

Part 4: Irrigation

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1.0 General Conditions

1.1 Scope of Work

- A. The intent of this specification is to define contractor/owner responsibilities and specify minimum standards for materials and workmanship.
 - 1. Any residential system over 24 zones shall be considered commercial for the purposes of these specifications.
- B. Irrigation layout/design shall meet the following parameters:
 - 1. Head to head spacing to ensure 100% coverage.
 - 2. Matched precipitation rates within a zone.
 - 3. Pipe sized to stay at or below 5 feet per second.
 - 4. Separation of zones by different types of plant material (e.g., turf, trees and shrubs, annuals).
 - 5. Rain sensor shall be included.
 - 6. Commercial projects must be designed and stamped by a Certified Irrigation Designer as designated by the Irrigation Association.
- C. Furnish all labor and materials, appliances, tools, equipment, facilities, transportation, and services necessary for and incidental to perform all operations in connection with the installation of the irrigation system.
- D. All local, municipal, and state laws, rules, and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications.
- E. Work noted “N.I.C.,” “existing,” or “to be supplied and/or installed by others” is not part of this section.
- F. Due to the scale of drawings, it is not possible to indicate all offsets, fittings, sleeves, and other materials that might be required. The drawings are generally diagrammatic and indicative of the work to be installed. The work shall be installed in such a manner as to avoid conflicts between irrigation system, planting and architectural features. Work called for on the drawings by notes or details shall be furnished and installed whether or not specifically called out in the written specifications.
- G. If discrepancies exist between drawings and specifications, and no specific interpretation is issued prior to bidding, the decision regarding any interpretation will rest with the owner’s representative. The contractor is to act on this decision as directed. In the event that the installation deviates from the direction given, it shall be corrected at the contractor’s expense.

1.2 Standards

- A. The contractor shall obtain and pay for all permits and inspections required by outside agencies.
- B. All materials shall meet minimum industry standards.
- C. The system shall be installed as per manufacturer’s recommendations by qualified, trained personnel.

1.3 Quality Assurance

- A. Commercial Projects
 - 1. The company engaged in the project must have three years of experience with projects of similar size and scope.
 - 2. The company must employ at least one full-time individual who maintains a current Certified Irrigation Contractor designation by the Irrigation Association.
- B. Residential Projects
 - 1. The company engaged in the project must employ an individual with one year of irrigation installation experience.

1.4 Submittals

- A. For commercial projects, prior to the start of installation, the contractor shall submit for approval to the owner or owner’s representative a materials list indicating the name of the manufacturer, model numbers, and performance data for the following:
 - 1. Sprinkler heads
 - 2. Valves and valve boxes
 - 3. Controllers and appurtenances
 - 4. Pumps
 - 5. Backflow
 - 6. Drip equipment
 - 7. Wire and electrical connection waterproofing method and materials
 - 8. Grounding equipment
 - 9. Pipe and fittings
 - 10. Water harvesting and storage components (pre-filters, post-filters, storage vessels and associated control systems)
- B. At completion of the installation, the contractor shall submit a minimum of four (4) individually bound copies or a PDF file of the irrigation system *Operation and Maintenance Instructions*, including a materials list, “As-Built” drawing, suggested operating schedule, seasonal shut-down procedures, and the name and phone number of the installing contractor.

1.5 Approvals

All approvals shall be in writing from the owner or owner's representative prior to installation.

1.6 Substitutions

It is the contractor's responsibility to make every reasonable effort to use the material specified by the designer. The contractor may offer substitutions to the owner's representative for consideration.

1.7 Existing Utilities

- A. Prior to excavation, the contractor shall notify utility companies in accordance with local codes and ordinances (Miss Utility: www.missutility.net for MD, DC, and DE or <http://va811.com> for VA).
- B. The contractor shall immediately notify appropriate utility of any inadvertent damage caused by the contractor's operation.
- C. The contractor shall not be responsible for "private utilities" unless accurate as-built drawings are supplied prior to the commencement of work.

1.8 Concealed Contingencies

The contractor shall not be liable for additional excavation expenses resulting from undisclosed subsurface conditions, such as, but not limited to, rock, water, clay pan, soils contaminated with toxic substances, or other obstacles encountered in excavation work that are not apparent at the time of estimating.

1.9 Water Supply

- A. The location and size of the water supply shall be as per the drawing and installed in accordance with all applicable codes and ordinances.
- B. An irrigation isolation valve shall be installed as the first component of the system on the exterior of the building. This valve shall be a bronze or PVC ball valve.
- C. All aboveground piping shall be copper (see section 2.3 in this guideline).
- D. Copper piping shall terminate and transition to PVC with a copper female adapter and a schedule 80 PVC nipple. Copper male threaded connections are not acceptable.

1.10 Primary Electrical Supply

- A. Unless noted on the drawing, the primary electrical source shall be a 120V AC, single-phase circuit.
- B. Electrical circuits required for additional devices shall be noted by the contractor in the drawings and contract documents.

1.11 Product Handling

- A. Materials used in the system shall be new and unused.
- B. Store materials at a location directed by the owner's representative. Store materials in an orderly manner and avoid interference with other construction activities.
- C. Protect all materials to prevent the intrusion of dirt and moisture.

1.12 Workmanship

- A. During delivery and installation, the contractor shall perform in a workmanlike, professional manner, coordinating installation activities so as not to interfere unduly with the work of other trades on site.
- B. During installation, all areas shall be kept neat and clean. Precautions shall be taken to avoid damage to existing plants, turf, and structures. The contractor shall notify the owner in writing of potential damage to all trees and other plant material that may be destroyed or damaged beyond repair during construction. Such notice shall relieve the contractor of responsibility for said damage. Failure to notify the owner of potential damage may make the contractor liable for tree and plant replacements. Replacements shall be included in the one-year warranty.
- C. The contractor shall park all employee or company vehicles only in areas designated by the owner's representative.

1.13 Inspection and Acceptance

- A. Inspection: There should be a verification of performance for work by contract documents, to be conducted by the architect or owner's representative on site and in the presence of the irrigation contractor, for the purpose of acceptance. Inspection shall be made within two (2) weeks of written notification from the irrigation contractor. Failure of the owner to inspect the work shall void the guarantee. During inspection for initial acceptance, the irrigation contractor should have an acceptance form to be signed by the owner or owner's representative.
- B. Initial Acceptance: The approval of work inspected. Acceptance can be on partially completed work under the contract, if approved by the landscape architect or owner's representative. If, for reasons beyond the irrigation contractor's control, work has stopped, inspection shall be made on partially completed work. The warranty period shall begin after inspection and acceptance. Maintenance after initial inspection and acceptance shall be the responsibility of the owner, unless an optional service contract has been specified.

1.14 Guarantee

- A. The contractor shall guarantee all labor, workmanship, materials, fixtures, and equipment covered by the contract documents to be free of defects for a period of one (1) year from the date of substantial completion and acceptance of the project. The contractor shall replace any part(s) found to be defective within the period of the guarantee at no cost to the owner, except repairs or replacement necessitated by damage by others.
- B. Backfilling of all excavation shall be guaranteed. If, at any time during the one year guarantee period, trenches should settle, the contractor shall repair any settling at no cost to the owner.

1.15 Maintenance

During the warranty period, the installing contractor must perform all maintenance of the system. Unless called out in the contract, maintenance of the system shall be addressed under a separate contract. Negligence on the owner's part to properly maintain the system or service to the system by another contractor may be used as grounds to void all warranties.

- A. Fall maintenance shall include (but not be limited to) draining of the system by compressed air.
- B. Spring maintenance shall include (but not be limited to) the closing of all manual drain valves, inspection and realignment of all heads, operational check/test each zone for proper operation, and inspection and adjustment of controller and run times. A written report of work completed and/or necessary repairs and recommended modifications shall be provided after each service.
- C. Periodic maintenance may be scheduled throughout the season to verify the proper operation of the system and to maintain the warranty within the warranty period. Maintenance shall include inspection and realignment of all heads, operational check/test of each zone for proper operation, and inspection and adjustment of controller and run times. A written report of work completed and/or necessary repairs and recommended modifications shall be provided after each service.
- D. The frequency shall be as stipulated in the maintenance contract.

1.16 Record Drawings

- A. The owner shall provide an electronic copy of the landscape plan in AutoCAD or PDF. In the absence of a landscape plan, a site plan shall be provided.
- B. The contractor shall, during the progress of work,

keep an accurate daily record of all changes and corrections to contract drawings.

- C. "As-Built drawings" shall indicate point of connection; control valve wire routing paths; controller location; electric, isolation, drain, and quick coupling valves; piping; and sleeves. For two-wire systems, locations of switches, decoders, and surge arrestors shall be noted.
- D. Accurately locate all dimensions from a minimum of two permanent reference points (buildings, monuments, sidewalks, curbs or pavements). Do not use these prints for any other purpose.
- E. When record drawings have been approved by the owner's representative, the contractor shall provide drawings as an electronic PDF. The quality and presentation of the completed reproducible shall be acceptable to the owner's representative.
- F. The irrigation legend must be changed to accurately reflect the irrigation equipment installed, if such equipment is not the same as originally specified.

2.0 Materials

2.1 General Conditions

The materials chosen for incorporation in the irrigation system may have been recommended by a specific manufacturer to enable the owner to establish the level of quality and performance desired. Substitution of equipment of another manufacturer may be allowed only after submittal to and approval by, the owner or owner's representative. Refer to section 1.7 (Existing Utilities) in this guideline.

2.2 Copper Pipe and Fittings

- A. Pipe: Minimum Type "L".
- B. Fittings: Wrought or cast copper, soldered, flared, or threaded joint type.
- C. Joints shall be soldered in accordance with current NSF (National Sanitation Foundation) standards.

2.3 Brass Pipe and Fittings

- A. Brass pipe shall be 85% red brass, American National Standard Institute (ANSI), schedule 40 threaded pipe.
- B. Fittings shall be medium brass, threaded 125 pound class.

2.4 Plastic Pipe, Fittings, and Adhesives

- A. PVC Pipe and Fittings: Manufactured from virgin polyvinyl chloride compound in accordance with ASTM D 2241 and ASTM D 1784.

1. Identify all pipe with the following indelible markings:
 - a. Name of manufacturer.
 - b. Nominal pipe size.
 - c. Schedule or class.
 - d. Pressure ratings psi.
 - e. NSF seal of approval.
 - f. Date of extrusion.
2. Minimum class or schedule
 - a. 1/2", schedule 40.
 - b. 3/4" +, Cl. 200-SDR 21.
3. Sizing
 - a. Maximum velocity in pipe shall be 5 feet per second.
4. Pipe type
 - a. 2½" and smaller shall be bell ended, solvent weld.
 - b. 3" and larger shall be gasket joint.
5. Fittings:
 - a. 2½" and smaller PVC pipe—standard weight, schedule 40, injection molded PVC. Comply with ASTM D 1784 and D 2466.
 - b. 3" PVC pipe—PVC or ductile iron gasketed fittings for all applications.
 - c. 4" and larger PVC pipe—ductile iron gasketed fittings at all changes of direction and ends of pipe lines. PVC plastic gasketed fitting for all other applications.
6. Threaded nipples: ASTM D 2464, schedule 80 with molded thread(s), TOE or TBE.
7. Connections
 - a. Solvent weld: Joint cement and primer as recommended by manufacturer of pipe and fittings.
 - b. Gasketed: Gasket material and lubricants as recommended by manufacturer of pipe and fittings.
 - c. Threaded connections: PVC male adapters shall be used in plastic-to-plastic connections. PVC-to-metal connections shall be metal female adapters and schedule 80 PVC nipples.
8. HDPE
 - a. Pipe: DR 13.5.
 - b. Fittings: butt fusion, socket fusion, or electro fusion.

c. Mechanical fittings: Pack joint fitting = grip joint fitting with set screw.

9. Polyethylene pipe and fittings: Manufactured from virgin polyethylene, in accordance with ASTM D 2239 and PE 2306.
 - a. Fittings: Manufactured in accordance with ASTM D 2609, PVC type I.
 - b. Clamps: Stainless steel screw or crimp clamps.

2.5 Valves

- A. Remote control valves shall be normally closed, 24-volt electric with plastic or bronze body. Valve shall be equipped with a bleeder valve to permit operation in the field.
- B. Isolation valves
 1. 2" and smaller, shall be domestic bronze gate valves with non-rising stem (bronze cross handles or bronze wheel handles used below grade) meeting MSS SP-80 or PVC ball valves constructed from Type I PVC, ASTM D1784 with EDPM O rings and full bore flow.
 2. Isolation valves 2½" and larger, unless noted on the drawings, shall be resilient wedge, epoxy coated, 250 psi rated working pressure, cast iron gate valves with non-rising stem and conforming to AWWA C509.
- C. Quick-coupling valves
 1. Valves shall be hinged cover, brass body, 150 lb class, with female threads at the base. Valve design shall permit operation with a special connection device (key) designed for this purpose.
 2. Swing joints shall match inlet size of quick coupler and be a triple 'O' ring, pre-fabricated triple swing joint, having an integral metal transition fitting and having the ability to be anchored for stability.
- D. Unless otherwise noted, manual drain valve shall be a bronze or PVC ball valve.
- E. Valve boxes shall be provided for all manual valves, electric valves, air relief valves, decoders, two-wire switch devices, drip flush valves, ground rods, and wire splices.

2.6 Sprinkler Heads

- A. Sprinkler heads shall be as shown and/or as required to coincide with the needs of the landscaping. Do not exceed the maximum or minimum spacing indicated by manufacturer.
- B. All heads within a zone operated by the same valve shall have matched precipitation rate.

- C. Sprinkler bodies may be brass or plastic material. Connections to lateral lines shall be either flex-swing pipe over barbed fittings or 3-ell swing joints.
- D. Nozzles may be brass or plastic material.

2.7 Water Conservation Devices

- A. Rain sensors shall be devices adjustable to react to rainfall from 1/8" to 1" by temporarily shutting down the automatic operation of the system.
- B. Moisture sensors shall be adjustable and compatible with the controller installed. The sensor, in conjunction with the controller, shall be capable of automatically stopping and restarting irrigation watering based upon a set moisture level.

2.8 Wire

- A. Control wire shall be UL/UF direct burial, sized as indicated or as required by valve and controller manufacturer's recommendations.
- B. Wire splice connectors shall be waterproof, made for direct burial, UL listed and rated for at least 30 volts.
- C. Wire and splices for two wire systems must be as specified by the manufacturer.

2.9 Controller

- A. The controller shall be as indicated, UL-approved for indoor or outdoor installation as required, with low voltage output (i.e., <30 Vac).
- B. The controller shall be fully automatic and have the following minimum features:
 1. Capable of operating the number of remote control valves indicated on drawings.
 2. Three programs.
 3. Rain delay.
 4. Multiple schedules to include odd/even, calendar, interval.
 5. An integral sensor terminal and circuit.
- C. The controller shall be grounded as per manufacturer's recommendations.

2.10 Sleeves

- A. SDR 21, CL 200, bell ended, solvent weld.
- B. Size of sleeve shall be a minimum of two pipe sizes larger than the pipe.

2.11 Backflow Devices

Backflow prevention devices shall be installed on all irrigation systems at the point of connection to the water source. Device shall include unions unless otherwise dictated by local codes. The device shall conform to all local codes and be installed as per manufacturer's

recommendations. All devices shall be approved by UPC, ASSE & AWWA, C-506. Installation must be performed by an individual or company licensed to do such work by the local governing authority.

2.12 Drip Components

Each drip zone shall include an electric valve, pressure regulator and filter.

- A. Filter shall be inline model constructed of noncorrosive material. Screen or disc shall be sufficient to eliminate debris and particulate matter as required (120 mesh or 75–600 microns). Size based on manufacturer's recommendations with an operating pressure from 20–140 psi.
- B. Pressure regulators shall be inline type constructed of noncorrosive materials and capable of handling designated flow at discharge pressure indicated on drawings.
- C. Emission devices shall be constructed of noncorrosive materials capable of delivering measured volumes of water to designated areas. An emission device shall be classified as:
 1. Single emitter
 2. Multi-outlet distribution manifold
 3. Polyethylene tubing manufactured with inline pressure emitters
 4. Micro-spinner or spray
 5. Pressure-compensating, self-flushing, and having an integral check valve
- D. Drip staples shall be minimum 11 gauge with U-shaped top. Square-top staples shall not be used.
- E. Fittings shall be insert or compression type and shall not require clamping below 45 psi.

2.13 Pumps

- A. Provide pump with capacity, total dynamic head, and electrical characteristics, as noted on drawing.
- B. Pump enclosure, if applicable, as noted on drawing.
- C. Pump fittings as per drawing details and as recommended by pump manufacturer.
- D. Pump start relay, flow switch, pressure transducer, pressure switch, or other control devices, as recommended by pump manufacturer.

3.0 Execution

3.1 Site Reviews

- A. Before any work commences, a conference shall be held with the owner's representative and contractor

to discuss general requirements of the work and coordinate the installation process.

B. The contractor shall examine surfaces for conditions that could adversely affect execution, permanence, and quality of work. The contractor shall also verify that grading has been completed and that the work of this section can properly proceed.

1. Notify the owner's representative in writing, describing unacceptable conditions.
2. Do not proceed with work until unacceptable site conditions are corrected.
3. Locate existing utilities.

C. The contractor shall notify the owner's representative in writing for the following reviews, allowing 48 hours for compliance by the owner's representative.

1. Submittal review.
2. Pressure supply line installation and testing.
3. Final review at substantial completion.

D. The contractor shall provide radio communication, remote control, and/or personnel to maintain communication from the review area to automatic controllers.

E. The contractor shall provide up to date "as-built" drawings and acceptance forms for authorized signature.

3.2 Utility Services

The contractor shall make connections to the provided power and water sources at locations indicated on drawing(s) and make any minor changes in location as may be necessary due to actual site conditions. As necessary, authorized, licensed trade professionals shall be used to conform to local codes.

3.3 System Layout

- A. All piping and equipment is shown diagrammatically on drawing(s).
- B. Lay out sprinkler heads and make any minor adjustments required due to differences between actual site conditions and the drawings. Minor adjustments shall be maintained within the original design intent.
- C. Lay out each system using staking method, as approved by owner's representative.

3.4 Pipe Installation

- A. Pipe assembly (PVC)
 1. Pipe shall be sized so that the water velocity in pipe shall not exceed five (5) feet per second.

2. Routing of all irrigation lines as indicated on the drawings is diagrammatic. Install lines (and various assemblies) to conform to details provided on drawing(s).

3. Pipe shall be kept free of dirt, rock, shavings, and other debris. Pipe ends shall be cut square and true with either a saw or pipe-cutting tool. When a saw is used, shavings must be removed from pipe ends.

4. Use primer and solvent to join pipe and fittings in a manner recommended by the solvent manufacturer regarding pipe size, air temperature and humidity. Allow pipe connections to cure as per solvent manufacturer's recommendations before pressurizing pipe. Wipe all excess glue from pipe after joint is made.

5. Service tees and service elbows installed in piping shall be oriented so FIPT outlet is on side of pipe.

6. Gasketed connections shall be installed per manufacturer's recommendations.

7. Thrust blocks or joint restraints shall be provided for gasket pipes.

Thrust blocks or joint restraints shall be provided whenever PVC pipe:

- a. Changes directions.
- b. Stops (as at a capped end).
- c. Joins a valve where thrust may be expected.

Thrust blocks shall be made of concrete and are to be installed between the fittings and undisturbed soil of the adjacent trench wall in accordance with current ASAE recommendations. Pipe and fittings shall be protected from concrete by wrapping in polyethylene film or fabric cloth.

8. Threaded fittings shall be assembled as follows:

- a. Using Teflon tape applied to male threads only. No more than two wraps.
- b. Using metal female adapters with schedule 80 PVC nipples as transitions.
- c. Do not use schedule 40 female adapters except for swing pipe connections.

- B. Copper pipe shall be installed as required by local plumbing codes. Underground copper lines shall be type "K" soft copper tubing. Depth of bury shall conform to this specification. Aboveground copper shall be type "L."

- C. Polyethylene pipe may be used only on residential lateral lines that are not under constant pressure.

1. Connections to insert fittings shall be installed over barbs. Pipe shall extend beyond the last barb on the fitting. Install two clamps per joint directly over barbs on all connections.
2. Internal double 'O' ring connection fittings may be used that have an integral lock mechanism and a minimum 400-psi burst rating.
3. Saddles used for service tees must be all plastic and have a locking mechanism to hold in place during on/off cycles and freeze/thaw cycles.
4. All mainlines shall be pressure tested. See section 3.19 (System Flushing) in this guideline.

3.5 Trenching

- A. Excavate trenches to required depths. Follow approved layout for each system. Maintain bottom of trenches flat to permit all piping to be supported on an even grade for entire length of run, with recesses as required for pipe bells.
- B. The minimum depth of soil cover shall conform to local codes, or shall be as shown or listed in the drawings, details, or specifications. Generally accepted practice is as follows:

	Pressure Lines		Non-Pressure Lines	
	In Landscaping	Under Vehicular Paving	In Landscaping	Under Vehicular Paving
Residential	12"	18"	8"	12"
Commercial	18"	24"	12"	18"

- C. Sleeves under walks shall be at a 12" depth. Sleeves under drives and parking lots shall be at an approximate 18" depth. Sleeves under roadways should be at an approximate 36" depth, or as mandated by governing authorities.
- D. Pipe "plowing" may be permitted by the owner's representative in favorable soil conditions. When plowing is permissible, depth of pipe shall be the same as for trenching.

3.6 Backfill

- A. The first 6" of backfill material shall be free of rock or foreign matter 2" in diameter or larger and hand tamped. The remainder of backfill shall be laid-up in maximum 6" lifts and tamped to a dry density equal to adjacent, undisturbed soil until the finish grade is reached.
- B. When more than one pipe is installed in the same trench, separate pipes with a minimum 2" of soil.
- C. Disturbed grade shall be restored to be free of dips, depressions, humps, or other irregularities. Compaction by truck or other vehicle is not acceptable.

3.7 Existing Pavements

- A. Piping under existing pavements may be installed by jacking, boring, or hydraulic driving, except as otherwise specified or directed. For minimum depths, install pipe at a depth equal to 12" per inch of diameter of bore below finished grade.
- B. Secure owner's permission prior to cutting or breaking existing pavements. Refer to section 3.5 (Trenching) in this guideline for minimum depths.
- C. At locations where cutting is approved, make all cuts clean using power saws. Make cuts at approved locations only.
- D. Replace and restore all disturbed surfaces to match adjacent undisturbed conditions, including grades and landscaping.

3.8 Automatic Valves and Valve Boxes

- A. Automatic valves shall be installed plumb within valve access box with all handles, bolts, connections, and electrical splices accessible through the valve box opening.
- B. Clearance between the highest part of the valve and the bottom of the valve box lid shall be 2" minimum and 18" maximum.
- C. Clearance between the valve body and the sides of the valve box shall be a minimum of 3". Clearance between the valve bodies shall be a minimum of 2". Valves shall not be "stacked" within a valve box.
- D. Valves or valve boxes shall not be installed within 12" of paving or structures.
- E. The valve box shall be supported so that it does not rest directly on any irrigation piping.

3.9 Control Wiring

- A. Control wiring shall be installed as follows:
 1. When in common trench with mainline, wiring shall be laid beside or at the same invert as the mainline.
 2. Use minimum number of splices, and make all splices in valve or splice boxes. Splice connectors shall be UL approved for direct bury.
 3. Provide 24" expansion coils at all valves and at 300' intervals between valves and directional changes. Wire shall at no time be installed taut.
 4. Tape, or cinch with cable cinches, wires at maximum of 25' intervals.
 5. Aboveground wire is to be installed in conduit and/or in accordance with electrical codes.
 6. Common, or neutral, wire shall be WHITE on single or multi-conductor wire. If single

conductor wire is used, valve wires and spare wires shall be of a different color consistent throughout the system.

7. Valve wiring shall be the same color from controller to valve.
8. Two wire control systems shall use wire approved by controller manufacturer.
9. Grounding wire shall be single-strand, solid, bare copper, at least two wire gauges larger than largest control wire used in the system.

3.10 Sprinkler Heads

- A. Sprinkler heads shall be set perpendicular and flush to grade or at elevations noted on the drawings.
- B. Pop-up heads shall be set 4" from paved surfaces. Rigid risers shall not be permitted adjacent to paved surface or other traffic areas.
- C. All heads shall be tested to verify proper coverage. See section 3.20 (Pressure Tests) in this guideline.
- D. Connections to piping:
 1. Flex pipe may be used for heads with flows of 6 gallons or less. Pipe length shall be a minimum of 1 foot and a maximum of 4 feet.
 2. For flows over 6 gallons per minute and on all sports fields, pre-fabricated triple 'O' ring swing joints shall be used. Swing joint size shall match head inlet. Lay length shall be such as to allow a 30–45 degree angle from pipe to lay nipple.

3.11 Quick-Coupling Valves

- A. Quick-coupling valves: Install downstream from backflow preventer on a swing joint assembly. When installed as a blowout connection, install as close to the point of connection as possible.
- B. Install quick coupler valve in a 10" round valve box at a depth that will allow quick coupler key to turn freely when inserted.
- C. A swing joint manufactured for use with quick couplers shall be used to connect valve to piping. A swing joint shall, as an integral brass male threaded nipple matching the inlet size of the valve, have the ability to be stabilized and have the proper lay length to allow for a 30–45 degree angle from the pipe to lay riser.

3.12 Drain Valves

Manual: Install at low points on main and laterals when specified. Provide valve box for access and 2 ft³ gravel sump with soil separator.

3.13 Drip Irrigation

- A. Six-inch (6") soil staples shall be placed every 3' on tubing and at every elbow, tee, and cross if tubing is installed on soil below mulch. Staples not required if tubing is buried.
- B. Tubing shall be installed below mulch layer in plant beds or buried up to a 4" depth. Tubing in turf shall be installed at a uniform depth of 4".
- C. Each zone shall have a supply and exhaust header sized so total flow does not exceed 5 feet per second.
- D. Inline emitter tubing dripper interval and row spacing shall be as recommended by manufacturer, taking into account plant type, soil type, slope, and emitter flow rate.
- E. Inline emitter tubing shall be installed as a looped grid system.

3.14 Sleeves

- A. Sleeves are to be installed beneath all paved surfaces as indicated on the drawing. Installation is to be coordinated with project general contractor.
- B. If sleeves are to be installed by others, an accurate as-built drawing is to be provided to the irrigation contractor prior to the commencement of work. The end of the sleeves shall be indicated with a visible marker.
- C. Wiring shall be installed in an individual sleeve, separate from sleeves designated for piping. A wiring sleeve may be installed within a larger sleeve containing other irrigation pipe.
- D. The size of a sleeve shall be a minimum of two pipe sizes larger than the pipe enclosed.

3.15 Controller

- A. Controller shall be located as generally noted on the plans in an accessible location. Controller should be level and properly anchored to the wall, or in the case of a pedestal, version to a concrete pad.
- B. Zones shall be ordered as directed on the plan or in consecutive geographic order.
- C. Controller shall be grounded per manufacturer's recommendations.
- D. Wiring inside controller shall be neat with external jacket of wire (multi-strand and two-wire) removed.
- E. Control wire shall be installed inside conduit from below grade to controller cabinet.
- F. Zone charts as described in section 3.22 (Coverage Test) in this guideline shall be left at controller location.

3.16 Sensor Devices

- A. A rain sensor shall be installed in an area exposed to direct rainfall but out of sprinkler coverage.
- B. Sensor wires shall not be spliced and shall terminate inside controller at sensor terminals.
- C. All devices shall be installed per manufacturer's recommendations.

3.17 Decoders (Two-Wire Only)

- A. Decoders shall be from the same manufacturer as the controller.
- B. Decoders shall be located in valve boxes for service access. Decoders shall be mounted to sides of valve boxes.
- C. Connections to two-wire path shall be made with UL-approved, direct bury splice kits rated for submersion.

3.18 Surge Arrestors (Two-Wire Only)

- A. Arrestors shall be located in valve boxes.
- B. Arrestors shall be grounded to rods/plates per manufacturer's recommendation following ASIC standards.
- C. Arrestors shall be installed at distances and locations on two-wire path as recommended by manufacturer.

3.19 System Flushing

- A. All mainlines shall be flushed prior to testing.
- B. After all pipe and flexible risers have been installed, and prior to the installation of control valves and sprinkler heads, thoroughly flush all lines with a full head of water.

3.20 Pressure Tests

- A. If required by owner, the contractor shall provide all equipment to test the system, including a force pump.
- B. All mainlines under constant pressure shall be filled with water at designated pressure for at least 24 hours and proven tight by visual inspection. The system shall then be tested under hydrostatic pressure of 150 psi for a period of two hours, unless otherwise approved. Leaks shall be repaired and the system shall again be flushed and retested.

3.21 Adjustment

- A. Install sprinkler bodies and nozzles. Adjust radius and arc for optimum performance. Make any necessary adjustments in head locations to achieve 100% coverage of landscaped areas designated to be watered.

- B. Adjust flow controls and pressure-reducing valves to attain the required pressure for optimum performance at the sprinkler head.

3.22 Coverage Test

- A. After sprinkler system is completed, test the system to ensure that all lawn and planting areas are watered completely and uniformly.
- B. Make any necessary adjustments as required by the owner's representative to provide proper coverage.

3.23 Operating and Maintenance Tools

- A. The following items shall be delivered to the owner when work is completed and prior to final acceptance of work.
 - 1. Two keys for each automatic controller.
 - 2. Two sets of any specialty adjustment or disassembly tools required for each type of sprinkler head supplied.
- B. The following items shall be delivered to the owner if applicable to the system.
 - 1. 30" valve keys for operation of manual drain valves.
 - 2. Two keys for opening lockable valve boxes.
 - 3. One 72" steel tee wrench for operating gate valves with square nut.
 - 4. One 72" steel tee wrench for operating bar handle stop and waste valve.
 - 5. One (1) quick-coupler key per three (3) quick couplers with matching swivel hose L's.
- C. Provide owner instruction in operating the system.
- D. Provide zone charts to owner that include:
 - 1. Zone geographic location.
 - 2. Head type.
 - 3. Type of landscape covered.
 - 4. Required run time.

3.24 Cleanup

Upon completion of all work, the contractor shall restore all ground surfaces disturbed during the irrigation installation to their original condition to the satisfaction of the owner's representative. Remove all excess irrigation material, waste, debris, and equipment from the site.

