Advanced Building Code
Plumbing - Appendix F
Design and Construction of
Landscape Irrigation Systems

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The Florida Building Code
Plumbing – Appendix F

The purpose of the code is to establish uniform minimum standards and requirements for the design and installation of safe, cost effective, reliable irrigation systems for turf and landscape areas which promote the efficient use and protection of water and other natural resources.

Florida Building Code
Plumbing - Appendix F

- Part I: General
- Part II: Design Criteria
- Part III: Standards
- Part IV: Materials
- Part V: Installation
- Part IV: Testing & Inspection

Part I - Scope of Appendix F

- A.3 - Applies to residential and commercial turf and landscape irrigation design, water quality, materials, installation and testing. Does not apply to golf, nursery, greenhouse, or agriculture.
- Applies to new systems and new work on existing systems.
- Existing systems are not affected until modified.

Part I – General - Permits

- B.1 - A signed Permit is required from the local building official if you construct, enlarge, alter, modify, repair or move any part of a system.
- Exempt work includes general maintenance and repair that does not alter the structure of the system, and the value of which does not exceed $600.00 in labor and materials. Even exempted work is to comply with the Code.

Part I – General - Pre Construction Submittals

C.- Plans and Drawings – prior to construction

Single-family residential – legible, scaled, showing entire site to be irrigated, with all improvements shown. Can be contractor provided.

Commercial, industrial, municipal and multiple-family – same as above except professionally designed with the addition of the following: date, scale, revisions, legend, specifications which list all aspects of equipment & assembly, water source, water meter, point of connection. If required: back flow, pump station size, location, design operating pressure and flow rate per zone. Locations of pipe, controllers, valves, sprinklers, sleeves, gate valves, etc. Prepare plans in accordance with Section 107 of the FBC, Building Section.
Part I – Definitions

- **Application Rate:** The average rate at which water is applied by an irrigation system, sometimes also called precipitation rate. Units are typically inches/hr or mm/hr.
  - Micro spray & drip emitters (12"x12" spacing) 1.6" per hour
  - (12"x18" spacing) 1.0" per hour
  - Spray nozzles = 1.75" per hour
  - Rotating spray nozzles = 0.4" per hour
  - Rotor heads = 0.5" per hour

- **Plant Water Need (inches per week):**
- **System Application Rate (inches per hour):**
- **Times:**
- **60 Minutes**
- **Equals:**
  - **Station Run Time**

- **Air Gap**
- **Reduced Pressure Device**
- **Double Check Valve**
- **Atmospheric Vacuum Breaker**
- **Check Valve**

- **Backflow Prevention Device:** An approved safety device used to prevent pollution or contamination of the irrigation water supply due to backflow from the irrigation system.

- **Bubbler Irrigation:** The application of water to the soil surface or a container as a small stream or fountain. Bubbler emitter discharge rates are greater than the 0.5 to 2 gph characteristic of drip emitters, but generally less than 60 gph.

- **Chemigation:** The application of water soluble chemicals by mixing or injecting with the water applied through an irrigation system.

- **Cycle:** Refers to one complete run of a controller through all programmed controller stations.

- **Demand (or irrigation demand):** Refers to the irrigation requirements of the irrigated area. Demand primarily depends on the type of crop, stage of growth, and climatic factors.
Part I - Definitions

- **Design Emission Uniformity**: An estimate of the uniformity of water application with an irrigation system.

- **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 emitters within that zone.

- **Drip Irrigation**: The precise low-rate application of water to or beneath the soil surface near or directly into the plant root zone. Applications normally occur as small streams, discrete or continuous drops, in the range of 0.5 to 2.0 gph.

- **Effluent water**: Also referred to as reclaimed or gray water is wastewater which has been treated per Florida Statute, §403.086 and is suitable for use as a water supply for irrigation systems.

- **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).
**Part I - Definitions**

- **Infiltration Rate:** The rate of water flow across the surface of the soil and into the soil profile. Units are usually inches/hr.

  - Micro spray & drip emitters = (12”x12” spacing) 1.6” per hour
  - (12”x18” spacing) 1.0” per hour
  - Spray nozzles = 1.75” per hour
  - Rotating spray nozzles = 0.4” per hour
  - Rotor heads = 0.5” per hour

- **Microirrigation:** The frequent application of small quantities of water directly on or below the soil surface, usually as discrete drops, tiny streams, or miniature sprays through emitters placed along the water delivery pipes (laterals). Micro irrigation encompasses a number of methods or concepts, including drip, subsurface, bubbler, and spray irrigation. Previously known as trickle irrigation.

- **Rain Shut off Device:** A calibrated device that is designed to detect rainfall and override the irrigation cycle of the sprinkler system when a predetermined amount of rain fall has occurred.

- **Spray Irrigation:** The micro irrigation application of water to the soil or plant surface by low flow rate sprays or mists.

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**Part II – Design Criteria**

- **A. Irrigation System Design - the science and art of properly selecting and applying all components within the system.**
  - Science, use of proven solutions, testing new theories for improvement of functions, predictable outcomes of uniform patterns and abiding to the physical laws of hydraulics, horticulture, soils and climates.
  - Art, challenging the status quo, creative process to respond to constraints or opportunities, unique settings and conditions, adjusting to unique settings and changing supply of resources.

- **B. Water Supply -** The water source shall have adequate volume, flow rate, pressure and water quality to meet the needs of the area to be irrigated, as well as other demands, if any, at the time the system is designed, and for the expected life of the system.

  - If the water source is effluent (reclaimed, or gray water) it shall be advanced waste treated per FS 403.086, as well as any other local government standard.
Part II – Design Criteria

C. Application Uniformity

- Describes how evenly water is distributed within an irrigation zone. Across the system this is also known as the uniformity coefficient. Use Application rates which avoid runoff and permit uniform water infiltration.
- Consider slopes, soil hydraulic properties, vegetation, and prevailing winds when setting Application Rates. Design systems with the appropriate uniformity for the type of plant being grown, and the type of soil found in that area.
- Avoid watering plants with different water requirements in one general group (same zone same emitter), also known as hydrozoning. Do not mix heads with different application rates on the same zone (sprays with rotors).

Part II – Design Criteria

D. System Zoning

- Divide valve zones by:
  - Available flow rate
  - Cultural use of the area
  - Type of planting, turf, shrubs, native plants, perennial peanut, annuals, vines, trees, ground covers.
  - Type of sprinkler, matched precipitation rates
  - Soil characteristics

Part II – Design Criteria

E. Sprinkler/Emitter Spacing and Selection

- Set sprinkler/emitter Spacing based on the irrigation work to be done, hydraulic character of the soils and the device, water quality on plant growth, walks, roads, buildings, and public access areas.
- Square spacing =
  - < 55% of manufacturer’s specified diameter, for wind speeds of 5 MPH or less.
  - 50% maximum of diameter (head to head spacing) in areas where wind speeds of 5 to 10 MPH
  - 45% maximum of diameter in areas with greater than 10 MPH exists.

Part II – Design Criteria

G. Wells

- Size well diameters and depths to meet the system demand. Refer to SCS Code FL-642, local and WMD regulations for well installations.
- Location and depth of wells shall be compliant to all Codes of the state, WMD and local jurisdiction.
Part II – Design Criteria

H. Pumps
- Pumps and Motors shall be sized to meet the volume and pressure demands of the system without invading the service factor of the motor, except at start-up and between zones.
- Place pumps in relation to the water surface to ensure NPSHr for proper operation.
- Protect the pumping system against the effects of interruption of water flow.

Part II – Design Criteria

L. Backflow Prevention Methods
- Provide BP assemblies at all Cross Connections according to County, Municipal, or other applicable codes. Determine the appropriate BPA for the given application. In the event of conflicting regulation, provide the BPA type that gives the highest degree of protection.
- If chemical injection is used, conform to FS Section 487.021 + 487.055, and the EPA Pesticide Reg. Notice 87-1, which requires BPA regulations to be printed on the chemical label. On Municipal water supplies, when using chemical injection, an air-gap separation, or an approved RPZ backflow device is required. RPZ to be approved by the Foundation for CCC and the Hydraulic Research Institute. Also comply with ASSE #1013 to protect the water supply from back-siphonage and back pressure.
- For other water supplies follow Florida State Law, EPA regulations, or other applicable local codes. In absence of legal guidelines, at least use a PVB device.

Part IV – Materials

A. PVC Pipe and Fittings
- Comply with ASTM D 1785, ASTM D 2241, AWWA C-900 or AWWA C-905. SDR PR pipe shall have a minimum wall thickness of SDR-26. All pipe used with effluent water shall be designated for non-potable use by label or industry standard color purple, Pantone.
- Solvent Weld Fittings shall be minimum of Schedule 40 in ASTM D 2466.
- Threaded Fittings shall be minimum of Schedule 40 in ASTM D 2464.
- Gasket Fittings shall conform to ASTM D 3139, and Gaskets to ASTM F 477.
- Flexible PVC pipe to be pressure regulated to ASTM D 2740 with standard ODs compatible with PVC IPS solvent weld fittings.
- PVC Cement to meet ASTM D 2564, and cleaner to meet ASTM F 656.
Part IV – Materials
E. Sprinklers, Heads, and Emitters
- Select units and nozzles per the area and planting to be irrigated. They must fit without excessive overspray onto anything but the lot plantings. Intentional direct spray onto walks, buildings, roads and drives is prohibited.
- Use equipment with seals, screens and springs suitable to the water supply and site conditions. (salt)

Part IV – Materials
E. Sprinklers, Heads, and Emitters
- Provide riser supports.
- Use swing joints, flexible or ridged, that are leak free, and allow movement of heads in any direction between the head and lateral line pipe.

Part IV – Materials
H. Valve Wiring – Low Voltage
- Direct buried wire (UF) must be labeled for such. Use water tight conduits for non-UF wire and have UL listed TWN or THHN type wire per the NEC. All wire under hardscape, roads or paving must be in a pipe and sleeve.
- Size wire per MR, in-rush current, wire length, number of solenoids and line pressure.
- Wire Splices are to UL approved for direct burial. All splices to be in a valve box, or splice box.

Part IV – Materials
H. Valve Wiring – Low Voltage
- Controller to be UL listed, conform to NEC, and be properly grounded per MR. Provide surge suppression devices on primary and secondary side of solid state controllers, except for single family residential systems.
- Controller housing shall protect from the hazards of the environment in which it is installed.
- Rain switch shall be placed on a stationary structure, minimum 5 feet clearance from equipment, free of overhead obstructions, and above the height of sprinkler coverage.

Part IV – Materials
J. Pumps & Wells
- Electrical system shall meet NEC.
- Protect from hazards of the environment.
- Use electric motors with a nominal horsepower rating greater than the maximum horsepower requirement of the pump during normal operation. The Pump Motor shall have a Service Factor of at least 1.15.

Part IV – Materials
J. Pumps & Wells
- Casing for drilled wells may be steel, reinforced plastic mortar, plastic, or fiberglass pipe. Use only steel pipe for a Driven Well. Steel pipe to be Sch. 40 wall thickness. Use SCS code FL-642. Steel Casing shall be > ASTM A 589.
Part V – Installation
A. Pipe Installation

- Install pipe a sufficient depth to protect from vehicular traffic, or normal maintenance of the property. Depth shall meet or exceed SCS Code 403-DD, Water conveyance, as follows:
  - Vehicle Traffic Areas:
    - .5”– 2.5” pipe: 18” depth
    - 3”–5” pipe: 24” depth
    - 6” pipe and larger: 30” depth
  - All Areas except Vehicle Traffic Areas:
    - .5”–1.5” pipe: 6” depth
    - 2”–3” pipe: 12” depth
    - 4”–6” pipe: 18” depth
    - 6” pipe and larger: 24” depth

B. Control Valve Installation

- Install valve to allow clearance for proper maintenance and operation. Put underground valves in valve boxes with cover extending from grade to body of valve. In non traffic area, 6” cover over body. In traffic area 18” cover over body. No VB is needed for valve under head valves.
- Do not let VB rest on pipe, interfere with valve operation, become a tripping hazard by not being flush with ground surface.

C. Sprinkler Installation

- Install heads plumb on level ground and tilted on slopes to prevent erosion. Adjust nozzle arc and radius to avoid excessive overspray on to paving or structures. Adjust arc and radius to prevent overspray on roads.
- Place heads 4” minimum from paving, 12” from buildings and vertical structures. Flush pipe before mounting heads or nozzles. Provide swing joints or PE nipples for pop-up heads. Mount riser nozzles on Sch. 40 PVC and use effective stabilizing equipment.

D. Pump Installation

- Install pump per MR. Set pump plumb and secure on a firm concrete base. Do not allow strain or distortion of the pipe or fittings. Support pipe and fittings to prevent undue strain on the pump. For 5 HP pumps use steel pipe and fittings.
- Install pump so that Loss of Prime is avoided. Install suction line to prevent accumulation of air pockets. All connections and reduction in suction pipe sizes should be designed to avoid causing air pockets and cavitation.
- Locate pumps to facilitate ease of service and removal. Provide fittings that allow the pump to easily be primed, services and disconnected. Provide an enclosure of adequate size and strength, with proper ventilation to protect the pump from the elements.

Part VI – Testing & Inspections

A. Purpose

- All materials and installations covered by this Code shall be inspected by the governing agency to verify compliance to the Code.

B. Rough Inspections

1. Perform RI throughout the duration of the installation by the Governing Agency. Ensure the installation is compliant with Design Intent, Specifications, and the Codes. Inspect the following at the discretion of the GA.
   - Sprinkler Layout and Spacing: Compare the head/emitter layout to the design plan. Allow for alteration or modifications for field conditions. Spacing should not exceed approximately 5% of the design spacing.
   - Pipe Installation Depth: Pipe depths shall be per the Code.
Part VI – Testing & Inspections

B. Rough Inspection

- 2. Pipe Installation Depth: Pipe depths shall be per the Code. *(From Part V – Installation, A. Pipe Installation)*
  - a. Vehicle Traffic Areas:
    - .5”– 2.5” pipe: 18” depth
    - 3”–5” pipe: 24” depth
    - 6” pipe and larger: 30” depth
  - b. All Areas except Vehicle Traffic Areas:
    - .5”–1.5” pipe: 6” depth
    - 2”–3” pipe: 12” depth
    - 4”–6” pipe: 18” depth
    - 6” pipe and larger: 24” depth

Part VI - Testing and Inspections

3. Test the Mainline integrity: Solvent weld joints should have no pressure loss. Use the following formula to determine the maximum allowable leakage limit of gasket joint PVC pipe.

\[ \text{L} = \frac{\text{NDP}}{7400} \]

Where:
- L = allowable leakage (gph),
- NDP = number of joints,
- D = nominal diameter of pipe (inches),
- P = average test pressure (psi), and
- S = length of pipe (ft).

- When testing a system, which contains metal-seated valves, an additional leakage per closed valve of 0.078 gph/inch of nominal valve size is allowed.

Part VI – Testing & Inspection

C. Final Inspection

- When the work is complete the installer shall request a final inspection.
- Cross Connection Control and Backflow Prevention
  - Public or domestic water systems: Check that an approved BPA is properly installed and functioning correctly. (Backflow Tester) Check that the location of the BPA is not creating a hazard to Pedestrians or vehicular traffic.
  - Other than Public or domestic water systems: Check that the proper BPA are provided.
  - All BPA’s that can be, are to be tested by a Certified Technician prior to use.

Part IV – Testing & Inspections

D. Site Restoration

- All existing landscape, pavement, and grade of areas affected by work must be restored to original condition or the satisfaction of the GA.
- Verify the pipeline trenches have been properly compacted to the densities required by the Plans and Specifications.

- All sprinklers (emitters) must be adjusted to minimize overspray onto buildings and paved areas.
- All sprinkler controls to be adjusted to minimize runoff of irrigation water.
- All sprinklers must operate at their design radius of throw. Nozzle sizes and types called for in the system design must have been used.
- Spray patterns must overlap as designed.
- Sprinklers must be connected, as designed, to the appropriate zone.
The Florida Building Code

Landscape Irrigation and the Advanced Building Code (ABC)