

SECTION 328400 – SPORTS FIELD IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Description: Furnish and install irrigation piping and irrigation sprinkler systems in conformance with the drawings and specifications, complete and ready to use. The work consists of furnishing all materials necessary for a complete installation, including but not limited to:

1. Piping and Fittings
2. Irrigation System Controller
3. Sprinkler Heads
4. Quick Coupling Valves
5. Manual Valves
6. Valve Boxes
7. Backflow Prevention
8. Swing Joints
9. Miscellaneous piping specialties

Included shall be all labor of installation including trenching, plumbing, backfilling, electrical work, adjustments, and all other items of labor necessary for a satisfactory operating 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. Demand (or irrigation demand): Refers to the irrigation requirements of the irrigated area. Demand primarily depends on the type of plant material, stage of growth, ET, soils, or other environmental conditions.
- D. Design Pressure: The pressure at which the irrigation system or certain components are designed to operate. The irrigation system design pressure is that measured at the pump discharge or entrance to the system if there is no pump, and a zone design pressure is the average operating pressure of all sprinkler/emitters within a zone.
- E. Discharge Rate: The instantaneous flow rate of an individual sprinkler, emitter, or other water emitting device, or a unit length of line-source micro irrigation tubing. Also, the flow rate from a pumping system. Discharge rates are expressed in units of volume per time such as gpm, gph, lph, or lpm.
- F. Effective Root Zone: The depth of soil in which most of the plant roots actively involved in water extraction are located. This is usually the upper 50% to 75% of the plant root zone rather than the depth to which the deepest root penetrates. It is this zone in which irrigations should be concentrated.
- G. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

- H. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- I. Filtration System: The assembly of physical components used to remove suspended solids from irrigation water. These include both pressure and gravity type devices, such as settling basins, screens, media filters, and centrifugal force units (vortex sand separators).

1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. The water source shall be tested for adequacy from the standpoint of flow rate, volume, quality, pressure, and other applicable factors to meet the irrigation requirements of the area to be irrigated for the expected life of the system. A water source flow test must be completed prior to sprinkler system design.
- C. Design flow rate through the meter shall not be greater than 75% of the maximum safe flow capacity as stated by the meter manufacturer. The flow should not be outside the meter manufacturer's recommended operating range.
- D. Irrigation systems shall be designed to meet peak usage. The system shall incorporate sufficient capacity to provide the necessary water for plant establishment.
- E. Delegated Design: Design 110 percent coverage irrigation system. Retain applicable soil conditions in subparagraph below.
- F. The irrigation system should be divided into zones:
 - 1. Available flow rate/pressure.
 - 2. Economic factors.
 - 3. Cultural use of the area.
 - 4. Type of vegetation irrigated, i.e., turf, shrubs, native plants, etc.
 - 5. Soil characteristics.
 - 6. Exposure.
 - 7. Topography.
- G. Within any given zone, the maximum variation in sprinkler flow rates should be less than 5% and must be less than 20% of the average flow rate for all sprinklers with the same areas of coverage.
- H. Flow rates of part circle sprinklers shall be normalized to that of a full circle sprinkler when both are used within a zone.
- I. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: 200 psig
 - 2. Circuit Piping: 150 psig
- J. Working pressure of the mainline pipe should not exceed 72 percent of the pressure rating of the pipe nor should the design velocity exceed 5 feet per second.
- K. Surge pressures shall not exceed 2.5 times the adjusted working pressure of the mainline pipe.

1.5 SUBMITTALS

The Contractor shall be responsible to submit three (3) binders of manufacturer's data for all materials to be used before performing any work including the following:

- A. Plans or Drawings: Provide design drawings prior to start of construction. Design drawings shall be clearly readable, to reasonable scale, and shall include at the minimum: date, scale, revisions, legend, water source, design operating pressure and flow rate per zone, average application rate per zone (listed in inches per hour), watering schedule, locations and sizes of pipe, controllers, valves, sprinklers, backflow prevention devices, elevation, electrical supply, roadways, sidewalks, structures and other relevant site conditions.
- B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- C. Wiring Diagrams: For power, signal, and control wiring.
- D. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional responsible for their preparation.
- E. Qualification Data: For qualified Installer.
- F. Zoning Chart: Show each irrigation zone and its control valve.
- G. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For sprinklers, controllers, and automatic control valves to include in operation and maintenance manuals.
- J. Equipment or materials installed or furnished without prior approval of the engineer will be rejected and such materials will be required to be removed and replaced with approved materials at the complete expense of the contractor.
- K. Submit shop drawings for review and approval prior to beginning work
- L. Record Drawings: At the project close, an as-built drawing shall be submitted showing all the locations of the irrigation plan and any and all changes. The main elements of the as-built drawings, i.e.; main line fittings, electric valves, gate valves, quick coupler, splice boxes and locations of ends of sleeves shall be shown on the as-built drawing. During the installation process, the contractor shall keep a field copy of changes on site. All features to be located by two (2) lift points.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Companies regularly engaged in manufacturing irrigation system materials and products, of types and sizes required as specified, whose products have been in satisfactory use in similar projects for not less than 15 years.
- B. Installer's Qualifications: Companies who have successfully completed a minimum of five (5) contracts over a three (3) year period involving installation of irrigation and piping projects similar to size and scope to that required for this project. Such experiences and references shall be attached to the bid sheet for this project.

C. Codes and Standards:

1. Comply with all applicable State and Local ordinances and codes.
2. All materials and work shall meet the requirements of ASTM, AWWA, UL and the USC Foundation for Cross Connection Control.

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. Underground Utilities and Elements: Locate all underground utilities and elements prior to digging and/or driving stakes. Take care to neither disturb nor damage any existing above ground or under ground utilities or elements. Keep streets, sidewalks and site clean, free from debris, and affected drains open and free flowing at all times.
- B. Site Inspection and Layout: Before proceeding with any work, the Contractor shall inspect the site, carefully check all grades, and verify all dimensions and conditions affecting the work to satisfy him/her and that he/she may safely proceed. Changes or alterations to the system to meet actual conditions shall be made at the Contractor's expense. Irrigation piping plan is diagrammatic and is not intended to show exact locations of existing or proposed piping, valves or controllers. Locate new items as closely as possible to related curbs, walls, fences or edges of paving. Pipelines shown parallel on drawing may be placed in a common trench but separated by at least 6 inches.
- C. Should utilities not shown on the plans be found during excavations, the contractor shall promptly notify the owner site agent for instructions as to further action. Failure to do so will make the contractor liable for any and all damage that arises from his neglect.
- D. The contractor shall take the necessary precautions to protect all existing site conditions, including plant materials. Should damage be incurred, the contractor shall repair or replace the damage to its original condition at his expense.

1.9 PIPING ARRANGEMENTS

- A. The contractor shall make necessary adjustments in the layout of the irrigation system and the pipe routing. Should conflicts arise during installation, the contractor shall obtain a change order for this adjustment to the plan. This change order shall not authorize an additional fee but shall resolve any existing site condition problems. The contractor shall not proceed without the work order and shall provide in written assurance that such changes will not cause any extra costs due to these changes. Any work that does not receive a work order and is in conflict with existing site conditions shall be removed and reinstalled by the contractor at no expense to the owner or owner's agent.

1.10 WORKMANSHIP

- A. The contractor shall follow the manufacturer's recommendations for installing all PVC pipes, fittings, valves, electric valves, sprinklers, controllers, and all other appurtenances.
- B. The contractor shall also follow all standards and installation practices that have been established by all related associations and local, state, and federal codes.

The contractor shall always perform his work in a professional and orderly manner. The contractor at all times shall have a Project Superintendent on the site who is completely familiar with all installed materials and will be responsible for the installation of all materials.

1.11 REVISIONS

- A. Any major revisions to the irrigation system must be submitted and answered in written form, along with any negotiated change in contract price.

1.12 COORDINATION

- A. All work shall be coordinated with other trades on the site; any conflicts shall be resolved by the project manager in order to proceed with the work as rapidly and efficiently as possible.

1.13 GUARANTEE

- A. All work shall be guaranteed for one (1) year from date of acceptance of the completed installation against all defects in materials, equipment and workmanship. Guarantee shall cover the repair of damage to any part of the installation site resulting from leaks or other defects in materials, equipment and workmanship to the satisfaction of the owner. Repairs, if required under the guarantee period, shall be done at no cost to the owner. All manufacturers' extended warranties shall be transferred to owner with the caveat that any labor after the one year general contractor guarantee shall be billable by the contractor, should the owner decide to use the contractor's service to install any manufacturer's equipment through the extended warranty.
- B. Guarantee shall include system shut down for first winterization, spring start up, and second winterization. The development of an approved water application schedule by the contractor and approved by the irrigation consultant. Winter damage due to improper winterizations will be the responsibility of the contractor and repairs to the irrigation system through both winterizations shall be performed at no cost to the owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide irrigation system components and materials by the following manufacturers, or approved equal:
 1. HUNTER INDUSTRIES, 1940 Diamond Street, San Marcos, CA 92078. Ph 760-744-5240.
 2. RAINBIRD SALES INC., P.O. Box 37, Glendora CA 91740-9945 Ph: 800-724-6247.

2.2 MATERIALS

- A. Provide all irrigation materials and factory-fabricated products of size, types, pressure ratings and capacities as indicated. If there are any discrepancies in materials or interpretation or their use, the contractor shall be responsible to obtain proper clarification before any materials are installed.
- B. All materials throughout the irrigation system shall be new and undamaged and in perfect working condition.
- C. All automated sprinkler system components, including controller, valves and sprinkler heads, shall be provided by the same manufacturer.

2.3 PIPING AND FITTINGS

- A. All piping 2 ½" and smaller shall be solvent weld SDR 21 class 200 PVC pipe, extruded from 100% virgin polyvinyl chloride conforming to ASTM D 2241 and shall be continuously and permanently marked with the manufacturers name, material, size and schedule or type. Pipe shall conform to all specifications form ASTM, Department of Commerce, NSFTL (NSF) or the latest revisions. Pipe shall be Crestline or Certainteed only.
 - 1. All fittings on 2" and smaller shall be SCH 40 PVC conforming to ASTM D-2466. No saddle or clamp type fittings shall be used.
- B. All piping 3" and larger shall be rubber ring joint type SDR 21 class 200 PVC pipe, extruded from 100% virgin polyvinyl chloride conforming to ASTM D 2241 and shall be continuously and permanently marked with the manufacturers name, material, size and schedule or type. Pipe shall conform to all specifications form ASTM, Department of Commerce, NSFTL (NSF) or the latest revisions. Pipe shall be Crestline or Certainteed only.
 - 1. All pipe ends shall be tapered to accept gasket fittings. Lubricant for assembling pipe and fittings all be water soluble, non-toxic and be in accordance with pipe manufacturer's recommendations. All fittings 2 ½" or larger shall be Harco or equal.
- C. All pipes for sleeves shall be SCH 40 PVC conforming to ASTM D-17585. Sleeve sizes shall be large enough to accommodate the ell housing of the ring tight pipe or the solvent weld belled end pipe. As a minimum, the sleeve pipe ID shall be 1 ¼ times the irrigation pipe OD at the bell housing.
- D. All copper pipes shall be type K copper, no lead based solder will be allowed.
- E. PVC pipe (zone lines) downstream of the control valves (laterals) shall be Schedule 40 or better and shall conform to all requirements of ASTM D1785-86.
- F. All PVC pipe shall be marked with the manufacturer's name, class of pipe and NSF seal. Pipe shall bear no evidence of interior or exterior extrusion marks. Pipe walls shall be uniform, smooth and glossy. Pipe may be pre-belled or with individual solvent-weld couplings.
- G. All PVC fittings shall be of the solvent weld type except where risers, valves, etc. require threaded transition fittings. All fittings shall conform to the requirements of ASTM D2466-78. All threaded PVC tees, fittings, adaptors and nipples shall be Schedule 80 or better.
- H. All PVC pipe must be delivered in at least 20 foot lengths.
- I. All PVC pipes and fittings for swing joints shall conform to all requirements of ASTM D 3139.
- J. Sleeves required for main and lateral lines located under paving shall be Schedule 40 PVC, with the inside diameter (I.D.) of sleeve to be twice the outside diameter (O.D.) of the insert pipe, maximum 1 insert pipe per sleeve. All wiring to be in separate sleeves from piping sleeves.
- K. Sleeves under roadways (street rights-of-way, boulevards or parkways) where heavy vehicular traffic is anticipated shall be ductile iron pipe, with the I.D. of the sleeve at least 1" greater than the O.D. of the total inserted pipe. All wiring shall be in separate conduit sleeve within the iron pipe.
- L. Use Teflon tape on all threaded fittings.
- M. Primer color shall be purple and glue color shall be gray.

2.4 AUTOMATIC CONTROL VALVE

- A. Valves shall be of all brass construction or iron body, bronze mounted, globe pattern. The valve pressure rating shall be 150 psi min. All connections shall be brass pipe, threaded.
- B. Valves shall be electrically operated, actuated by a solenoid utilizing AC current, 24 volts, and rated at not more than 8.5 VA with an in-rush maximum of 1.0 amp. The solenoid coil is to be sealed in an "epoxy" material so it is completely waterproof.
- C. Operation of all valves (except the master valve) shall be normally closed solenoid control capable of operating within minimum flow requirements.
- D. Diaphragm operated of one-piece construction. The diaphragm shall be fully pressure balanced in both the open and closed positions.
- E. Solenoid shall be mounted directly on the valve or bonnet. All parts and tubing down stream of the entrance shall be of larger size to permit passage of foreign particles.
- F. A flow adjustment stem with cross handle shall be provided that limits the travel of the valve plug from full closed to full open, allowing manual closure or flow regulation. A manual control shall be provided for operation with or without the control wiring installed.
- G. Construction shall be so that all operating parts are accessible and removable from the top by removing the bonnet without having to disconnect the valve body from the pipeline. The valve shall be capable of being operated in any position.
- H. Valves shall be of types, manufacture and sizes as shown on the drawings and/or the following: "Buckner" VB/HD Series – 2-way solenoid brass valves with 24 VAC -50/60 Hz coil. If contaminated or dirty water conditions exist, "Buckner" VBDW valves shall be used.
- I. Gate valves 3" and larger shall be resilient wedge valves; valves shall be line size with a 2" square nut, with a non-rising stem. Furnish two (2) gate valve keys with tee handles.
- J. Gate valve 1 ½" and smaller shall be bronze threaded, class 150 W.O.G. with cross handles. All 2½" and larger gate valves shall be in 10" round valve boxes with a 10" PVC sleeve.
- K. Ball valves shall be forged brass, 600 W.O.G./150WSP two piece, full port, conforming to WWV 35, type II style with T-style handles.
- L. Electric control valves shall be as the size and location on the plans; all 1" and 1½" electric valves shall be 100 series with OmniReg (OMR-100) regulator. All electric and line size isolation valves shall be in standard boxes with extensions.
- M. Quick coupler valves shall be 1" brass with swing joint with top flange to prevent QCV from being unscrewed from swing joint. Swing joint shall accommodate brass nipple to connect QCV; all QCV shall be in 10" round valve boxes. Model 474-00 Toro or approved equal.

2.5 CONTROL WIRE FOR AUTOMATIC CONTROL VALVES

- A. Control wire shall be insulated single strand copper designed for 20 to 50 volts and UL approved as type U.F. (underground feeder). The UL and U.F. designations shall be clearly marked or indented on the insulation jacket of the wire.

- B. Expansion curls shall be provided within 3 feet of each wire connection to solenoid and at least every 300 feet in length of control wire length. Expansion curls are formed by wrapping at least 5 turns of control wire around a rod or pipe 1" or more in diameter. Withdraw the rod or pipe once curls are formed.
- C. All 24-volt control wires from controller to the electric valves shall be #14/1 red wire for direct burial. All 24-volt common wire from the controller to the electric valves shall be #12/1 white wire for direct burial. Splices and connections to the electric valves shall be with 3M DBY and DBR connectors. There will be no tee splices allowed. The common wire will be one continuous run, more than one common run may be used and spliced at the controller. Spare wires shall be run from the controller a minimum of six (6) from each controller location to the last electric valve on the run. Spare wire shall be #14/1 yellow wire for direct burial. No wire splices will be allowed in wire runs of less than 1000'.
- D. All wire shall conform to ASTM B3 or B-8 for soft drawn bare copper wire with polyethylene insulation.

2.6 IRRIGATION SYSTEM CONTROLLER:

- A. Hybrid type controller that combines electromechanical and microprocessor based circuitry capable of fully automatic and manual operation. Station timing: 1-120 minutes in 1-minute increments, and 1-12 hours in 10-minute increments. Input: 117 volt AC, 60HZ. Output: 26.5 Volt AC, 1.5 amps. Controller shall have an integral circuit breaker or fuse.

1. Controller shall be Rainbird RZX4i-120V Controller (wall mount), or approved equal.

2. Controller shall be installed in a vandal resistant, weather proof enclosure.

Note: Model and exact type of controller varies based on number of zones and other site conditions.

- B. Controller – General Conditions:

- 1. Controller shall be hard wired in conduit. All conduits are to be UL approved electrical conduit
- 2. Conduit size for irrigation control wires shall be minimum 1 ½ inch diameter.
- 3. Communication cable shall be the type recommended by the irrigation controller manufacturer. No splices in the communication cable will be allowed unless approved in writing by the engineer.
- 4. All controllers shall be grounded with three (3) ground rods to a resistance of less than 10 ohms.

2.7 CONTROLLER ENCLOSURE

- A. Controller Enclosure for the single or multiple controllers shall be a vandal resistant, weather proof, lockable wall or pole mount NEMA-3R enclosure and shall be sized according to the control equipment required by the design. Each unit shall be mounted to a mounting rack constructed of 1-5/8" SQ. Stainless Steel channel equipment frame mounted to a 16"x16"x16", 4000 psi concrete pad. Contractor to position pad per owner direction.
- B. Controller enclosures shall be constructed with interior mounting panels, compression latches, and vandal resistant locking mechanism.

2.8 SPRINKLER HEADS

- A. All heads shall have a built in pressure regulating device. The device shall regulate nozzle pressure to the design pressure. The pressure regulating device shall be an internal part of the pop-up stem.

- B. The heads shall have matched precipitation rate nozzles with adjusting screws.
- C. All heads shall have screens under the nozzles.
- D. The heads shall be equipped with check valves to prevent low head drainage. The check valves shall hold back pressures equivalent to 10 feet of head.
- E. The heads shall be of types, manufacture and sizes shown on contractor submitted and approved plans and details and/or the following:

2.9 QUICK COUPLING VALVES

- A. Universal valve stubs shall match existing equipment.

2.10 MANUAL VALVES

- A. Gate valves 2" and larger shall be flanged, iron body, brass trimmed, resilient double disc wedge, and integral taper seats with non-rising stem and square actuator. All gate valves shall be Class 150 with a minimum 150 psi – 300 WOG.
- B. Curb or gate valves 1 ½" and smaller shall be all bronze construction with "tee" handle, 175 psi water working pressure, Mueller Oriseal Mark II, or approved equal.
- C. Stop and Waste valves shall be all bronze construction, 175 psi water working pressure, Mueller Oriseal Mark II, or equal.
- D. Drain valves shall be of types, manufacture and sizes as shown on the plans and details and/or the following, or approved equal:
 - 1. Gate Valves: Kennedy, Mueller or Hammond.
 - 2. Drain Valves: Mueller Mark II Oriseal H-10284, stop and waste.

2.11 VALVE BOXES

- A. Automatic control valves shall be enclosed in valve boxes of HDPE or polyolefin and fibrous material (preferably recycled material) with locking lids. The bottom section is to be slotted so as to extend below the pipe. Extensions shall be added as required to meet grades per the details. Automatic control valves shall read ACV, master valve boxes shall read MV, gate valves shall read GV, etc.
- B. Drain valves and individual gate valves shall be enclosed in a cast iron roadway box, as manufactured by Olympic Foundry, Tyler, or approved equal, with bottom, top, and lid, sizes and extensions, as required. Lid shall have the work "water" printed on it.
- C. Provide two (2) sets of all keys required for valves, valve box covers, and protective sleeves covers unless otherwise noted.
- D. Occasionally, valves may need to be installed in athletic field areas of play. In those cases, valve boxes shall be installed underground with the box cover 6" below finished grade and shall have covers with a 4"x4"x1/8" thick steel located plate attached to the top of the cover.

2.12 BACKFLOW PREVENTION ASSEMBLIES

- A. The reduced backflow prevention assembly shall be a double check backflow preventer suitable for installation below grade. The working pressure rating on the backflow assembly shall be 175 PSI, the

pressure difference between the two (2) check valves shall be maintained at least 5 PSI lower than the inlet pressure. The reduced pressure backflow prevention assembly shall be model 850 as manufactured by Febco, or approved equal.

2.13 SWING JOINTS

- A. Swing joints for quick couplers shall be triple swing joints using schedule 40 galvanized metal with threaded fittings. Swing joints shall consist of street ells, ells, and nipples for full adjustability. Galvanized swing joint, quick coupler assemblies shall be installed in valve boxes per the details.
- B. Prefabricated swing joints for irrigation heads shall be triple swing joints using minimum PVC Class 315 threaded fittings. Swing shall consist of street ells, ells, and nipples for full adjustability. Fittings shall have "O" ring seals. Lasco, or approved equal.

2.14 OTHER SUPPLIES

- A. Electrical tape shall be black plastic, ¾" wide and a minimum of 0.007 inches thick and the all-weather type.
- B. Teflon tape shall be used for all threaded connections. Tape shall be set back a minimum of ¼" into the pipe threading.
- C. Pressure gages for the pressure reducing valve assembly shall be liquid-filled Ashcroft 1009AL with ¼" gage cock attached, or approved equal.
- D. Encapsulate all splices with approved splice kit with sealant. The SPR approved Wire Splice Kit is the 3M-DBY splice kit, or approved equal.

2.15 GROUNDING

- A. All controllers shall be grounded in accordance with the manufacturer's recommendations and shall be 10 ohms or less. Should the grounding requirements not be achieved, the contractor shall submit a cost and options for reducing the resistance readings to the general contractor for his approvals.

2.16 IDENTIFICATION

- A. Underground Type Plastic Line Markers (Detect-a-Tape): Permanent, bright colored, continuous printed plasticized aluminum tape, intended for direct-burial service; not less than 3" wide x 5 mils thick and shall be placed directly over the pipes at 6" below finished grades. Provide blue tape with black printing reading "CAUTION IRRIGATION LINE BURIED BELOW". Line Tec Inc., PO Box 67, Glen Ellyn, IL 60138. Detectable Marking Tape; Allen Systems, P.O. Box 33569, Houston, TX 77233 (713) 943-7213 (800) 231-2077; or Magnatec by Thor Enterprises, Inc. P.O. Box 450, Sun Prairie, WI 53590.
- B. Identification tags manufactured from polyurethane, incorporating an integral attachment neck and reinforced attachment hole and will be capable of withstanding 180 pounds full force. Tag shall be 2-1/4"x2-3/4" in size. All lettering shall be hot stamped in black and capable of withstanding outdoor use. Tag color shall be yellow. Marking tag shall be double side stamp with valve identification number.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

- B. Install warning tape directly above pressure piping below sub-grade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches to 12 inches below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
 - 1. Irrigation Main Piping: Minimum depth of 24" below finished grade.
 - 2. Circuit Piping: 18"
 - 3. Drain Piping: 18"
 - 4. Sleeves: 24"

3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system before construction begins. Obtain construction manager approval before excavation.

3.3 LAYOUT OF SPORTS FIELD IRRIGATION SYSTEMS

- A. Alterations and changes in the layout may be expected in order to conform to the ground conditions and to obtain full adequate coverage of water. It is understood that corrective measures in the system may become necessary, but no changes or alterations in the system as planned shall be made without the prior authorization of the construction manager.
- B. Irrigation system zones to provide 100 percent coverage within each field's perimeter fencing limits.
- C. Before starting work, determine that work may proceed without disruption of activities of other trades.
- D. The contractor shall carefully check grades to ensure that area is ready to begin work.
- E. Contractor is responsible for taking all reasonable investigative actions and precautions when working around all utility systems.
- F. Trench for pipe shall be wide enough to allow for proper tamping around the pipe in accordance with the manufacturer's recommendations. Trenches shall also be made wide enough to allow a minimum of 2" between parallel pipelines. Trenches for pipelines shall be made of sufficient depths to provide minimum cover from finish grade as follows:
 - 1. Maintain all warning signs, shoring, barricades, flares and red lanterns as required by OSHA, and any local ordinances. The bottom of the trench shall be clean and smooth, with all rock, loose soil, and organic matter removed. The contractor shall insure that there are no conditions in the trench that could damage the pipe or the wires. Any deviations from the above must be approved by the owner. Vibratory plowing of wire and solvent weld pipe will be acceptable subject to Owner approval of plowing equipment and procedures. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations to their original condition and in a manner approved by the owner.
- G. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- H. Install piping free of sags and bends.
- I. Install groups of pipes parallel to each other, spaced to permit valve servicing.

- J. Install fittings for changes in direction and branch connections.
- K. Install unions adjacent to valves and to final connections to other components with NPS 2 or smaller pipe connection.
- L. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 or larger pipe connection.
- M. Install underground thermoplastic piping according to ASTM D 2774.
- N. Install expansion loops in control-valve boxes for plastic piping.
- O. Lay piping on solid sub-base, uniformly sloped without humps or depressions.
- P. Install ductile-iron piping according to AWWA C600.
- Q. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.
- R. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- S. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- T. Install piping in sleeves under parking lots, roadways, and sidewalks.
- U. Install sleeves made of Schedule 40 or Schedule 80 PVC pipe and socket fittings, and solvent-cemented joints.

3.4 DELETERIOUS MATERIAL

- A. Excavated material that consists of rock larger than 1" in diameter or other material unsuitable for backfill (as defined by the pipe manufacturer's installation instructions) shall be classified as deleterious material. The Contractor shall remove this material and haul it to an off-site dump location. In back filling excavations where deleterious material has been removed, the contractor shall install select backfill. The contractor will provide a supply of select backfill at one on site location. The unit price (cubic yard) for deleterious material on the Bid Proposal shall include the excavation and hauling off of the deleterious material, and the hauling and placement of select backfill.

3.5 PIPE LINE ASSEMBLY

- A. Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by manufacturer of the pipe, except where screwed connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent with a non-synthetic bristle brush. Pipe may be assembled and welded on the surface. Snake pipe from side to side of trench bottom to allow for expansion and contraction. Make all connections between plastic pipe and metal valves or steel pipe with threaded fittings using SCH 80 PVC.
- B. All copper pipes shall be supported by the proper size pipe hangers and anchored to the concrete by approved means and local codes and ordinances, all hangers and supports shall be metal.

3.6 THRUSTING

- A. Install thrust blocks or anchoring for all isolation valves larger than 3" and all piping including changes in direction and reducers, in strict accordance with pipe manufacturer's recommendations. Construct thrust blocks of Sakrete or concrete of the following mix, having a compressive strength of 2000 PSI: 1 part concrete, 2.5 parts sand, 4 parts washed gravel.

3.7 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- F. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- G. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End PE Pipe and Fittings: Use butt fusion.
 - 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- J. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 3. PVC Non-pressure Piping: Join according to ASTM D 2855.

3.8 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
 - 1. Install valves and PVC pipe with restrained, gasketed joints.
- C. Aboveground Valves: Install as components of connected piping system.
- D. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves.
- E. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- F. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.9 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Heads along curbs, walks, paving, etc. shall be placed ½" above finish grade and no closer than 4" from paving edge.
- D. All impact sprinkler heads located in athletic turf areas shall be equipped with rubber covers.
- E. All pop-up sprinkler heads and quick couplers shall have swing joints that allow the head to be set perpendicular and flush with finish grades.
- F. Locate part-circle sprinklers to maintain a minimum distance of 4 inches from walls and inches from other boundaries unless otherwise indicated.

3.10 CLOSING PIPE AND FLUSHING LINES

- A. Cap or plug all openings as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation. Thoroughly flush out all water lines before installing heads. Test in accordance with paragraph on Hydrostatic Tests. Upon completion of the testing, the contractor shall complete assembly and adjust sprinkler heads for proper distribution.

3.11 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install exterior freestanding controllers on pre-cast concrete bases.
 - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install control cable in same trench as irrigation piping and at least 2 inches below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.12 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221113 "Facility Water Distribution " for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.
- C. Connect wiring between controllers and automatic control valves.

3.13 AUTOMATIC CONTROLLERS

- A. Install irrigation controllers per manufacturer's specifications and shop drawings.
- B. Electrical wiring (120 V.A.C.) shall be installed according to local code. A licensed electrician must perform hard wiring of controller, and the work must be permitted per Town of Laurel, Sussex County and State of Delaware requirements. The cost of all electrical work necessary to make the automatic equipment operate properly shall be included in this contract.
- C. Conduit for power supply wires shall be installed as shown on plans and details and controller manufacturer's shop drawings. The ends of all conduits, whether shop cut or field cut, shall be reamed to remove burrs and rough edges. Cuts shall be made square and true. Conduit bends, except factory bends, shall have a radius of not less than six times the inside diameter of the conduit. A 3/16 inch polyethylene pull rope shall be installed in all conduits with two feet of pull rope extended beyond the conduit openings and then secured. All conduits shall be free of debris. All conduit openings shall be sealed with duct tape to prevent fouling.
- D. The owner/architect shall direct final location and type of mounting of controllers.
- E. A diagram of schedule shall be posted in the controller to facilitate the selection of the valves to be operated.

3.14 CONTROL WIRING

- A. Install control wires, sprinkler mains and laterals in common trenches wherever possible. Install control wires at least 12 inches below finish grade and lay to the side and below main line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10' intervals. Control wire splices will be allowed only in runs more than 1000 feet. Any splices must be installed in an existing valve box or separate valve box installed with finished grade.
- B. All wire power and control wire shall be in separate conduits run inside the building. All conduits shall be metal and supported with the proper hangers and brackets and shall be installed in accordance with all local, state and federal codes. Minimum wire for power shall be tray cable 3-wire conductor. Conduit for zone wire shall be large enough to carry 3 common wires and 6 spare wires plus zone wire.
- C. Control wires shall be taped together at 10' intervals with black electrical tape, and then this bundle shall be taped to the bottom of the supply lines at 10' intervals with at least 3 wraps of electrical tape. A bare copper wire (#14 or greater), shall be installed on top of the PVC supply line for future detection with the wire ends clearly exposed in the valve boxes.
- D. Tie a loose 24" long loop in all wiring at changes of direction greater than 30 degrees. Untie all loops after all connections have been made.

- E. Splices shall be permitted only at junction boxes, valve boxes, or at control equipment and never between valves or valve and controller. A minimum of 24" of excess conductor shall be left at all splices, terminal and control valves to facilitate inspection and future splicing. All splices must be encapsulated with sealant in approved splice kit. Splice kit shall be 3M-DBY type water-proof wire splice.
- F. One unconnected spare orange control wire (one spare wire for each 5 valves) is to be run from the controller through each intermediate control box. Provide a 24" long tight loop in each box. Where control valves run in opposite directions from the controller, run a separate spare wire in each direction.
- G. A schedule diagram shall be posted in the controller to facilitate the selection of the valves to be operated.
- H. Minimum size of wire is to be determined strictly by the following chart:

Maximum Length of Common Wire

<u>No. of Valves</u>	<u>500'</u>	<u>1000'</u>	<u>2000'</u>	<u>3000'</u>
1	14	14	14	14
2	14	14	14	10
3	14	14	10	8
4	14	14	10	8
5	14	10	8	6
6	14	10	6	6
7	14	8	6	4
8	14	8	6	4
9	13	8	4	4
10	10	6	4	2
11	10	6	4	--

- I. The control wires shall be color coded as follows:
 - 1. Neutral or common wire: White
 - 2. Lead-in wire: Black
 - 3. Extra wire: Orange
- J. Control wires shall be installed in 1-1/2" minimum PVC schedule 40 sleeve under all paved areas.
- K. Flow sensor wire shall be computer interface (Maxi) wire between flow sensor and controller. Install computer-interface wire on the underside of the mainline irrigation pipe and attached in the same manner as for controller wires. The computer interface wire shall be continuous with no splices.

3.15 ELECTRIC ZONE VALVES

- A. The contractor shall lower the electric zone valve assembly completely with valve boxes and extension to cover the PVC lateral pipe with the valve box. All brick supports shall be complete around the valve box and brick shall be placed on undisturbed soil.
- B. Prior to installation of zone valves, all main line piping shall be flushed and free from contaminants.

3.16 WIRE AND WIRE SPLICING

- A. Do not yank, stretch, or pull wires during installation. Provide a minimum of one foot of slack, in an expansion loop, in each 100 feet of wire. Lay wire on a firm even bed in the trench which shall support the entire length. At splice locations, provide sufficient slack to allow the splice to be raised a minimum of 24" above grade for inspection. Do not lay wire above or on top of the pipe except when wire and pipe are being plowed simultaneously. When power wire runs do not follow the pipe, lay them in a straight line which shall be carefully located on the as-built plan. Minimum 2.5" pipe shall be used as wire conduit for sleeves.
- B. Splice all wires to requirements of local minimum regulations or to the following recommendations, whichever is more restrictive. Make all splices by baring a minimum of 3/4" of copper conductor, twisting the leads together, and soldering them with a non-acid core solder. Wire nuts are acceptable in lieu of soldering. Make the splice completely waterproof by using connector kits in strict accordance with the manufacturer's recommendations.

3.17 BACKFILLING

- A. Backfilling shall be done when pipe is not in an expanded condition due to heat or pressure. Cooling of the pipe can be accomplished by operating the system for a short time before back fill, or by back filling in the early part of the morning before the heat of the day.
- B. In refilling the trenches, the fill around 4" below and 6" above the pipe and fittings shall be suitable bedding material or sand, as required, and tamped. The remainder of the backfill shall contain no lumps or rocks larger than 3". A 6" separation is required between all pipes when more than one pipe occupies the trench. If no sodding is required, the top 6 inches of backfill shall be replaced by topsoil where it exists (free of rocks over 1", subsoil or trash), or selected fill soil or sand if soil conditions are rocky.
- C. All roots, rocks and surplus excavation shall be removed from the site unless otherwise directed. Any turf areas buried under ditch excavation shall be raked clean of any excavated material.
- D. Trenches under roads or paved areas shall be back filled and tamped with a mechanical tamper in successive 6" lifts. Paving shall be replaced to the satisfaction of the Architect.
- E. Prior to completing the backfill, place detection tape 6" below finish grades and directly above the installed lateral and supply mains for future line detection. Provide extra length to clearly expose ends in the valve boxes.
- F. Before complete back filling, all underground appurtenances including risers, valves, double check valve assembly, drain valves, and joints must remain exposed so that they can be viewed during testing and located "as built" by the Engineer. It is suggested the contractor partially backfill the pipe as it is laid, leaving all joints exposed; then complete back filling later after flushing, pressure testing provisions and "record drawing" location. The location, inspecting and testing provisions of these specifications will be strictly adhered to. If for any reason, any part of the sprinkler system is back filled before approved location, testing, or inspection is authorized, it must be completely uncovered and exposed until approved for back filling by the Architect.

3.18 IDENTIFICATION

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

- B. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

3.19 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 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.
- C. Any irrigation product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.20 CLEAN-UP

- A. Upon completion of operations and prior to watering, clean all adjoining areas such as paving, curbs, and lawns of debris caused by the work on this project, or any part of this project. All hard surfaced areas shall be washed clean. Daily clean up shall be required on all areas used for circulation, parking, or other daily use.

3.23 TESTING AND INSPECTIONS

- A. Pressure Testing:
 - 1. Make hydrostatic tests only in the presence of the Owner/Architect. No pipe shall be backfilled until it has been inspected, tested and approved.
 - 2. Furnish necessary pump, gauges and all other test equipment.
 - 3. All PVC main lines with valves installed and closed shall be flushed and pressure tested with all joints exposed to 150 psi until watertight. Maximum psi loss in a 30 minute test period shall be 5 psi.
 - 4. Similarly, all PVC lateral lines with risers installed and capped shall be flushed and pressure tested with all joints exposed to service line pressure required for design for 30 minutes. Maximum psi loss allowed shall be 5 psi. The Architect shall visually inspect all several lines, joints, and swing joints for leakage.
 - 5. To be valid, all tests must be witnessed and approved by the Architect. The contractor must give the Architect 48 hours notice prior to the anticipated date of inspection.
 - 6. All gauges used in the testing of water pressures shall be certified correct by an independent testing laboratory immediately prior to use on the project. Gauges shall be retested when directed by the Architect.
 - 7. All testing shall be approved prior to installation of valves or irrigation heads

B. Coverage Test:

1. Before the irrigation system will be accepted, the Contractor, in the presence of the Architect, shall perform a water coverage test for each zone of the system. Contractor to be responsible to change nozzles, etc. at discretion of Architect in order to obtain full coverage with minimum over spray. Contractor will be required to adjust and/or replace nozzles, etc. to meet this requirement. Prior to arrival of Architect, the contractor shall accomplish the following: complete all work including balancing, adjusting the system (pressure reducing valves, flow adjustment keys, nozzles, etc.) to provide optimum coverage without fogging.
2. Notify the Architect at least 48 hours in advance of coverage test.

D. Complete System Inspection (Punch List):

1. Upon approved completion of the Coverage Test, trenching and installation of all equipment, the Contractor shall request a Complete System Inspection of the entire irrigation system including: backfilling, irrigation heads, valves, valve boxes, controller and all other equipment.
2. From this inspection, a punch list shall be prepared by the Architect and presented to the contractor for completion. The Architect shall give a date for completion of the punch list, not to exceed two weeks.
3. Notify the Architect at least 48 hours in advance of complete system inspection. The contractor shall be responsible for having a two-way communication system or sufficient personnel so that directions from the inspection areas to the controller of the system can be readily accomplished.

E. Substantial Completion

1. Contractor shall write a letter to the Architect requesting substantial completion of the irrigation system.
2. Refer to Section 01770 of these specifications for information about how the irrigation system shall be determined to be substantially complete

F. System Operations Orientation:

1. System Operation Training Session:
 - a. Prior to the training and orientation session, the date and time of the session shall be subject to approval of the Architect.
 - b. The "as-built" plans shall be reviewed and all features explained. The "as-built" plans shall consist of red-lined corrections, notes, comments, etc. on a clean bond copy print. All critical dimensions shall be shown to the nearest inch.
 - c. A complete maintenance and operations manual shall be prepared by the contractor and three (3) copies of the manual shall be turned over to the Architect for final inspection. The manuals shall consist of three-ring binders containing:
 - 1) catalogs of all materials used,
 - 2) a complete parts list of all materials,
 - 3) a written summary of all operations data including spring start-up and winterization techniques, controller programming, valve cleaning, irrigation adjustments, backflow preventer operation, and any other information required to operate and maintain system;
 - 4) two (2) local distributors.
2. Controller Charts:
 - a. As-built drawings shall be approved by the Architect before charts are prepared. The chart shall be a reduction of the actual as-built drawing prepared by the consultant.
 - b. Provide one controller chart per controller. Controller chart shall fit in behind controller door.

- c. Chart shall be a bond copy print with a different pastel transparent color to show each separate zone. Verify that the zone number as shown on the Controller Chart matches the number on the actual control valve identification tag.
 - d. When completed and approved, hermetically seal (lamine) the chart between two pieces of plastic.
 - e. The charts shall be completed before the project can be considered Physically Complete.
3. The contractor shall provide the owner with the necessary keys and/or other tools necessary to operate/drain/activate the system and spend sufficient time with the owner to ensure that the system operation/maintenance/winterizing can continue after departure of the contractor.

G. Functional Test:

1. Functional test of the control system shall be performed, and demonstrate that all parts of the control system function as specified or intended. The functional test for each new system shall consist of not less than 30 days of continuous, satisfactory operation.
2. Any materials determined to be faulty as part of the installation shall be replaced or corrected by the Contractor at his expense, in a manner respective to the plans, details, and other sections of this specification. In the event of a system failure due to faulty installation or workmanship, the 30-day period will be repeated until testing is complete.

3.25 GUARANTEE

- A. Contractor shall submit a written guarantee, in approved form, stating that all work showing defects in materials or workmanship will be repaired or replaced at no cost to the engineer for a period of one (1) year from date of Substantial Completion.

END OF SECTION 328400