Attachment 4

STANDARDS AND SPECIFICATIONS FOR TURF AND LANDSCAPE IRRIGATION SYSTEMS

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FOREWORD

Attachment 4

The Florida Irrigation Society (FIS), a non-profit corporation, was founded in 1965 for the purpose of advancing the design, manufacture and use of irrigation equipment and systems in the State of Florida.

To meet this purpose, FIS continually disseminates information on the latest concepts, techniques and design data to irrigation designers, installers and users through statewide programs and technical publications.

The primary objective of this "Standards and Specifications" document is to enable the irrigation professional to improve design, installation, and operational procedures for of irrigation products and systems. It is intended to provide the professional designer and installer with sufficient information to permit the safe design and installation of irrigation products and systems in accordance with commonly accepted industry practice.

Although irrigation has been practiced for many years, it continues to advance at a rapid pace. As a result, the Standards and Specifications include procedures and practices that may not be common to all areas. Some of the recommendations are under further review and study by FIS committees or are the subject of ongoing research. The designer and installer must recognize that no standard or code can substitute for experienced judgment.

Efforts have been made to ensure that data and information in the Standards and Specifications are accurate. However, FIS cannot accept responsibility for any errors or oversights in the use of material or in the preparation of irrigation plans. This publication is intended for use by professional personnel competent to evaluate the significance and limitations of its contents and able to accept responsibility for the application of the material it contains.

Users of the Standards and Specifications are encouraged to offer comments to FIS on the contents of this publication and suggestions for changes in the next edition. Questions concerning the source and derivation of any material in the Standards and Specifications should be directed to FIS.

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STANDARDS AND SPECIFICATIONS FOR TURF AND LANDSCAPE IRRIGATION SYSTEMS

PART 1: GENERAL

1.01 Description

A. Purpose

The purpose of this document is to establish standards for the design and installation of safe, cost effective, reliable irrigation systems for turf and landscape areas and to promote the efficient use and protection of water resources.

B. Definition – Irrigation System

Turf and landscape irrigation systems apply water by means of permanent above-ground or subsurface sprinkler or micro-irrigation equipment under pressure.

C. Scope

These standards and specifications apply to all irrigation systems used on turf and landscape areas. They address the design requirements, water quality, materials, installation, inspection, testing, and warranties for such systems. These standards and specifications do not apply to irrigation systems for nurseries, greenhouses, or agricultural production systems.

D. Exceptions

Deviations from these standards will at times be necessary. Any deviation should at no time contradict the purpose stated above.

1.02 Definitions: See Glossary of Irrigation Terminology.

1.03 References: See "Reference List and Agencies Developing Standards and Procedures for Irrigation Practices included in this publication."

1.04 Pre-Construction Submittals

A. Plans or Drawings

1. **Commercial, Industrial, Municipal and Residential**

Provide design drawings, where none exist, for installation prior to start of construction. Design drawings shall be clearly readable, to reasonable scale, and shall include but not be limited to: 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 of pipe, controllers, valves, sprinklers, backflow prevention devices, elevation, electrical supply, roadways, sidewalks, structures and other relevant site conditions.

Irrigation design drawings shall consider existing and/or proposed landscaping plant materials in the design layout.

The owner or their representatives should supply the following site information, including but not limited to; high voltage electrical wires, water lines, telephone, cable and other utility lines, septic tanks, drain fields, well fields and easements.

PART 1: GENERAL CONTINUED

B. **List of Materials:** The Contractor shall provide manufacturer's product description sheets for all major components with specific models and/or items numbers highlighted.

C. **Deviations from Specifications:** Any deviation from the specified brands, models or sizes shall be clearly identified and manufacturer's product description sheets for the proposed replacement materials shall be submitted to owner or the owner's representative. Material deviations or design changes must be shown to comply with the system design intent and identify any necessary performance changes that are resultant from the deviation.

1.05 Post Construction Documentation

A. Commercial, Industrial, Municipal and Residential:

1. Provide the manufacturers' recommended operating instructions for all major components incorporated into the irrigation system.

2. Provide system operation manuals, maintenance schedules, recommended schedule of operation including average application rates, with seasonal adjustments for each zone.

3. Provide all required testing and inspection certificates to the owner or owner's representative.

B. **Record Drawings:** Provide drawings and plans showing all changes in the design to indicate the actual installation and location of all equipment and materials with the application for final payment.

The following specific items must be included:

1. Mainline and lateral pipes and their types and sizes.
2. Control valve locations, sizes, zone numbers and areas of coverage.
3. Sprinklers, controller, rain shutoff device, filter, and backflow prevention equipment.
4. Point of connection including type of water source, size, flow rates, and operating pressure range.
5. Date and scale.
6. Contractor's name, address, and telephone number.
7. Contractor's license number (where applicable).
8. Designer's name, address, and telephone number.
9. Designer's professional registration number (where applicable).

C. **Testing and Inspection Certifications:** Provide all required testing and inspection certifications to the owner or prime contractor with the final application for payment. (See Part V, Testing and Inspections)

1.06 Materials and Equipment Warranties

The irrigation system contractor shall assume full responsibility for the proper installation of the system. The irrigation system contractor shall make all necessary, reasonable efforts to handle any warranty claims in a reasonable time period. Contractor shall guarantee the installation workmanship for a minimum period of one year from date of completion.

END OF PART 1

PART 2: DESIGN CRITERIA

2.01 Design Defined

Within the scope of this document, irrigation system design is defined as the science and art of properly selecting and applying all components within the system utilizing them to comply with proper pipe hydraulics and to match precipitation rates to site conditions and other necessary design criteria.

2.02 Water Supply

A. The water source shall be adequate from the standpoint of volume, flow rate, pressure, quality and other applicable factors to meet the irrigation requirements of the area to be irrigated for the expected life of the system.

B. Review all potential water supplies as part of the irrigation system design, and advise the owner concerning cost and suitability of each. When using reclaimed water as the water supply, consult with governing agencies regarding setback requirements and special nozzles or other equipment as required by State or Local codes.

C. Available Pressure and Capacity:

1. Metered water systems: Determine the available pressure and flow rate at the water supply meter. Fluctuations in the supply pressure and available flow should be considered.

2. Design flow rate through the meter shall be no greater than 75% of the maximum safe flow capacity as stated by the meter manufacturer. In no case shall the flow be outside the meter manufacturer's recommended operating range.

3. Other systems: Assess the adequacy of surface water, well water or water purveyor to meet both flow rate and total irrigation water requirements.

4. Irrigation systems shall be designed with the capacity to meet peak water requirements that are used. The design shall also incorporate sufficient capacity to provide the necessary water for plant establishment.

5. The system designer shall review applicable codes and water restrictions. The system shall be designed to apply the necessary water while also complying with these regulations.

6. See also sections 2.08 Wells and 2.09 Pumps

2.03 Application Rate

Application rate is the rate at which water is applied to the irrigated area, normally measured in inches per hour or millimeters per hour.

A. Use application rates that avoid runoff and permit uniform water infiltration into the soil. Land slope, soil hydraulic properties, vegetative ground cover, and prevailing winds will be considered when application rates are specified.

PART 2: DESIGN CRITERIA CONTINUED

B. Calculate sprinkler application rates using one of the following formulas:

FORMULA ONE **- Application Rate – Individual Head Method**

$$\text{Application rate} = \frac{34650 \times \text{GPM (for any arc)}}{\text{Degrees Arc} \times \text{Head Spacing} \times \text{Row Spacing}}$$

Where:

Application rate	=	precipitation rate in inches per hour
GPM	=	flow for given sprinkler of any arc, in gallons per minute
Degrees Arc	=	the arc of the given sprinkler in degrees
Head Spacing	=	the space between the heads in a row, in feet
Row Spacing	=	the space between rows of heads, in feet
34650	=	constant for conversion of area and flow into common units

FORMULA TWO **- Average Application Rate – Total Area Method**

$$\text{Application Rate} = \frac{96.25 \times \text{Total GPM}}{\text{Total Area}}$$

Where:

Average Application rate	= precipitation rate in inches per hour
Total GPM	= total flow of all sprinklers in the given area in gallons per minute
Total Area	= the given area irrigated in square feet
96.25	= constant for conversion of area and flow into common units

C. Calculate micro-irrigation application rates using one of the following formulas:

FORMULA THREE **-** Where tubing is installed in such a manner as to wet an entire area:

$$\text{Appl. Rate} = \frac{231.1 \times \text{Dripper flow (GPH)}}{\text{Dripper spacing (inches)} \times \text{Dripperline spacing (inches)}}$$

where:

Appl. Rate	=	application rate in inches per hour
Dripper flow	=	gallons per hour flow of one dripper
Dripper spacing	=	spacing in inches of drippers inside tubing
Dripperline Row Spacing	=	inches between tubing laterals

FORMULA FOUR **-** When irrigating individual shrubs or trees, express the application rate on a "per plant" basis in gallons per day per plant. The following formula may be used for this calculation:

$$\text{Appl. Rate} = Q \; Ne \; T$$

where:

Appl. Rate	=	application rate (gpd per plant),
Q	=	emitter discharge rate (gph per emitter)
Ne	=	number of emitters per plant, and
T	=	operating time per day (hours)

PART 2: DESIGN CRITERIA CONTINUED

FORMULA FIVE - To calculate the average application rate for a micro irrigated zone, the following equation can be used:

Appl. Rate = QNzT

where:

Appl. Rate	= average zone application rate (gpd per zone)
Q	= emitter discharge rate (gal per hour per emitter)
Nz	= number of emitters per zone
T	= operating time per day (hours)

2.04 Irrigation Uniformity

Irrigation uniformity describes how evenly water is distributed within an irrigation zone. Irrigation system uniformity is the uniformity of the zone with the lowest uniformity coefficient.

A. Sprinkler Systems:

1. 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 i.e. (maximum flow rates – minimum flow rates)/(average flow rates of all sprinklers).

2. For this design calculation, flow rates of part circle sprinklers shall be normalized to that of a full circle sprinkler when both are used within a zone.

3. It is recommended within any given zone that the maximum pressure variation be 10% or less to limit flow rate variation to approximately 5%.

4. Irrigation systems should be designed with consideration for the types of plant being grown and the type of soil found in that area. The general watering of different types of plants as one group without regard to their individual water requirements is to be avoided if at all possible.

5. In general, the uniformity of coverage in an irrigation system should be in excess of 60 (sixty) percent.

6. In the absence of manufacturers' data required to calculate Uniformity Coefficients, it is recommended that when using square spacing, sprinklers should not be spaced farther apart than 55 percent of their manufacturer-specified diameters of coverage for prevailing wind speeds of 5 miles per hour (mph) or less.

7. Spacing should not exceed 50 percent of sprinkler diameters of coverage for wind speeds of 5 to 10 mph, and 45 percent for prevailing wind speeds greater than 10 mph.

8. When using triangular spacing the above overlap percentages can be increased by five percent.

PART 2: DESIGN CRITERIA CONTINUED

B. Micro-irrigation systems should be designed using the Emission Uniformity concept.

FORMULA SIX

$$EU = 100\% (1.0 - 1.27\ Cv / \sqrt{n}\ ) (Qmin/Qave)$$

where:

EU	=	emission uniformity (percent) which ranges from 0% (low uniformity) to 100% (perfect uniformity)
Cv	=	coefficient of manufacturing variation for the emitter used when operated at the average system operating pressure
n	=	number of emitters per plant (for example, the number of drip emitters per tree for drip-irrigated tree crops) or 1.0, whichever is less
Qmin	=	minimum emitter flow rate calculated for an irrigated zone
Qave	=	average emitter flow rate within an irrigated zone

The number, type and spacing of micro-irrigation emitters should be determined based on the plant water requirements, root zone size and soil conditions.

2.05 System Zoning

A. The irrigation system should be divided into zones based on consideration of the following:

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.

2.06 Sprinkler/Emitter Spacing and Selection

Sprinkler/Emitter spacing will be determined considering the irrigation requirements, hydraulic characteristics of the soil, and water quality with its effect on plant growth, sidewalks, buildings, and public access areas. Water conservation will be emphasized by minimizing irrigation of non-vegetated areas.

A. It is recommended that the sprinklers and emitters be spaced according to the guidelines laid out in the "Application Rate" section of Part 2.03 above.

B. Each zone of the irrigation system shall be designed to conform to Part 2.04 Application Uniformity.

C. Do not install riser-mounted sprinklers or emitters in areas subject to vehicular or pedestrian traffic.

D. When using sprays or rotors, select nozzle sizes to match application rates within each zone.

E. Space micro-irrigation emitters to respond to plant root zone size, plant water requirements, and soil type.

PART 2: DESIGN CRITERIA CONTINUED

F. Sprinkler and emitter locations on systems using reclaimed water shall conform to S62-610FAC regarding setbacks, drift, over spray and runoff.

G. Individual Drip Emitters (also known as point-source emitters with flows that generally do not exceed 4 GPH per emitter) – Emitters systems shall be designed to apply water directly to the plant root zone to maintain soil moisture.

H. In Line Tubing (also known as line source emitters with flows that generally do not exceed 4 GPH per emitter) – Emitters shall come preinstalled from the factory in the tubing at defined intervals. The design intent is to provide an overlapping continuous wetting pattern. Tubing emitter spacing and flow shall be selected based on soil type and manufacturer's recommendation.

I. Microsprays (Generally does not exceed 30 GPH per emitter) – Microspray nozzles with matched application rates should be used in dense or uniform plantings. For mixed or sparsely spaced plantings, design criteria must consider individual plant needs rather than overall average application rate.

J. Bubblers (Range from .5 GPH to 4 GPM) - Bubblers may be classified as micro irrigation or as conventional irrigation based upon their flow rate. Caution should be used in selecting this equipment due to the wide range of flow rates. Bubblers less than 30 GPH may be considered as micro irrigation. All other bubblers should be zoned separately from other types of micro irrigation products.

K. Note: The above definitions or descriptions apply to micro irrigation used in landscape applications. Nursery and agricultural micro irrigation products may be covered by other industry guidelines.

2.07 Pipelines

Pipelines will be sized to limit pressure variations so that the working pressure at all points in the irrigation system will be in the range required for uniform water application as defined in Part 2.03 and 2.04.

A. Mainline Pipe Selection

1. 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.

   If water temperatures exceed 73 degrees Fahrenheit pipe pressure ratings shall be adjusted in accordance with ASAE S-376.2. To avoid damage due to cyclic pressure variations in pressurized mains the total pressure variation should be minimized.

2. Total Pressure Developed/Surge Pressures: Surge pressures shall not exceed 2.5 times the adjusted working pressure of the mainline pipe.

PART 2: DESIGN CRITERIA CONTINUED

3. To calculate surge pressures use the following equation:

FORMULA SEVEN

$$Pt = \frac{Po + (V \times L \times 0.07)}{t}$$

Where

Pt	=	the total pressure developed
Po	=	the operating pressure at the time of the water hammer, in psi.
V	=	velocity at the time the reduction in velocity occurred, in fps
L	=	Length straight pipe (i.e. without tees or elbows) measured in feet between source and point where reduction in velocity occurred in feet. This would be the longest section.
t	=	seconds during which the velocity was reduced.
0.07	=	constant used to convert velocity, length and time into pressure.

B. Thrust Restraint

Thrust blocks are required on all unrestrained (for example, push-on gasketed joints) pipe joints and fittings at dead ends and whenever the line changes direction of 30 degrees or more. Concrete having a compressive strength of 2000 psi or higher will be specified. Thrust blocks will be formed against solid, unexcavated earth that has been undamaged by mechanical equipment. The space between the pipe and trench wall will be filled to the height of the outside diameter of the pipe. Size thrust blocks in accordance with ASAE Standard S-376.2.

2.08 Wells

A. Select well diameters and depths according to the irrigation system demand and in consultation with a Florida licensed well driller. Give consideration to the hydraulic properties of the source aquifer to reduce excessive drawdowns. Refer to NRCS Code FL-642 and local water management district regulations.

B. Well location and depth shall be in compliance with applicable State, water management district and local codes.

C. All wells constructed to recover water from unconsolidated aquifers shall be equipped with manufactured screen sections, well points or perforated sections meeting the criteria stated in NRCS Code FL-642 to prevent aquifer materials from entering the water system.

2.09 Pumps

A. Pump and motor combinations shall be capable of satisfying the total system demand without utilizing the service factor of the motor at any flow the pump is capable of producing.

B. Pumps shall be sized to ensure that the net positive suction head required (NPSHr) for proper pump operation is achieved. All factors effecting NPSHr shall be considered and these shall include but not be limited to the following:

1. Pump position relative to water surface.
2. Intake line sizing and type.
3. Check valve sizing and type.
4. Discharge equipment.
5. Pump or intake submergence.

PART 2: DESIGN CRITERIA CONTINUED

C. The pumping system should be protected against the effects of the interruption of water flow also known as a "dead head condition."

D. The system demand shall not be less than 25% of the pump's best efficiency point.

2.10 Control Valves and Systems

2.10.01 – Control Valves

A. Control valve size shall be based on the flow rate through the valve. Friction loss through the valve should not exceed 10% of the operating pressure upstream of the valve except where the valve includes a factory provided pressure regulator device.

B. In control systems using hydraulic communication between controller and valve(s), consult the manufacturers' recommendations for maximum distance between controller and valve both horizontally and vertically (elevation change).

C. Size electrical control wire in accordance with the valve manufacturer's specifications, based on the solenoid in-rush amperage and the circuit length, considering the number of solenoids operating on the circuit.

D. Electrical control wire to be direct-buried shall be UL approved for direct burial. If electrical control wire is not UL approved for direct burial, it must be installed in watertight, electrical, conduit and be UL listed TWN or THHN as described in the National Electric Code.

E. Locate manually operated control valves so they can be operated without wetting the operator.

2.10.02 - Two Wire Systems

A. Two wire or decoder systems use a single pair of wires to operate a large number of stations with individual decoders.

B. Contractor shall follow manufacturer's instruction for determining wire path, wire layout, size, etc.

C. Where multi zone decoders are used, the manufacturer should be consulted to determine the appropriate wire sizing method and maximum length of wire runs.

2.11 Automatic Irrigation Controller

A. Automatic irrigation controllers must have an adequate number of stations and power output per station to accommodate the irrigation system design.

B. Automatic irrigation controllers must have adequate programming flexibility to respond to the needs of the irrigation devices being used.

C. Automatic irrigation controllers must have an adequate number of stations and power output per station to accommodate the irrigation system design.

PART 2: DESIGN CRITERIA CONTINUED

2.11 Automatic Irrigation Controller - continued

D. Automatic irrigation controllers must have adequate programming flexibility to respond to the needs of the irrigation devices being used.

E. Considerations shall be given to governmental agency water restrictions.

F. Considerations shall be given to seasonal and environmental factors.

2.12 Chemical Injection

A. Chemical injection systems for the injection of fertilizer, pesticides, rust inhibitors, or any other injected substance will be located and sized according to the manufacturers' recommendations.

B. Injection systems will be located downstream of the applicable backflow prevention devices as required by Florida Statutes, Sections 487.021 and 487.055; the Environmental Protection Agency (EPA); Pesticide Regulation Notice 87-1; or other applicable codes.

C. If an irrigation water supply is also used for human consumption, an air gap separation or an approved reduced pressure principal backflow prevention device is required.

2.13 Filters and Strainers

A. The filter element, strainer, or filtration media must be sized to prevent the passage of foreign material in sizes or quantities which would obstruct the sprinkler/emitter outlets, typically 1/4 the diameter of the smallest outlet or the mesh size recommended by the irrigation device manufacturer and/or the filter manufacturer.

B. Under clean conditions the pressure loss across the filter will be no greater than 5 psi or the amount recommended by the manufacturer, whichever is less.

C. Provide sufficient filtering capacity so that backwash time is 20% or less of the system operation time. Within the 80% non-backwash time period, the pressure loss across the filter must remain within the manufacturer's specifications. Specifically designed continuous flushing type filters are exempt from this 20% requirement. These systems must, however, remain at all times within the manufacturer's specifications concerning head loss across the filter.

D. For manually flushed filters and strainers, it is recommended that a pressure gauge and isolation valve be installed both upstream and downstream of the filters/strainers.

2.14 Backflow Prevention

Provide backflow prevention assemblies at all cross connections with all water supplies in accordance with county, municipal, or other applicable codes. Determine acceptable backflow prevention assembly types and installation procedures for each application. At a minimum, provide a pressure vacuum breaker. Atmospheric vacuum breakers or dual check valves alone are not acceptable. In the event of conflicting regulation provide the assembly type that gives the highest degree of protection.

A. Install backflow prevention assemblies upstream of any outlets from the irrigation system, upstream of any chemical injection points, and in locations that allow for inspection, testing and servicing.

PART 2: DESIGN CRITERIA CONTINUED

B. Types of Backflow Prevention Assemblies:

1. Air gap separation: This method consists of a physical separation between the water supply and the irrigation system, so that there is no possibility of the discharged water flowing back into the water supply. The air gap separation must be a minimum of twice the diameter of the discharge pipe or one inch whichever is larger.

2. Atmospheric Vacuum Breakers (AVB) (not acceptable alone)

   a. Installed downstream of the last shut-off valve. AVBs must not be constantly pressurized.
   b. Must be at least 12-inches above the highest outlet.
   c. Must not be exposed to back-pressure.
   d. Must only be used in low hazard applications.

3. Pressure Vacuum Breakers (PVB)

   a. Must be installed upstream of all control valves.
   b. Must be at least 12 inches above highest outlet.
   c. Must not be exposed to back-pressure.
   d. May be used in high hazard or low hazard applications.

4. Dual Check Valves (not acceptable alone)

   a. Must be installed upstream of all control valves.
   b. Do not require installation above the highest outlet. These devices may be buried. However, they should be installed in valve boxes to facilitate removal for testing and service.
   c. Must not be used for backflow prevention under high hazard conditions.

5. Double Check Valve Assemblies (DCA)

   a. Must be installed upstream of all control valves.
   b. Do not require installation above the highest outlet. These devices may be buried. However, they should be installed in valve boxes to facilitate removal for testing and service.
   c. Must not be used for backflow prevention under high hazard conditions.

6. Reduced Pressure Principal Assemblies (RPA) or (RPZ)

   a. Must be installed upstream of all control valves.
   b. Must be installed so that the vent is a minimum of 12-inches above grade in locations that are well drained so that the assembly will not become submerged during rainfall or irrigation.
   c. Should be used for high hazard (chemical injection) applications.

C. Irrigation systems into which chemicals are injected shall conform to Florida state law (Florida Statutes 487.021 and 487.055) and Environmental Protection Agency Pesticide Regulation Notice 87-1, which requires backflow prevention regulations to be printed on the chemical label.

2.16 General Safety

A. Reasonable care should be taken selecting sprinkler equipment to avoid the devices and methods of application that would present a hazard to people using the area in a normal manner.

B. Irrigation systems using reclaimed water shall be designed to comply with S62-610FAC regarding cross connection, signage, color codes and misapplication of the water.

END OF PART 2

PART 3: MATERIALS

3.01 General Pipe and Fittings

Pipe bearing reclaimed water shall be purple colored or identified by other accepted method as described in S62-610FAC to differentiate reclaimed water from domestic or other water.

3.02 PVC Pipe and Fittings

A. PVC pipe should comply with one of the following standards: ASTM D-1785-99, ASTM D-2241-00, AWWA C-900-97, or AWWA C-905-97. SDR-PR pipe shall have a minimum wall thickness as required by SDR-26.

B. All solvent-weld PVC fittings shall, at a minimum, meet the requirements of Schedule 40 as set forth in ASTM D-2466-01.

C. Threaded PVC pipefittings shall meet the requirements of Schedule 40 as set forth in ASTM D-2464-99.

D. PVC gasketed fittings shall conform to ASTM D-3139-98. Gaskets shall conform to ASTM F-477-99.

E. PVC flexible pipe should be pressure rated with standard outside diameters compatible with PVC IPS solvent-weld fittings.

F. PVC cement should meet ASTM D-2564-96a. PVC cleaner should meet ASTM F-656-96a.

3.03 Ductile Iron Pipe and Fittings

A. Gasket fittings for iron pipe should be of materials and type compatible with the piping material being used.

3.04 Steel Pipe and Fittings

A. All steel pipe shall be rated Schedule 40 or greater and be hot-dipped galvanized or black in accordance with ASTM A-53-01.

B. Threaded fittings for steel pipe should be Schedule 40 Malleable Iron.

3.05 Polyethylene Pipe

A. Swing joints shall be thick-walled with a minimum pressure rating of 75 psi in accordance with ASTM D-2239-99.

B. Low pressure polyethylene pipe for micro irrigation systems shall conform to ASAE S435.

C. Use fittings manufactured specifically for the type and dimensions of polyethylene pipe used.

3.06 Sprinklers, Spray Heads and Emitters

A. Select units and nozzles in accordance with the size of the area and the type of plant material being irrigated.

B. Use equipment that is protected from contamination and damage by use of seals, screens, and springs where site conditions present a potential for damage.

PART 3: MATERIALS

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C. Use fittings manufactured specifically for the type and dimensions of polyethylene pipe used.

3.06 Sprinklers, Spray Heads and Emitters

A. Select units and nozzles in accordance with the size of the area and the type of plant material being irrigated.

B. Use equipment that is protected from contamination and damage by use of seals, screens, and springs where site conditions present a potential for damage.

PART 3: MATERIALS CONTINUED

C. Support riser-mounted sprinklers to minimize movement of the riser resulting from the action of the sprinkler.

D. Swing joints shall be constructed to provide a flexible, leak-free connection between the sprinkler and lateral pipeline to allow movement in any direction and to prevent equipment damage.

E. Sprinklers and emitters used with reclaimed water shall be colored purple or identified by other accepted means as described in S62-610FAC to differentiate reclaimed water from domestic or other water.

3.07 Valves

A. Valves must have a maximum working pressure rating equal to or greater than the maximum pressure of the system, but not less than 125 psi. This requirement may be waived for low mainline pressure systems (30 psi or less).

B. Use valves that are constructed of materials designed for use with the water and soil conditions of the installation.

C. Use valves that are designed to be protected from debris buildup in the control passages if there is a potential for such contamination from the water supply.

D. Use valves that are constructed from materials that will not be deteriorated by chemicals injected into the system and/or water characteristics such as pH, mineral content, etc.

E. Valves used with reclaimed water shall be colored purple or identified by other accepted means as described in S62-610FAC to differentiate reclaimed water from domestic or other water.

3.08 Valve Boxes

A. Use valve boxes that are constructed to withstand traffic loads common to the area in which they are installed. At a minimum valve boxes should be sized to allow manual operation of the enclosed valves without excavation. Where possible, valves boxes should be sized to allow routine maintenance without excavation.

B. Each valve box should be permanently labeled to identify its contents.

C. Valve boxes used with reclaimed water shall be purple or identified by other accepted means as described in S62-610FAC to differentiate reclaimed water from other waters.

3.09 Low Voltage Wiring

A. All low voltage wire, which is directly buried, must be labeled for direct burial. Wire not labeled for direct burial must be installed in watertight conduits, and be UL listed TWN or THHN type wire as described in the NEC.

B. Connections are to be made using UL approved devices specifically designed for direct burial.

PART 3: MATERIALS CONTINUED

3.10 Irrigation Controllers

A. All irrigation controllers shall be UL listed, conform to the provisions of the National Electric Code, and properly grounded in accordance with manufacturer's recommendations.

B. The controller housing or enclosure shall protect the controller from the hazards of the environment in which it is installed.

C. Use controllers that are programmable for varying irrigation durations that are consistent with the water to be applied in each zone.

D. Equip commercial installations using solid-state controls with surge suppressors on the primary and secondary wiring.

3.11 Pumps and Wells

A. Irrigation pump electrical control systems must conform to NEC and local building codes.

B. The pumping system shall be protected from the hazards of the environment in which it is installed.

C. Use electric motors with a nominal horsepower rating greater than the maximum horsepower requirement of the pump during its operation. Motors 5hp and greater shall have a minimum service factor of 1.15.

D. The well shall be constructed following local water management district regulations and county codes to protect the aquifer from contamination.

E. Casings for drilled wells may be steel, reinforced plastic mortar, plastic, or fiberglass pipe. Only steel pipe casings shall be used in driven wells. Steel pipe must have a wall thickness equal to or greater than Schedule 40. See NRCS code FL-642. Steel casings shall be equal to or exceed requirements of ASTM A-589-96.

3.12 Chemical Injection Equipment

A. Chemical injection equipment must be constructed of materials capable of withstanding the potential corrosive effects of the chemicals being used. Equipment shall be used only for those chemicals for which it was intended as stated by the injection equipment manufacturer.

3.13 Backflow Prevention Methods

A. Air gap separation: This method consists of a physical separation between the water supply and the irrigation system, so that there is no possibility of the discharged water flowing back to the water supply. The air gap separation must be a minimum of twice the diameter of the discharge pipe or 1-inch, whichever is larger. Refer to local plumbing codes for non-standard air gap installations.

B. Backflow Prevention Assemblies:

1. An atmospheric vacuum breaker consists of an air inlet port and a float type check valve. This device must meet ASSE Standard 1001.

PART 3: MATERIALS CONTINUED

2. A pressure vacuum breaker consists of an air inlet port, one positive seating check valve and an internally force loaded disc float assembly downstream of the check valve, installed as a unit between two resilient seated shutoff valves and fitted with properly located test cocks. This device must meet ASSE Standard #1020.

3. A dual check consists of independently acting, spring-loaded check valves in a corrosion resistant material. Dual checks usually have to be removed for testing. They are not recommended for high hazard conditions. This device must meet ASSE Standard #1024 and be approved by the Foundation for Cross Connection Control and Hydraulic Research of the University of Southern California. Dual checks are not acceptable in Florida irrigation systems according to the Florida Building Code.

4. A double check valve assembly consists of two positive-seating check valves installed as a unit between two resilient-seated shutoff valves and fitted with properly located test cocks. This device must meet ASSE #1015 and be approved by the Foundation for Cross Connection Control and Hydraulic Research of the University of Southern California.

5. A reduced pressure principle backflow prevented consists of two positive-seating check valves and an automatically-operating pressure differential relief valve integrally located between the two check valves, installed as a unit between two tightly closing, resilient-seated shutoff valves and fitted with properly located test cocks. This device must meet ASSE standard #1013 and be approved by the Foundation for Cross Connection Control and Hydraulic Research of the University of Southern California.

3.14 Filters and Strainers

A. Use filtration equipment and strainers constructed of materials resistant to the potential corrosive and erosive effects of the water, and sized in accordance with the manufacturer's recommendations.

B. Use the equipment that is constructed of materials capable of withstanding the potential mechanical damage caused by contaminants (for example, sand) in the water.

C. The filter element, strainer, or filtration media must be sized to prevent the passage of foreign material in sizes or quantities which would obstruct the sprinkler/emitter outlets, typically 1/4 the diameter of the smallest outlet or the mesh size recommended by the emitter manufacturer.

3.15 Rain Shutoff Device

A. Rain shut off devices shall be capable of being incrementally adjusted to activate at a range of rainfall amounts.

B. Shall be attachable to roof eaves, post or other mounting structures.

C. The device shall be UV resistant.

END OF PART 3

PART 4: INSTALLATION

4.01 Pre-Installation

A. Verify location of existing utilities with municipal and private utilities and with the property owner.

B. Obtain all necessary permits and licenses.

C. Inspect the site for existing conditions that will affect the irrigation system design or installation, and develop a plan to minimize disturbance of existing and/or proposed structures and landscape.

4.02 Installation of Backflow Prevention Assemblies

A. Flush all lines before installing backflow prevention assemblies.

B. Provide protection of backflow prevention assemblies if they are installed in a manner that subjects them to annual damage by freezing temperatures.

C. Install with adequate clearance to allow for servicing and testing per local codes.

D. DCA and RPZ devices must be installed horizontally unless approved for vertical installation by a recognized testing authority.

E. After installation, backflow prevention assemblies shall be inspected and/or tested according to applicable local codes.

4.03 Pipe Installation

A. Flag the location of all sprinklers, valves, controllers, source of water and electrical components in the field prior to installation.

B. Conduct all necessary excavation for the proper installation of pipelines and accessories. Dewater, shore, and brace as needed to completely install the pipe.

C. Pipe shall be installed at sufficient depth below ground to protect it from hazards such as vehicular traffic. Landscape vehicular traffic areas are those landscaped areas subject to vehicular use such as traffic crossings, parking areas, etc. Depths of cover shall conform to NRCS-FL- 430-DD, Water Conveyance, as follows:

1. **Landscaped Vehicle Traffic Areas** – Landscaped areas subject to routine automotive or heavy equipment traffic.

Pipe Size (Inches)	Depth of Cover* (inches)
½" – 2 ½"	18"
3"-5"	24"
6" and larger	36"

PART 4: INSTALLATION CONTINUED

2. Non-Traffic and Non-Cultivated Areas

Pipe Size (Inches)	Depth of Cover* (inches)
½" – 1 ½"	6"
2"-3"	12"
4"-6"	18"
More than 6"	24"

Note: The Contractor should notify the Owner or their representative when technical compliance with these guidelines may result in damage to property such as existing trees, structures etc. In such cases, the Contractor in cooperation with the Owner should seek to change the route of the pipe around such obstacles or reach other such reasonable accommodations

D. The trench bottom must be uniform, free of debris, and of sufficient width to properly place pipe and support it over its entire length. Blocking or mounding shall not be used to bring the pipe to final grade.

E. Make all pipe joints and connections according to the material manufacturer's recommendations. Perform all solvent-weld connections in accordance with ASTM D-2855. Caution should be used to prevent entry of foreign materials into pipes during installation.

F. Where pipe or fitting manufacturers recommend the use of thrust blocks, they must be formed against a solid, hand-excavated trench wall undamaged by mechanical equipment. They shall be constructed of concrete, and the space between the pipe and trench wall shall be filled to the height of the outside diameter of the pipe.

G. After installation of pipe, flush lines as follows:

1. Flush supply line prior to installing backflow preventers.
2. Flush main line before installing control valves.
3. Flush lateral lines prior to installation of sprinkler heads or emitters.
4. Inspect all lines and joints. Repair any leaks.

H. After installation, flushing, and inspection or testing, backfill and compact the excavated soil to minimize post-construction settlement in the pipe trench.

1. Native excavated material may be used to backfill the pipe trench. However, the initial backfill material shall be free from rocks or stones larger than 1-inch in diameter. At the time of placement, the moisture content of the material shall be such that the required degree of compaction can be obtained with the backfill method to be used.

2. The initial backfill material shall be placed so that the pipe will not be displaced, excessively deformed, or damaged. The initial fill shall be compacted firmly around and above the pipe to the density specified by the designer to provide adequate lateral support to the pipe.

3. If the water packing method of compaction is used, fill the pipeline first with water. The initial backfill before wetting shall be of sufficient depth to insure complete coverage of the pipe after consolidation. Water packing is accomplished by adding enough water to diked lengths of the trench to thoroughly saturate the initial backfill without excessive pooling. The wetted fill shall be allowed to dry until firm before beginning the final backfill. The pipeline shall remain full of water until after the final backfill is made.

PART 4: INSTALLATION CONTINUED

I. Pipe sleeves must be used to protect pipes or wires installed under pavement or roadways. Use pipe sleeves at least two pipe sizes larger than the carrier pipe or twice the diameter of the wire bundle to be placed under the paving or roadway, and extending a minimum of 3 feet beyond the paved area or as required by the Florida Department of Transportation (FDOT). Use sleeve pipe with wall thickness at least equal to the thickness of schedule 40 or PR 160 pipe, whichever is thicker.

Piping under paved traffic areas shall be encased in full lengths of sleeving material to avoid placement of joints under pavement if possible. Use the same techniques to place pipe sleeves to serve as conduits for automatic control wires or tubing. Sleeve material may be steel or plastic pipe, suitable to slide pipe, wire or tubing through. Proper backfill and compaction procedures should be followed.

J. Pipes conveying reclaimed water shall be separated from other piping or utility services by 3 feet horizontal distance. An 18-inch vertical separation shall be maintained where reclaimed lines cross other piping or utility services.

4.04 Valve Installation

A. Valve installation shall allow enough clearance for proper operation and maintenance. Where valves are installed underground, they shall be provided with a valve box with cover extending from grade to the body of the valve. The top of the valve body should have a minimum of 6 inches of cover in non-traffic and non-cultivated areas and 18 inches of cover in traffic areas.

B. All valves installed underground shall be installed in a valve box. If an automatic valve is installed under each sprinkler, then the valve box may be omitted. Valves must be installed with enough clearance for operation and maintenance.

C. Install valve boxes so that they do not rest on the pipe, the box cover does not conflict with the valve stem or interfere with valve operation and so that the valve box lids are flush with the ground surface.

D. Install quick coupling valves on swing joints or flexible pipe with the top of the valve at ground level, however, installation in a valve box is recommended.

E. Valves bearing reclaimed water shall be purple colored or identified by other accepted method as described in S62-610FAC to differentiate reclaimed water from domestic or other water.

4.05 Sprinkler Installation and Micro irrigation installation

4.05.01 Sprinkler installation

A. On flat landscaped areas, install sprinklers plumb. In areas where they are installed on slopes, sprinklers may be tilted as required to prevent erosion.

B. Sprinklers should be adjusted to avoid unnecessary discharge on pavements and structures.

C. Provide a minimum separation of 4 inches between sprinklers and pavement. Provide a minimum separation of 12 inches between sprinklers and buildings and other vertical structures or as local codes dictate.

PART 4: INSTALLATION CONTINUED

D. Piping must be thoroughly flushed before installation of sprinkler nozzles. Surface mounted pop-up heads shall be installed on swing joints, flexible pipe, or polyethylene (PE) nipples. Above-ground (riser mounted) sprinklers shall be at a minimum mounted on Schedule 40 PVC or steel pipe, manufacturer's risers or rigid copper pipe. Risers shall be effectively stabilized.

4.05.02 Micro Irrigation Installation

A. Micro-irrigation devices shall be installed according to the manufacturer's recommendations for the specific application.

B. Drip Emitters (point source emitters) - Individual emitters shall be inserted into polyethylene supply tubing (normally 3/8" or larger). Emitters may be combined into one device known as multi-outlet emitters or manifolds. Such devices may be installed using either polyethylene or PVC. Emitters shall be extended to the plant utilizing distribution tubing (Generally ¼" nominal size). Distribution tubing should be covered with a minimum of three inches of mulch or soil. Supply tubing and distribution tubing shall be secured or buried where the shrub beds are susceptible to disturbance from foot traffic, impact or tubing movement, etc.

C. Emitters and distribution tubing should be installed in a way that minimizes damage due to vandalism, insects, animals and landscape maintenance.

D. In-Line Drip Tubing (in line – emitters) - Tubing spacing, emitter spacing and length of run shall not exceed manufacturer's recommendations. Tubing shall be secured with stakes or staples every three to six feet depending on site conditions and manufacturer's recommendations.

E. Micro-sprays – Micro sprays may come with fixed, adjustable or interchangeable nozzles. Spray pattern should be appropriate for given plant materials or irrigated area. Nozzle selection criteria may include: pattern, radius of coverage, direction of spray, or flow rates

F. Supply tubing and inline tubing installation shall include the capability to flush the tubing laterals. Flush valves or other devices shall be able to deliver a flush rate of one to two feet per second.

G. Air/vacuum release valves are recommended to be installed in areas with changing topography or unusual site conditions.

H. Pressure regulating devices shall be used where water source pressure exceeds equipment manufacturer's rating.

Pressure compensation devices should be considered where there exist significant elevation changes, long tubing runs or where relative uniform flow at emitters is desirable.

4.06 Pump Installation

A. The well shall be developed until it stops producing detrimental quantities of solid particles at a continuous discharge rate of approximately 20% greater than the anticipated normal production rate (see NRCS-FL-642) prior to setting the permanent pump.

B. Set pumps plumb and secure to a firm concrete base. There should be no strain or distortion on the pipe and fittings. Pipe and fittings should be supported to avoid placing undue strain on the pump.

PART 4: INSTALLATION CONTINUED

C. Pumps must be installed in a manner to avoid loss of prime. Install suction line to prevent the accumulation of air pockets. All connections and reductions in suction pipe sizes should be designed to avoid causing air pockets and cavitations.

D. Pumps must be located to facilitate service and ease of removal. Appropriate fittings should be provided to allow the pump to readily be disconnected.

E. The installer should verify that the electrical connection produces correct rotation of the pump motor and that the electric power source is of the proper voltage and phase.

4.07 Low Voltage Wire Installation

A. Install low voltage wire (30 volts or less) with a minimum depth of cover of 12 inches.

B. Where wire is to be installed below grade, use only UL listed direct burial wire. In all other cases install wire in water-tight conduit.

C. Use wire connectors that are approved for direct burial. A valve box shall be used for all underground wire splices.

D. Provide a sufficient length of wire at each connection to allow for thermal expansion/shrinkage. As a minimum, provide a 12-inch diameter loop at all splices and connections. Terminations at valves will have 24" minimum free wire.

E. Install all above-ground wire runs and wire entries into buildings in conduit.

F. Provide common wires with a different color than the power wires (white shall be used for common wires).

G. On two wire systems where decoders operate individual valves, the decoder and the valve shall be installed in appropriately sized valve box. Splices used on this wire shall be approved for use with their product by the manufacturer. The contractor will determine prior to installation whether the manufacturer's wire may or may not be "looped."

4.08 Hydraulic Control Tubing

A. For hydraulic control systems, use a water supply that is filtered and free of deleterious materials, as defined by the hydraulic control system manufacturer.

B. Install a backflow prevention device where the hydraulic control system is connected to potable water supplies.

C. Install tubing in trenches freely and spaced so that it will not rub against pipe, fittings, or other objects that could score the tubing, and with a minimum 12-inch diameter loop at all turns and connections. Provide a minimum depth of cover of 12-inches.

D. Connect tubing with couplings and collars recommended by the tubing manufacturer. All splices should be made in valve boxes.

E. Pre-fill tubing with water; expel entrapped air; flush particulates and test for leaks prior to installation.

F. Install exposed tubing in a protective conduit manufactured from Schedule 40 PVC or electrical conduit.

PART 4: INSTALLATION CONTINUED

4.09 Rainfall Shutoff Device

A. Rain sensor shall be installed on building fascia or parapet if at all practical. The rain sensor can also be placed on a wall but must extend out a minimum of 18 inches from the wall. Sensors can also be placed on other stationary structures, such as posts or fences.

B. The device shall not be located where rainwater is channeled, to avoid false readings.

C. The vertical area directly above the rain sensor shall be unobstructed to the sky.

D. The rain sensor shall not be installed over or within 5 feet of the edge of either an air conditioner's compressor or a pool heater unit.

E. Rain sensor shall not be installed on a backflow prevention assembly.

F. Rain sensors shall be installed above the height of the sprinkler spray. When this is not possible, locate the sensor in the last zone to operate.

G. Rain sensors shall be installed as close as possible to the control equipment.

H. Rain sensor wire that is UV resistant may be left exposed to sunlight. The first 18 inches where the wire leaves the ground shall be encased in a conduit. If the wire is not UV resistant, its entire above ground length shall be encased in a conduit.

I. Rain sensor wire that is UL listed UF wire for direct burial may be installed in the ground without a conduit, but the first 18 inches where the wire leaves the ground shall be encased in a conduit. Wire that is not so rated must be encased in a conduit.

J. In systems pressurized by a pump, provision shall be made to ensure shutoff device does not allow pump to activate.

4.10 Signage - Re-use

A. Provide all necessary signs and or labeling necessary for reclaimed water in accordance with FAC – S62-610.

END OF PART 4

PART 5: TESTING & INSPECTIONS

5.01 Scope

This section addresses items that are to be provided to the owner by the installing contractor prior to scheduling an inspection by a governing agency.

5.02 Periodic Inspections

Periodic inspections will be performed throughout the duration of the installation. These inspections will be made by the contractor to insure that the installation is in compliance with the design intent, specifications, these standards, local and state codes and ordinances. Inspections will be made on the following items:

A. **Sprinkler/emitter Layout and Spacing:** This inspection will verify that the irrigation system design is accurately installed in the field. It will also provide for alteration or modification of the system to meet field conditions. To pass this inspection, sprinkler/emitter spacing should be within ± 5% of the design spacing.

B. **Pipe Installation Depth:** All pipes in the system shall be installed to depths as previously described in this standard.

C. **Cross Connection Control And Backflow Prevention:**

1. Public or domestic potable water systems: Check that an approved backflow prevention assembly is properly installed and functioning correctly. Review the location of the assembly to check that it is not creating a hazard to pedestrians or vehicular traffic.

2. For water systems other than public or domestic water systems, check that the proper backflow prevention assemblies and/or cross connection prevention device(s) are provided.

D. **Inspection Log:** Where applicable, an inspection log shall be kept at the job site. This log will show signatures and dates with description of inspections performed. This log may be required to be submitted to the governing agency upon their request.

5.03 Leakage Testing

A. **Single Family Residential Systems** – Generally these systems are not subject to "formal" leakage tests.

1. At a minimum fill the completely installed mainline slowly with water to expel air. Visually check for leaks.

B. Where additional testing is specified by the designer, owner or required by code, the following shall be included in the leakage testing:

1. Backfill the pipe prior to filling with water to confine the pipe to the trench.

2. If the trench is not completely backfilled because of additional testing requirements, it should have a minimum cover of 1-1/2 times the diameter of the pipe prior to testing.

PART 5: TESTING AND INSPECTION CONTINUED

3. Fill the mainline and allow the pipe to sit full of water for 24 hours to dissolve remaining trapped air.

4. Using a metering pump, elevate the water pressure to the maximum static supply pressure expected and hold there for a period of 2 hours, adding water as needed to maintain the pressure.

5. Record the amount of water added to the system over the 2 hour period.

6. Use the following formulas to determine the maximum allowable leakage limit of gasketed pipe.

FORMULA EIGHT
DUCTILE IRON:

$$L = S D \sqrt{P} / 133{,}200$$

where:

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

FORMULA NINE
PVC, GASKETED JOINT:

$$L = \frac{N D \sqrt{P}}{7400}$$

where:

L = allowable leakage (gph),
N = number of joints,
D = nominal diameter of pipe (inches),
P = average test pressure (psi).

C. PVC solvent-weld pipe connections shall have no leakage. Polyethylene control tubing lines shall have no leakage. Where site conditions such as long runs where small pipe-soil movement is possible, combination of solvent weld and oring fittings are used, temperature variations during testing, etc. then formula eight may be used to determine allowable leakage.

D. 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.

E. Pressure testing requirements shall not exceed manufacturer's recommended pressure for the elements being tested. Such elements may include pipe, isolation valves, solenoid valves, backflow preventer, etc.

F. Where possible, it is recommended that testing should not include individual solenoid valves.

G. Repair all leaks and retest the pipeline until it passes the test.

PART 5: TESTING AND INSPECTION CONTINUED

5.04 Application Uniformity Testing

A. The uniformity of application is a measure of system performance. Factors affecting uniformity shall include but not be limited to:

1. Wind.
2. Spacing of sprinklers.
3. Water pressure at the sprinkler.
4. Nozzle sizes and compatibility between sprinklers.
5. Sprinkler discharge pattern.
6. Speed and uniformity of rotation of rotary sprinklers.
7. Radius adjustment.

B. Application uniformity testing is not mandatory. However, if it is desired to conduct a uniformity test, in addition to the other tests described herein, it should be conducted in accordance with ASAE S-398.1, Procedure for Sprinkler Testing and Performance Reporting. The uniformity of microirrigation systems can be tested by direct measurement of the emitter discharge rates.

C. The application uniformity can be determined by collecting field data and calculating the coefficient of uniformity (**Cu**) using either the Christiansen or Statistical Uniformity Coefficient methods described in the following section. For sprinkler systems, a minimum of three locations within a zone should be selected for data collection. These locations should be selected near the beginning, middle and end of the sprinkler lateral. For microirrigation systems, a minimum of 18 to 24 data points or locations should be randomly collected across the field being evaluated. If the resulting coefficient of uniformity is low, then additional field data should be taken to improve the statistical reliability of the estimate.

D. Uniformity coefficients should be calculated using the Christiansen Uniformity Coefficient Cu_c given in equation 10 or the Statistical Uniformity Coefficient CU_s) given in equation 11. For randomly distributed data, both methods will produce approximately the same result.

FORMULA TEN

$$\mathbf{Cu_c = (100)\ [\ 1.0 - (\ Ex\ /mn)\ ]}$$

where:

Cu_c = Christiansen's Uniformity Coefficient (percent), which ranges from 0% (low uniformity) to 100% (perfect uniformity);

n = number of measurements, observation points, or calculated water applications at points beneath the irrigation system;

m = the mean value of all observations, and

Ex = the sum of the deviations of the individual observations from the mean value.

FORMULA ELEVEN

$$\mathbf{CU_s = 100\% - 80\% (s/x)}$$

where:

CU_s = the Statistical Uniformity Coefficient (percent) which ranges from 0% (low uniformity) to 100% (perfect uniformity),

s = standard deviation of the number of observations, measurements or calculated water applications at points beneath the irrigation system, and

x = average depth or volume of water measured at all observation points.

PART 5: TESTING AND INSPECTION CONTINUED

E. Distribution Uniformity

Measurement of Distribution Uniformity may be used as an alternate means of measuring uniformity.

FORMULA TWELVE

$$DU = \frac{\text{Average collected volume of lower quarter of catch cans}}{\text{Average collected volume of all catch cans}} \times 100\%$$

F. Distribution Uniformity (DU) is the measure of how evenly water is applied across the landscaped area. Obtaining a DU for a given system requires the use of a catch can test. When conducting a catch can test, the cans are placed throughout the zone. The irrigation is operated long enough to apply a measurable quantity of water. The amount of each can is recorded. The average of all the cans is computed and the average of the lowest quarter is computed. Formula twelve is than used to compute the distribution uniformity.

5.05 Sprinkler/emitter Testing

A. All sprinklers must be adjusted to minimize over-spray onto buildings and paved areas.

B. All sprinkler controls must be adjusted to minimize runoff of irrigation water.

C. All sprinklers must operate at their design radius of throw.

D. Spray patterns must overlap as designed.

E. Verify that the sprinklers are connected to the appropriate zone.

F. Verify that nozzle or emitter sizes and types called for in the system design have been used.

5.06 Pressure Distribution Testing

A. **Pressure head loss tests:** The design operating pressure of the system shall be stated on the plan. The pressure at any point in the system shall not be more than plus or minus 10% of the design operating pressure at that point.

B. **Testing Will Be Performed as Follows:**

1. Zones to be tested will include, at minimum, the largest zone, smallest zone, the zone closest to the source in terms of mainline distance, and the zone farthest from the source in terms of mainline distance.

2. Testing of each zone will be done by measuring pressure at a minimum of 2 points. One pressure will be measured at the sprinkler closest to the zone control valve and the second will be measured at the sprinkler farthest from the zone control valve.

5.07 Backflow Prevention Assembly Testing

A. A certified technician will test all assemblies that can be tested prior to being placed into service.

PART 5: TESTING AND INSPECTION CONTINUED

5.08 Site Restoration

A. Verify that all existing landscaping, pavement, and grade of areas affected by work were restored to original condition or to the satisfaction of the system owner.

B. Verify that the pipeline trenches have been properly compacted to the densities required by the plans and specifications.

5.09 Rainfall Shutoff Device

The device shall be tested to ensure proper shut-off of control equipment.

5.10 Certification

A. All inspections and tests described herein will be certified to the owner in writing by the installing contractor. Certification will include the following:

1. The date on which inspections and/or tests were performed.
2. List of attendees at inspections/tests.
3. The signature of the contractors.
4. Record drawing.

B. It is suggested that, upon receipt of the letter of certification, the governing inspection authorities perform at least the following inspections:

1. Inspect backflow prevention assemblies to verify that the make, model, and size conform to specifications, and it was installed and functions in conformance with applicable code.
2. Inspect valves to verify they are properly housed and installed to grade. Wire splices and connections shall be made using appropriate methods.
3. Inspect controlling devices to verify that they function, and to assure that they conform to applicable codes.
4. Observe the system operating through one complete cycle (with abbreviated irrigation periods) of the control system.

C. Where certification is not required by designer, owner, or by local code, the Contractor shall still provide at a minimum, a record drawing and warranty information.

END OF PART 5

Attachment 4

FLORIDA IRRIGATION SOCIETY
IRRIGATION STANDARDS

LIST OF ABBREVIATIONS

cfs: cubic feet per second

FAC: Florida Administrative Code

ft: feet

fps: feet per second

gal: gallons

gph: gallons per hour

gpm: gallons per minute

hr: hour

I.D.: inside diameter of a pipe

L: liters

m: meters

min: minute

NIR: net irrigation requirement

O.D.: outside diameter of a pipe

POC: Point of Connection

psi: pounds per square inch

sec: second