

SECTION 328400 - IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes piping, valves, sprinklers, specialties, controls, and wiring for automatic-control irrigation system.

1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. Irrigation Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- D. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. FRP: Fiberglass-reinforced plastic.
 - 3. PA: Polyamide (nylon) plastic.
 - 4. PE: Polyethylene plastic.
 - 5. PP: Polypropylene plastic.
 - 6. PTFE: Polytetrafluoroethylene plastic.
 - 7. PVC: Polyvinyl chloride plastic.
 - 8. TFE: Tetrafluoroethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

- A. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as trees, signs and light standards. Excavation within drip line of existing trees shall be limited to hand digging. No mechanical excavation equipment will be allowed. Maintain 100 percent water coverage of turf and planting areas indicated.
 - 1. Minimum Working Pressures: Contractor shall determine the available working pressure against the irrigation design and notify the architect of any discrepancies.

- B. The sprinkler system shall include sprinklers, valves, piping fittings, controller, wiring, all of sizes and types as shown on the drawings and specified. The system shall be constructed to grades and conform to areas and locations as shown on the drawings.
- C. Sprinkler lines shown on the drawings are essentially diagrammatic. Spacing of the sprinkler heads or quick coupling valves are shown on the drawings and shall be exceeded only with written permission of the Designer.
- D. Unless otherwise specified or indicated on the drawings, the construction of the sprinkler system shall include the furnishing, installing, and testing of all mains, laterals, risers and fittings, sprinkler heads, gate valves, control valves, controllers, electric wire, controls, backflow preventers, enclosures, and other necessary specialties and the removal and/or restoration of existing improvements, excavating and backfill, and all other work in accordance with the plans and specifications a required for a complete system.

1.5 SUBMITTALS

- A. Product Data: Include pressure ratings, rated capacities, and settings of selected models for the following:
 - 1. Water regulators.
 - 2. Water hammer arresters.
 - 3. General-duty valves.
 - 4. Specialty valves.
 - 5. Control-valve boxes.
 - 6. Sprinklers.
 - 7. Irrigation specialties.
 - 8. Controllers. Include wiring diagrams.
 - 9. Control cables. Include splice kits and conduit.
 - 10. Piping: including fittings, solvents, and primers
- B. Operation and Maintenance Data: For irrigation systems, to include in emergency, operation, and maintenance manuals per Division 1 Section Closeout Procedures.
- C. Contractor shall review drawings and data to supply actual precipitation rates and times for each zone in maintenance package (i.e. system scheduling).
- D. Upon completion of installation, Contractor shall produce as-built drawings in Autocad 2010 format and furnish one set of reproducible and one set of printed record drawings showing all sprinkler heads, valves, drains, and pipelines to scale with dimensions. These drawings shall have dimensions from easily located stationary points (cross measured) as they relate to all valves, mainlines, and wire. Clearly note all approved substitutions of size, material, etc. Complete, concise instruction sheets and parts lists covering all operating equipment and weathering techniques shall be bound into folders and furnished to the Owner in three (3) copies. Submission of this information is a requirement for final acceptance
- E. Upon completion of installation, Contractor shall provide the owner with a color-coded zones diagram plan, 8-1/2"x11" laminated sheet(s), which will identify controller stations to the control valve number for each controller. Sheets to be located in adhesive pouch attached inside of each controller.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Conference: Before any work is started a conference shall be held between the Contractor and the Owner concerning the work under this contract.
- C. The Contractor shall maintain continuously a competent superintendent, satisfactory to the Owner, on the work during progress with authority to act or him in all matter pertaining to the work.
- D. It is the Irrigation Contractor's responsibility to coordinate and cooperate with the other Contractors to enable work to proceed rapidly and efficiently.
- E. The Contractor shall confine his operations to the area to be improved and to the areas allotted him by the Designer and General Contractor for material and equipment.
- F. Contractor shall take all necessary to protect the existing site conditions and vegetation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Construction Manager no fewer than two days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Construction Manager's written permission.

1.9 COORDINATION

- A. Coordinate with installation of water meter and electrical connection to controller (by others).

1.10 SITE CONDITIONS

- A. The Contractor shall examine the site, plans and specifications (i.e. system requirements).
- B. It shall be the Contractor's responsibility to report in writing to the Designer any deviations between drawings, specification, and actual site conditions. Failure to do so prior to the installing of equipment shall be done at the Contractor's expense.

- C. Adjustment of the sprinkler heads and automatic equipment will be done by the Contractor, upon completion of installation, to provide optimum performance.
- D. After completion, testing, and acceptance of the system, the Contractor shall verbally instruct the Owner's personnel in the operation and maintenance of the system. All written instruction shall be included in the bound maintenance package as stated in Paragraph 1.3 - Submittals.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting, and joining materials.
- B. PVC Pipe: ASTM D 1785, PVC 1120 compound, Class 200.
 - 1. PVC Socket Fittings, Schedule 80: ASTM D 2467.
 - 2. PVC Threaded Fittings: ASTM D 2464.

2.2 IRRIGATION VALVES

- A. Automatic Control Valves: Globe-type diaphragm valves of normally closed design, with bronze bodies or heavy-duty plastic and covers (type noted on drawings). Operation accomplished by means of an integrally mounted heavy-duty 24 volt AC solenoid complying with National Electrical Code, Class II Circuit, solenoid coil potted in epoxy resin within a plastic-coated stainless steel housing. Solenoids shall be completely waterproof, suitable for direct underground burial. Provide a flow stem adjustment in each valve.
- B. Drip Control Valves shall be prefabricated assemblies as noted on drawings.

2.3 CONTROL-VALVE BOXES

- A. Plastic Control-Valve Boxes: Box and cover, with open bottom and openings for piping; designed for installing flush with grade. Include size as required for valves and service.
 - 1. Shape: Rectangular or Circular (as per plans/details)
 - 2. Sidewall Material: PE
 - 3. Cover Material: PE
 - 4. Edit subparagraph below for specific lettering required and verify availability, or delete subparagraph.
 - 5. Manufacturers:
 - a. Carson or approved equal.
- B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch (19 mm) minimum to 3 inches (75 mm) maximum. Minimum 2 cubic feet per valve box.

2.4 SPRINKLERS

- A. Description: Brass or plastic housing and corrosion-resistant interior parts designed for uniform coverage over entire spray area indicated, at available water pressure.
 - 1. Bubblers: Fixed pattern, with screw-type flow adjustment.
 - 2. Shrubbery Sprinklers: Fixed pattern, with screw-type flow adjustment.
 - 3. Pop-up, Spray Sprinklers: Fixed pattern, with screw-type flow adjustment and stainless-steel retraction spring.
 - 4. Pop-up, Rotary, Spray Sprinklers: Gear drive, full-circle and adjustable part-circle types.
 - 5. Pop-up, Rotary, Impact Sprinklers: Impact drive, full-circle and part-circle types.

2.5 AUTOMATIC-CONTROL SYSTEM

- A. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
 - 1. Material: Plastic
 - 2. Mounting: Surface type for wall mounting.
- B. Interior Control Enclosures: NEMA 250, Type 12, drip-proof, with locking cover and two matching keys.
 - 1. Material: Enameled-steel, sheet metal.
- C. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
- D. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate 2 or more times daily.
 - 1. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
 - 2. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
 - 3. Surge Protection: Metal-oxide-varistor type on each station and primary power.
- E. Wiring: UL 493, Type UF-B multiconductor, with solid-copper conductors and insulated cable; suitable for direct burial.
 - 1. Joining of underground wires shall be made with watertight connectors in valve boxes. No splicing outside of valve boxes is acceptable.
 - 2. Available Manufacturers:
 - a. AFC Cable Systems Inc.
 - b. Alcatel Canada Wire, Inc.
 - c. American Electric Cable Co.
 - d. American Insulated Wire Corp.
 - e. Cerro Wire & Cable Co., Inc.
 - f. Colonial Wire and Cable Co., Inc.
 - g. Essex Group, Inc.; Building Wire Products Division.
 - h. Precision Cable Manufacturing Co., Inc.
 - i. Southwire Company.
 - j. Triangle Wire and Cable Co.
 - k. Tucor

3. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
4. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
5. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.

- F. Install Rain/Freeze type shut off device to override the control timer in the event of rain and/or freeze

2.6 DRIP IRRIGATION

- A. Drip tubing to be as shown on plans (type, emitter flow, emitter spacing, line spacing, installation, etc).
- B. Automatic flush valves shall be installed at low point(s) of each drip zone.
- C. Air vent valves shall be installed at high point of each drip zones.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Install piping and wiring in sleeves under sidewalks, roadways, parking lots, and railroads.
 1. Install piping sleeves by boring or jacking under existing paving if possible.
 2. Trenching within driplines of existing trees shall be limited to hand digging. No mechanical equipment will be allowed.
- B. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches (19 to 75 mm), to 12 inches (300 mm) below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- C. Provide minimum cover over top of underground piping according to the following:
 1. Irrigation Main Piping: 18 inches (450mm).
 2. Circuit Piping: 12 inches (300 mm).
 3. Drain Piping: 12 inches (300 mm).
 4. Sleeves: 24 inches (600 mm).
- D. Trenches for pipe sprinkler lines shall be excavated of sufficient depth and width to permit proper handling and installation by any other method the Contractor may desire if approved by the Owner, pipe manufacturer, and Designer. The backfill shall be thoroughly compacted and evened off with the adjacent soil level. Selected fill dirt or sand shall be used if soil conditions are rocky. In rocky areas the trenching depth shall be two (2) inches below normal trenching depth to allow for this bedding. The fill dirt or sand shall be used in filling (4) inches above the pipe. The remainder of the backfill shall contain no lumps or rocks larger than three (3) inches. The top twelve (12) inches of backfill shall be topsoil, free of rocks, subsoil, or trash. Any open trenches or partially backfilled trenches left overnight or left unsupervised shall be barricaded to prevent undue hazard to the public.

- E. The Contractor shall backfill in six (6) inch compacted lifts as needed to bring the soil to its original density.
- F. In the spring following the year of installation, the Contractor shall repair any settlement of the trenches by bringing them to grade with topsoil, and seeding with the existing lawn type(s). Watering and maintenance of the repaired areas shall be the Owner's responsibility.

3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

3.3 PIPING APPLICATIONS

- A. Select piping applications from this Article. Coordinate with piping materials specified in Part 2.
- B. Pipe sizes shall conform to those shown on the drawings. No substitutions of smaller pipe sizes will be permitted, but substitutions of larger size may be approved. All pipe damaged or rejected because of defects shall be removed from the site at the time of said rejection.
- C. All mainline piping (21/2") two and one half inches and larger will be equipped with gaskets.
- D. All fittings for mainline pipes two and one half (21/2") inches or larger will be equipped with gaskets.
- E. All piping downstream of electric valves, sizes (3) inches and smaller, shall be rigid unplasticized PVC 200 PSI working pressure extruded from virgin parent material of the type specified on the drawings. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, wrinkles and permanently marked with the manufacture's name, material, size, and schedule type. Pipe must bear the NFS seal.
- F. All mainline piping and underground piping under continuous pressure shall be rigid unplasticized PVC-Class 200 PSI working pressure extruded from virgin parent material of the type specified on the drawings. The pipe shall be homogeneous throughout and free from visible cracks, holes, and foreign materials, blisters, wrinkles and dents.
- G. All plastic fittings to be installed shall be molded fittings manufactured of the same material as the pipe and shall be suitable for solvent weld, slip joint ring tight seal, or screwed connections. NO fitting made of other material shall be used except as hereinafter specified.
- H. Slip fitting socket tapers shall be so sized that a dry unsoftened pipe end conforming to these special provisions can be inserted no more than halfway into the socket. Plastic saddle and flange fittings will not be permitted. Only Schedule 80 pipe may be threaded.
- I. H.Fittings for all Mainline Piping 4" and larger shall be Harco Ductile Iron Gasketed Fittings. All mainline 4" and larger shall utilize approved thrust blocking and or restraints. Thrust Blocking and restraints to be installed as per manufacturer's recommendations for pipe type, pipe size and local environmental conditions.

3.4 SLEEVES

- A. All sleeves shall be Class 200 PVC or stronger. All sleeves are required at every crossing indicated on drawings. (Size Noted)
- B. All sleeves shall be installed under proposed pavement areas prior to subgrade and base construction.
- C. Sleeves shall have a minimum horizontal separation of 18" and a maximum of twenty-four (24) inch clearance below bottom of curb.
- D. All sleeves shall have a minimum horizontal separation of twenty-four (24) and maximum of thirty-six inches from center to center.
- E. Stub up sleeve pipe twelve (12) inches above ground surface and cap. Paint cap with fluorescent orange paint for easy identification.
- F. The location of all sleeves shown on the plans is schematic. The contractor shall make any adjustments necessary to accommodate existing vegetation, utilities, or other existing conditions.
- G. If the road crossings are designated as being bore locations the bore must be ample size to accommodate the size sleeve specified.

3.5 VALVE APPLICATIONS

- A. Control Valves:
 - 1. NPS 2 (DN 50) and Smaller: Bronze automatic control valve.
- B. Drain Valves:
 - 1. NPS 1/2 and NPS 3/4 (DN 15 and DN 20): Automatic drain valve.

3.6 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.
- G. Install underground thermoplastic piping according to ASTM D 2774.
- H. Lay piping on solid subbase, uniformly sloped without humps or depressions.

- I. Install PVC piping in dry weather when temperature is above 40 deg F 5 deg C. Allow joints to cure at least 24 hours at temperatures above 40 deg F 5 deg C before testing unless otherwise recommended by manufacturer.
- J. Place one cubic ft. of concrete for each inch of pipe diameter for thrust block. Thrust shall not allow vertical or horizontal movement of pipe in any direction unless otherwise noted on design. Thrust blocking shall be provided on all piping three (3) inch diameter and larger.
- K. Plastic pipe shall be installed in a manner that permits expansion and contraction as recommended by the manufacturer.
- L. Plastic pipe shall be cut with a handsaw or hacksaw with the assistance of a square in sawing vice or in a manner so as to ensure a square cut. Burrs at cut ends shall be removed prior to installation so that a smooth unobstructed flow will be obtained.
- M. All plastic-to-plastic joints shall be solvent weld joints or slip seal joints. Only the solvent recommended for the pipe and fittings shall be installed as outlined and instructed by the pipe manufacturer. The Contractor shall assume full responsibility for the correct installation.
- N. The joints shall be allowed to set at least twenty-four (24) hours before pressure is applied to the system on PVC pipe.

3.7 VALVE INSTALLATION

- A. Control Valves: Install in control-valve box.

3.8 SPRINKLER INSTALLATION

- A. Flush circuit piping with full head of water and install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries, unless otherwise indicated.

3.9 AUTOMATIC-CONTROL SYSTEM INSTALLATION

- A. Install controllers on building wall in location to be approved by owner.
- B. Install control cable in same trench as irrigation piping and at least 2 inches (50 mm) below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas if irrigation piping is installed in sleeve.

3.10 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- C. All electrical connections shall conform to the National Electrical Code, latest edition.
- D. Control wires installed beneath walks, drives, or other permanent surfaces shall be placed in sleeves.
- E. Wires shall be spliced only at valve boxes.
- F. Leave twenty-four (24) inch loop of wire at each valve for expansion/contraction and servicing.
- G. Controllers and valves shall be from the same company e.g. (Rain Bird, Toro or approved equal).

3.11 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, the contractor shall perform the two following pressure (leak) tests for the system:
 - a. 2-hour pressure test of the system at 1.5 times the system static pressure.
 - b. 24-hour pressure test of the system at the system static pressure.The tests shall be continued (repeated) until no drop in pressure during the tests occur.
 - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace units and retest as specified above.

3.12 STARTUP SERVICE

- A. Verify that controllers are installed and connected according to the Contract Documents.
- B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.
- C. Complete startup checks according to manufacturer's written instructions.

3.13 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade.

3.14 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.
- B. Upon completion of work, Contractor shall keep project site clean and orderly.

3.15 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain controller and automatic control valves. Refer to Division 1 Section Closeout Procedures."

3.16 WINTERIZING THE SYSTEM

- A. Contractor's responsibility to winterize the irrigation system the first winter following Substantial Completion of the Project.

3.17 INSPECTION

- A. Periodic Inspections will be made by the Landscape Architect/Owner's Representative to review the quality and progress of the work. Work found to be unacceptable must be corrected within a timely matter (to be determined by Owner's Representative). Remove rejected materials promptly from the project site.
- B. It will be the responsibility of the Irrigation Contractor to provide a reliable communication system (i.e. Two way radios or remote radio control activation system) for Substantial Completion and all periodic inspections.

PART 4 – CODES, PERMITS, WARRANTY, AND GUARANTEE**4.1 CODES AND ORDINANCES**

- A. All materials, installation parameters, and operations shall conform to all applicable codes and ordinances. It is the Contractor's responsibility to investigate and follow all regulations. Contractor is responsible to verify applicable codes and ordinances prior to submitting bid. Before bid submittal, it is the Contractor's responsibility to notify the Irrigation Consultant/Designer at least 5 days before bid submittal, of any changes due to code or ordinance discrepancies. If the Contractor does not comply with this process and notification, the Contractor shall be responsible for the necessary installation change and redesign costs for non-compliance.

4.2 PERMITS AND FEES

- A. The Contractor shall obtain, at his expense, all required permits and shall pay all required fees. Any penalties imposed due to failure to obtain any permit or pay any fee shall be the responsibility of the Contractor.

4.3 WARRANTY AND GUARANTEE

- A. The Contractor shall furnish a certificate of warranty registration and a written guarantee of work and materials for a one year period from the date of final acceptance of the Irrigation System by the Owner and the Designer.

END OF SECTION 328400