform distribution within any one sprinkler head area and over the entire area. Operate entire installation to demonstrate the complete and successful operation of all equipment.

## D. Maintenance Services:

## SPEC WRITER NOTES:

1. Adjust verbal instructional hours in following paragraph to suit installation. Cemetery equals 16 hours, minimum.
2. Modify following paragraph to fully describe requirements specific to this project. Add, modify, or delete items provided according to site specific project. Results should be a clear requirement for fully annotated, tabbed and indexed manual describing normal operations, troubleshooting, and emergency procedures, as well as start-up and shut-down procedures.

1. Maintenance and Operating Instructions: Before final acceptance, provide verbal instructions, minimum \_\_\_\_\_ hours, to operating personnel. Provide two additional years of software support for one

hour each month. Provide Maintenance and Operating Instructions for the provided irrigation system in the form of manuals as follows:

- a. 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:
- b. Catalog cut sheets for control system, valves, sprinklers, pipe and fittings, wire and wire connectors, ID tags, shop drawings, and all other irrigation equipment shown or described on the drawings and within these specifications.
- c. Manufacturer's Operation and Maintenance manuals.
- d. Manufacturer's Technical Service Bulletins.
- e. Manufacturer's Warranty Documentation.
- f. Software License Information.
- g. Recommended routine maintenance inspections for weekly, monthly and annual inspections and recommended actions for the inspections and a recommended method for recording the findings of the inspections.
- h. Predictive schedule for component replacement.
- i. Listing of technical support contacts.

### **3.13 WINTERIZATION AND SPRING START-UP**

- A. Winterize new irrigation system according to local practices in first fall after completion of construction of irrigation system and start up in spring after completion of construction. Repair any damage caused in improper winterization. Coordinate winterization and start-up with cemetery landscape maintenance personnel.

### **3.14 CLEANING**

- A. Clean exposed // product // surfaces. Remove contaminants and stains.

### **3.15 DEMONSTRATION AND TRAINING**

- A. Instruct VA personnel in proper irrigation system operation and maintenance.
  1. Trainer: Manufacturer approved instructor.
  2. Training Time: 30 days minimum.
- B. Submit training plan and trainer qualifications. See Section XX XX XX - // RELEVANT COMMISSIONING SECTION //.
- C. Acceptance Condition: After completing work, operate irrigation system 15 consecutive calendar days without breakdown.

## SPEC WRITER NOTES:

Adjust the following depending upon the control system provided and the computer equipment available at this facility. Coordinate the following with the Project Manager before including in the specifications. If included modify to make clear exactly what is to be provided.

- D. Provide training video on DVD or CD, whichever is compatible with the computer system provided for the central computer, to familiarize maintenance personnel with equipment provided. Coordinate final training presentation with Architect/Engineer and COR in outline form before creation, verify format and organization of content is applicable for facility staff utilization.

**3.16 PROTECTION**

- A. Protect // product // from // traffic and // construction operations.
- B. Cover // product // with reinforced kraft paper, and plywood or hardboard.
- C. Remove protective materials immediately before acceptance.
- D. Repair damage.

- - - E N D - - -