UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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SECTION 32 84 24

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USACE / NAVFAC / AFCEC / NASA	**UFGS-32 84 24 (August 2011)**
	Change 1 - 05/17

Preparing Activity: NAVFAC	**Superseding**
	UFGS-32 84 24 (May 2010)

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SECTION 32 84 24

IRRIGATION SPRINKLER SYSTEMS
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****
NOTE: This guide specification covers the requirements for irrigation sprinkler systems.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

****
NOTE: Some paragraphs may need to be supplemented to meet project requirements.
****

PART 1 GENERAL

1.1 REFERENCES

****
NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature

when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN PETROLEUM INSTITUTE (API)

API Std 598	(2009) Valve Inspecting and Testing

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 189.1	(2014) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.2	(1983; Errata 1992; R 2017) Gages and Gaging for Unified Inch Screw Threads
ASME B16.3	(2021) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2021) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B40.100	(2022) Pressure Gauges and Gauge Attachments

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1010	(2021) Performance Requirements for Water Hammer Arresters
ASSE 1020	(2020) Performance Requirements for Pressure Vacuum Breaker Assemblies
ASSE Series 5000	(2022) Cross-Connection Control Professional Qualification Standard

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C500	(2019) Metal-Seated Gate Valves for Water Supply Service
AWWA C511	(2017; R 2021) Reduced-Pressure Principle Backflow Prevention Assembly
AWWA C651	(2014) Standard for Disinfecting Water Mains
AWWA C901	(2020) Polyethylene (PE) Pressure Pipe and Tubing, 3/4 In. (19mm) Through 3 In. (76 mm), for Water Service
AWWA M14	(2015) Manual: Recommended Practice for Backflow Prevention and Cross-Connection Control

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B43	(2020) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2287	(2019) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D2464	(2015) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

ASTM D2774	(2021) Underground Installation of Thermoplastic Pressure Piping
ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3261	(2016) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM F441/F441M	(2023) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List	(continuously updated) List of Approved Backflow Prevention Assemblies

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023) National Electrical Code

NSF INTERNATIONAL (NSF)

NSF/ANSI 14	(2022) Plastics Piping System Components and Related Materials

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-51145	(Rev D; Notice 1; Notice 2; Notice 3; Notice 4) Flux, Soldering, Non-Electronic, Paste and Liquid

UNDERWRITERS LABORATORIES (UL)

UL 651	(2011; Reprint May 2022) UL Standard for

Safety Schedule 40, 80, Type EB and A
Rigid PVC Conduit and Fittings

1.2 RELATED REQUIREMENTS

****
NOTE: Use only when using water pumps.
****

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section, with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

This system is designed with a water pressure minimum of [_____] kPa pounds per square inch (psi) maximum of [_____] kPa psi at connection to main [meter] [building] [backflow prevention device] and [_____] kPa psi at the last head in each zone.[Provide a system pressure calculations and irrigation requirements of the area.] If pressure falls above or below indicated values, Contractor shall notify Contracting Officer. For Irrigation Sprinkler System, indicate the following:

a. Head, piping, valve, [controller], [sensor] layout. Provide separate hydrozones for plant materials with different water requirements.

b. Pipe, valve, backflow preventer, and controller.

****
NOTE: Use the following in freeze-thaw climates only.
****

c. Invert elevations. Indicate obstructions interfering with operation.

****
NOTE: At the text below, if source of water supply is from station water system through a service line and water meter, determine amount of water required for station irrigation system from static pressure at point of connection of station main. These factors are essential in designing for system pressure. In many cases, water supply is adequate for short durations only. Provide adequate valves for each zone to irrigate an area effectively.
****

d. Water source equipment, including existing mains, piping, valves and meters.

****
NOTE: At the text below, the system pressure and irrigation requirements of the area are determined from water supply, static pressure, soil, plants, freezing conditions, elevation changes, and wind direction and velocity.
****

e. System and supply pressures.

f. Indicate wiring diagram between existing power source and controller/water pump.

g. Number and extent of control valve circuits.

h. Provide details of all irrigation components and accessories.

1.4 SUBMITTALS

****

NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.

****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

****

NOTE: Delete the following except in Design/Build projects.

****

Irrigation Sprinkler System

Drawings including irrigation legend prepared by a licensed, registered or certified Landscape Architect or Irrigation Specialist.

SD-03 Product Data

Piping Materials, tubing, and fittings

Valves and Accessories

Sprinkler Heads

Backflow Preventers

Automatic Controller

Controller Enclosure

Solvent Cement

Control Wiring

Drip Irrigation Equipment and ccessories

Water Hammer Arresters

Water Meter

Rain Shut-Off Device

Freeze Shut-Off Device

Soil Moisture Sensor

Tapping Tee

Valve Boxes and Lids

Drip Head Accessories

SD-05 Design Data

****

NOTE: If source of water supply is from station water system through a service line and water meter, determine amount of water required for station irrigation system from static pressure at point of connection of station main. These factors are essential in designing for system pressure. In many cases, water supply is adequate for short durations only. Provide adequate valves for each zone to irrigate an area effectively.

****

****

NOTE: The system pressure and irrigation

requirements of the area are determined from water supply, static pressure, soil, plants, freezing conditions, elevation changes, and wind direction and velocity.

****

System Pressure Calculations

Irrigation Requirements

SD-06 Test Reports

Valves, and Accessories Tests

Backflow Preventers

Pressure Test

Operation Test

Including verification of sprinkler head layout

Submit record of pressure tests conducted on recording gage.

SD-07 Certificates

Backflow Preventers

ASSE Series 5000, Submit a certificate of Full Approval or a current Certificate of Approval from FCCCHR List for size, and make of backflow preventer being provided for this project. A Certificate of Provisional Approval will not be acceptable.

SD-08 Manufacturer's Instructions

Automatic Controller

Sprinkler Heads

Piping Materials

Tubing and fittings.

Backflow Preventers

Valves

Solvent Cement

Control Wiring

Drip Irrigation and accessories

Water Hammer Arresters

Water Meter

Rain Shut-Off Device

Freeze Shut-Off Device

Soil Moisture Sensor

Submit mounting details for automatic controllers.

SD-10 Operation and Maintenance Data

Piping Materials and Fittings, Data Package 2; G[, [_____]]

Sprinkler Heads and Accessories, Data Package 2; G[, [_____]]

Backflow Preventers, Data Package 2; G[, [_____]]

Valves, Data Package 2; G[, [_____]]

Automatic Controller, Data Package 2; G[, [_____]]

Drip Irrigation and Accessories, Data Package 2; G[, [_____]]

Water Hammer Arresters, Data Package 2; G[, [_____]]

Water Meter, Data Package 2; G[, [_____]]

Rain Shut-Off Device, Data Package 2; G[, [_____]]

Freeze Shut-Off Device, Data Package 2; G[, [_____]]

Soil Moisture Sensor, Data Package 2; G[, [_____]]2

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Include troubleshooting procedures with respect to valve and controller problems.

SD-11 Closeout Submittals

Controller Charts

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in original rolls, packages, cartons, and containers with the name of manufacturer, brand, and model. Inspect materials delivered to the site for damage.

1.5.2 Storage

Store materials on site in enclosures or under protective covering. Store [plastic piping and] rubber gaskets under cover out of direct sunlight. Do not store materials directly on ground. Keep inside of pipes and fittings free from dirt and debris.

1.5.3 Handling

Handle and carry pipe, fittings, valves, and accessories in such a manner as to ensure delivery to trench in sound undamaged condition. Do not drag pipe.

1.6 EXTRA STOCK

a. [2] [_____] additional sprinkler heads (nozzles, bodies, screens, pressure compensating devices) of each size and type;

[b. [2] [_____] valve keys for operating manual valves;

] c. [2] [_____] wrenches for removing and installing each type of head;

[d. [2] [_____] quick coupler keys and hose swivels;

] e. [4] [_____] irrigation controller housing keys.

f. [4] [_____] irrigation controller enclosure keys; and

g. [2] [_____] hand-held remotes compatible with controller system.

1.7 QUALITY ASSURANCE

1.7.1 Required Test

Submit tests signed by an authorized official of a testing laboratory of sprinkler head, valve, automatic controller, emitter heads, vacuum breaker, backflow preventer, and water hammer arrester.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

****
NOTE: Select material with copper, brass, steel, PVC, and PE, according to project requirements. Verify soil and water conditions on site, use copper or plastic pipe where corrosion problems exist.
****

2.1.1 Copper Tubing and Associated Fittings

2.1.1.1 Tubing

ASTM B88MASTM B88, Type K.

2.1.1.2 Fittings

****
NOTE: Sn 95 and Sn 94 are alloy grades with 95 and 94 percent tin base alloy. Both grades composed of 0.10 percent lead intended for potable water systems. A maximum of 0.20 percent lead in alloy is suitable for drinking. Type I flux is used for tin-lead solders for joining metal except aluminum.
****

ASME B16.22 and ASME B16.18, solder joint. Solder, ASTM B32 alloy Grade Sn95 or Sn94. Flux, CID A-A-51145, Type I.

2.1.2 Red Brass Pipe and Associated Fittings

2.1.2.1 Pipe

ASTM B43, regular.

2.1.2.2 Fittings

ASME B16.15, Class 250, cast bronze threaded.

2.1.3 Galvanized Steel Pipe and Associated Fittings

2.1.3.1 Pipe

****
NOTE: Schedule 40 is standard weight pipe. Use of pipe is limited to fixed shrub head risers and reduced pressure type backflow preventers.
****

ASTM A53/A53M, Schedule 40.

2.1.3.2 Fittings

****
NOTE: Class 150 is pressure temperature rating of 1034 kPa at 177 degrees C 150 psi at 350 degrees F.
****

ASME B16.3, Class 150.

2.1.4 Polyvinyl Chloride (PVC) Pipe, Fittings and Solvent Cement

****
NOTE: PVC pipe may be used where frost line is less than 300 mm 12 inches deep.
****

NSF/ANSI 14, seal of approval for potable water.

2.1.4.1 Pipe

****
NOTE: ASTM D1785, PVC 1120, Schedule 40 is Type I, Grade 1 with 13.8 MPa 2.000 psi hydrostatic design stress, and wall thickness of Schedule 40. ASTM D1785, PVC 1120, Schedule 80 is Type I, Grade 2 with 13.8 MPa 2.000 psi hydrostatic design stress, and wall thickness of Schedule 80. ASTM D2241, PVC 1120, SDR 21 is Type I, Grade 1 with 13.8 MPa 2,000 psi hydrostatic design stress, and standard dimension ratio of 21.
****

ASTM D1785, PVC 1120 Schedule [40] [80]; or ASTM D2241, PVC 1120 SDR 21, [Class 315][Class 200].[Provide integral lavender-color pipe for non-potable use.][Provide ultra-violet resistant piping for on-grade use.]

2.1.4.2 Fittings

****
NOTE: At the text below, use Schedule 40 PVC fittings when solvent welded. Do not use threaded Schedule 40 pipe.
****

a. Solvent Welded Socket Type: ASTM D2466, Schedule 40.[Provide lavender-colored fittings.][Provide ultra-violet resistant fittings.]

b. Threaded Type: ASTM D2464, Schedule 80.[Provide lavender-colored fittings.][Provide ultra-violet resistant fittings.]

2.1.4.3 Solvent Cement

****
NOTE: Use for unthreaded PVC pipe and fittings.
****

ASTM D2564.

2.1.5 Polyethylene (PE) Plastic Piping

2.1.5.1 Pipe

AWWA C901, outside diameter (od) base with dimension ratio (DR) of 9.3 to provide 1034 kPa 150 psi minimum pressure rating.

2.1.5.2 Fittings

ASTM D3261, DR of 9.3.

2.1.6 Dielectric Fittings

****
NOTE: Provide dielectric fittings between copper and ferrous metal piping materials.
****

ASTM F441/F441M, Schedule 80, CPVC threaded pipe nipples, 100 mm 4 inch length.

2.1.7 Drip Irrigation Tubing

ASTM D2287, maximum inside diameter (id) of [3] [6] [10] [13] [19] [25.40] mm [1/8] [1/4] [3/8] [1/2] [3/4] [one] inch, vinyl plastic extruded from non-rigid chloride, integrally algae-resistant, homogeneous throughout, smooth inside and outside, free from foreign materials, cracks, serrations, blisters and other effects. Provide [slip] [barbed] [compression] fittings.

2.1.8 Pipe Sleeving

a. Provide [PVC] [cast iron] [_____] piping two times the diameter of main or lateral piping.

b. Provide gray PVC electrical conduit sized according to number of control wires. Minimum 50 mm 2 inch size.

2.2 IRRIGATION AND DRIP SPRINKLER HEADS

[Provide lavender-colored body, nozzle, and/or cap indicator for non-potable use.

]2.2.1 Fixed Riser Irrigation Heads

2.2.1.1 Stream Rotors, Full or Part Circle

Sprinkler body, nozzle, and screen constructed of heavy-duty, ultra-violet resistant plastic. Heavy duty, stainless steel internal construction with plastic body.[Provide check valve below each sprinkler body on riser.]

2.2.1.2 Gear Rotor Irrigation Head, Full or Part Circle

Single-stream, water lubricated, gear drive type capable of covering [_____] mm feet radius [_____] kPa psi with distribution rate of [_____] L/s gpm. Part circle sprinkler with an adjustable arc coverage of 0.52 to 6.28 rad 30 to 360 degrees. Stainless steel internal construction with plastic body, with matched precipitation rate nozzles in standard /low/ flat angle trajectories, filter screen, reducible watering radius, and choice of [_____] nozzles.

2.2.1.3 Impact Irrigation Head

Capable of covering [_____] mm feet radius at [_____] kPa psi with a distribution rate of [_____] L/s gpm, and [_____] V pop-up. Provide one or two nozzles to distribute water, an inlet strainer to prevent debris from clogging nozzles, and non-corrosive [brass] [plastic] head and stainless steel assemblies. Seal bearing assembly from abrasives. Provide entire assembly including strainer removable from top of case without disturbing case installation. Provide plastic housing.

2.2.1.4 Spray Irrigation Heads, Full or Part Circle

Capable of covering [_____] mm feet radius at [_____] kPa psi with a discharge rate of [_____] L/s gpm. Sprinkler body, nozzle, and screen constructed of heavy-duty, ultra-violet resistant plastic. Matched precipitation rate [plastic] [brass] nozzle with an adjustable screw capable of regulating the radius and the flow. Capable of housing under the nozzle; protective, non-clogging filter screen and/or pressure compensating devices. Screen used in conjunction with the adjusting screw from regulating.[Provide check valve below each sprinkler body on riser.]

2.2.1.5 Adjustable Flood Bubbler Head

****

NOTE: A water outlet that does not spray water but permits water to bubble and flow to the surrounding plants.

****

Capable of providing a discharge rate of [_____] L/s at kPa [_____] gpm at psi, operating over a pressure range of 69 to 414 kPa 10 to 60 psi. Constructed of durable ultra-violet resistant plastic with a plastic inlet filter screen to protect the nozzle against clogging, and a stainless steel adjustable screw, capable of shutting off the bubbler and regulating the flow.

2.2.1.6 Pressure Compensating Flood Bubbler Head

Capable of providing a consistent discharge rate of [_____] L/s at kPa [_____] gpm at [_____] psi. Plastic inlet filter screen bubbler assembly to protect the nozzle against clogging. Permanently assembled design constructed of durable, ultra-violet resistant plastic with a integral rubber flow washer for regulating the discharge rate at an operating pressure range of 138 to 621 kPa 20 to 90 psi.

2.2.2 Pop-Up Irrigation Head

****

NOTE: Pop-up heads lay flush with the housing, then pop up when the water pressure is activated in system.

****

2.2.2.1 Stream Rotor Irrigation Head, Full or Part Circle

Sprinkler body, nozzle, and screen constructed of heavy-duty, ultra-violet resistant plastic. Heavy duty, stainless steel internal construction with plastic body. Pop-up height of [75] [100] [150] [300] mm [3] [4] [6] [12] inches as measured from top of cap at normal installation to middle of nozzle orifice.[Provide check valve in head.]

2.2.2.2 Gear Rotor Irrigation Head, Full or Part Circle

Sprinkler body, nozzle, and screen constructed of heavy-duty, ultra-violet resistant plastic. Heavy duty, stainless steel internal construction with plastic body and match precipitation rates for standard low or flat angle trajectories. Single-stream, water lubricated, gear drive type capable of covering [_____] mm feet radius [_____] kPa psi with distribution rate of [_____] L/s gpm. Part circle sprinkler with an adjustable arc coverage of 0.52 to 6.28 rad 30 to 360 degrees. Pop-up height of [75] [100] [150] [300] mm [3] [4] [6] [12] inches as measured from top of cap at normal installation to middle of nozzle orifice. Provide wiper seal that positively seals against nozzle flange to keep debris out of rotor and cleans debris from pop-up steam as it retracts.[Provide check valve in head.]

2.2.2.3 Impact Irrigation Head

Capable of covering [_____] mm feet radius at [_____] kPa psi with a distribution rate of [_____] L/s gpm. Provide one or two nozzles to distribute water, an inlet strainer to prevent debris from clogging nozzles, and non-corrosive [brass] [plastic] head and stainless steel assemblies. Seal bearing assembly from abrasives. Provide entire assembly including strainer removable from top of case without disturbing case installation. Provide plastic housing. Pop-up height of [75] [100] [150] [300] mm [3] [4] [6] [12] inches as measured from top of cap at normal installation to middle of nozzle orifice.

2.2.2.4 Spray Irrigation Head, Full or Part Circle

Capable of covering [_____] mm feet radius at [_____] kPa psi with a discharge rate of [_____] L/s gpm. Sprinkler body, nozzle, and screen constructed of heavy-duty, ultra-violet resistant plastic with wiper seal. [Brass] [Plastic] nozzle with matched precipitation rate and an

adjustable screw capable of regulating the radius and flow. Capable of housing under the nozzle; protective, non-clogging filter screen and/or pressure compensating devices. Screen used in conjunction with the adjusting screw from regulating. Pop-up height of [75] [100] [150] [300] mm [3] [4] [6] [12] inches as measured from the top of cap at normal installation to middle of nozzle orifice.[Provide check valve below each sprinkler body on riser.]

2.2.3 Bubbler Irrigation Head

2.2.3.1 Adjustable Flood Bubbler

Capable of providing a discharge rate of [_____] L/s at kPa [_____] gpm psi. operating over a pressure range of 69 to 414 kPa 10 to 60 psi. Construct of durable ultra-violet resistant plastic with a plastic inlet filter screen to protect the nozzle against clogging, and a stainless steel adjusting screw, capable of shutting off the bubbler and regulating the flow. Pop-up height of [75] [100] [150] [300] mm [3] [4] [6] [12] inches as measured from top of cap at normal installation to middle of nozzle orifice.

2.2.3.2 Pressure Compensating Flood Bubbler

Capable of providing a consistent discharge rate of [_____] L/s at kPa [_____] gpm at psi. Plastic inlet filter screen bubbler assembly to protect the nozzle against clogging. Permanently assembled design constructed of durable, ultra-violet resistant plastic with an integral rubber flow washer for regulating the discharge rate at an operating pressure range of 138 to 621 kPa 20 to 90 psi. Pop-up height of [75] [100] [150] [300] mm [3] [4] [6] [12] inches as measured from top of cap at normal installation to middle of nozzle orifice.

2.2.4 Fixed Drip Head

****

NOTE: Drip head is an outlet device that permits water to drip or trickle from small tubings. Drip irrigation is frequent, slow application of water to specific root zone area of plants. The goal is to provide a constant level of subsurface moisture to the root ball for most favorable growth.

****

2.2.4.1 Multi-Port Outlet Device

****

NOTE: Choose one of the following options

****

[Multi-outlet, pressure compensating emitter manifold that is ultra-violet resistant, algae, and heat resistant, non-corrosive PVC material for above or below grade installation. Integral 75 micrometers 200 mesh fabric screen that can be serviced from the top of the unit by unscrewing the top cap. [Six] [eight] [twelve] [_____], [top] [bottom] mounted outlet ports that will accept [3] [6] mm [1/8] [1/4] inch vinyl tubing. The [six] [eight] [twelve] [_____] ports can be accessed through the top of the unit by unscrewing the lid from the base. Each outlet port accepts a pressure compensating emitter controlling the flow from 1.89 to 90.84 0.5 to 24.0 gph per outlet. Operating range of unit is 103 to 345 kPa with 13 mm 15

to 50 psi with 1/2 inch female national pipe thread (FNPT) inlet.

][Multi-outlet, pressure-compensating emitter constructed of a ultra-violet resistant algae and heat resistant, non-corrosive PVC material. Diaphragm/flap constructed of a silicone elastomer material. Pressure-compensated emitter with each outlet delivers a nominal flow of [1.89] [3.79] [7.57] L/h [0.5] [1.0] [2.0] gph at 103 to 345 kPa 15 to 50 psi. [Three] [four] [six] [_____] barbed outlet unit that will accept [3] [6] mm [1/8] [3/4] inch vinyl tubing with continuous "self flushing" emitter feature.

]2.2.4.2 Single Outlet Pressure Compensating Emission Device

[Pressure compensated] emitter body constructed of ultra-violet, algae, heat resistant and chemical resistant, non-corrosive PVC material. Diaphragm constructed of a silicone elastomer material. Capable of delivering a nominal flow rate of [1.89] [3.79] [7.57] [_____] L/h [0.5] [1.0] [2.0] [_____] gph at a pressure range of 103 to 345 kPa 15 to 50 psi. [A self piercing inlet barb type 13 mm 1/2 inch female national pipe thread (FNPT) inlet mounted onto a 13 mm 1/2 inch male national pipe thread (MNPT) riser.] Barbed emitter outlet configuration that will accept [3] [6] mm [1/8] [1/4] inch vinyl tubing.

2.2.4.3 Microspray Device

Capable of covering [0 to 4500] [_____] mm [0 to 15] [_____] feet radius at [_____] kPa psi with a discharge rate of [_____] L/h gph with overall pop-up height of [100] [150] [300] [_____] mm [4] [6] [12] [_____] inches. Sprinkler body, nozzle, and screen constructed of heavy-duty, ultra-violet resistant plastic with wiper seal on sprinkler. Matched precipitation rate [brass] [plastic] nozzle with an adjustable screw capable of regulating the radius and flow and capable of housing under the nozzle; protective, non-clogging filter screens and/or pressure compensating devices. Screen used in conjunction with the adjusting screw for regulating. Mount with 13 mm 1/2 inch female national pipe thread (FNPT) adapter [poly flex riser stake].

2.2.4.4 In-Line Tubing Device

Factory installed, heavy-walled flexible polyethylene (PE) tubing, pressure compensating, self-cleaning emitters at spacings of [300] [450] [600] [_____] mm [12] [18] [24] [36] [_____] inches. Emitter flow of [1.89] [3.79] [7.57] [_____] L/h [0.5] [1.0] [2.0] [_____] gph with inlet pressure of [_____] kPa psi. Tubing diameter of [13] [19] mm [1/2] [3/4] inch.

2.2.5 Pop-Up Drip Head

****

NOTE: Drip head is an outlet device that permits water to drip or trickle from small tubings. Drip irrigation is frequent, slow application of water to specific root zone area of plants. The goal is to provide a constant level of subsurface moisture to the root ball of plant for most favorable growth.

****

Capable of covering 0 to 4500 mm 0 to 15 feet radius at [_____] kPa psi with a discharge rate of [_____] L/h gph with overall pop-up height of

[100] [150] [300] mm [4] [6] [12] inches. Sprinkler body, steam, nozzle, and screen constructed of heavy-duty, ultra-violet resistant plastic with wiper seal on sprinkler. Provide a heavy-duty, stainless steel retract spring for positive pop-down and a ratcheting system for easy alignment of the pattern. Matched precipitation rate [brass] [plastic] nozzle with an adjusting screw capable of regulating the radius and flow and capable housing under the nozzle; protective, non-clogging filter screens and/or pressure compensating devices. Screen used in conjunction with the adjusting screw for regulating. A side and bottom 12.70 mm 1/2 inch female national pipe thread (FNPT) inlet for the [150] [300] mm [6] [12] inch model. Mount with 12.70 mm 1/2 inch female national pipe thread (FNPT) adapter [poly flex riser stake].

2.3 VALVES

[Provide lavender-colored assembly for non-potable use.

]2.3.1 Isolation Valve

2.3.1.1 Ball Valves, Less than 75 mm 3 inches

API Std 598, [brass] [plastic] body, [threaded] [soldered] ends.

2.3.1.2 Gate Valves, 75 mm 3 inches and Larger

AWWA C500, bottom wedging double discs, parallel seats, non-rising stems, open by counterclockwise turning. Provide flanged end connections. Provide bronze interior construction of valves including stem containing a maximum 2 percent aluminum and maximum 16 percent zinc.

2.3.2 Control Valves

2.3.2.1 Pressure Regulating Master Control Valve

****
NOTE: Master valve automatically reduces a higher inlet pressure to a constant lower pressure regardless of supply fluctuations
****

Automatic mechanical self-cleaning, self-purging control system having an adjustable pressure setting operated by a solenoid on alternating current (ac) with [0.70] [_____] amperes at [18] [24] volts. [Direct current (dc) latching with [_____] amperes at [_____] volts.] Valve shall close slowly and be free of chatter in each diaphragm position. Provide a manual flow stem to adjust closing speed and internal flushing. Provide an adjusting screw for setting pressure and schrader valve for monitoring pressure. Provide [one] [two] inlet tappings capable of being installed as a straight pattern valve. Provide heavy duty [cast iron] [brass] [plastic] valve body with brass seat that is removable and serviceable from top without removing valve body from system. Maximum working pressure of valve is 1034 kPa 150 psi and pilot range from 69 to 862 kPa 10 to 125 psi.

2.3.2.2 Remote Control Valve, Electrical

****
NOTE: An activated open and shut-off device for controlling water flow to sprinkler branch line.
****

Solenoid actuated [globe] [angle] valves of 20 to 75 mm 3/4 to 3 inch size, [alternating current (ac), 60/50 cycle [_____] amps in rush current and [_____] amps holding current.] [Direct current (dc) latching with [_____] amperes at [_____] volts.] Provide [brass] [plastic] valve housing suitable for service at 1034 kPa 150 psi operating pressure.[Provide pressure regulating module capable of regulating outlet pressure between 103 to 172 kPa 15 to 25 psi (plus or minus) 34 kPa 5 psi and adjustable screw for setting pressure schrader valve connection for monitoring pressure.]

2.3.2.3 Manual Angle Control Valve, Manual Globe Control Valve

Less than 65 mm 2 1/2 inch MSS SP-80, type 3, Class 150 [threaded] [soldered] ends. [Angle] [globe] valve 65 mm 2 1/2 inch and larger MSS SP-85, Type II, Class 250 [threaded] [flanged] ends.

2.3.3 Quick Coupling Valves

****
NOTE: A device that permits quick coupling and uncoupling of valves. It is an effective method of keeping sprinkler out of the way when not in use, eliminating the possibility of damage, injury or theft.
****

Two piece unit consisting of a coupler water seal valve assembly and a removable upper body to allow spring and key track to be serviced without shutout of main. Provide brass parts. Provide [yellow] [lavender] [vinyl] [rubber] lockable lids with springs for positive closure on key removal.

2.3.4 Hose Bib

One piece consisting of all brass construction with full flow [13] [19] [25.40] mm [1/2] [3/4] [one] inch hose connection outlet and [with attached handle] [removable key handle] with gaskets and washers.

2.3.5 Drain Valves

[2.3.5.1 Manual

MSS SP-80, Type 3, Class 150 [threaded] [soldered] ends for sizes less than 65 mm 2 1/2 inches. MSS SP-85, Type II, Class 250 [threaded] [flanged] ends for sizes 65 mm 2 1/2 inches and larger.

][2.3.5.2 Automatic

****
NOTE: Delete automatic drains for warm climate areas. This saves water to prevent draining 50 to 100 mm 2 to 4 inch diameter lines during irrigation cycles and avoid continuously saturated soil at drain joints. Automatic drains are necessary for cold climate areas to prevent freeze damage to sprinklers and pipes.
****

Brass, spring loaded ball drip type, 1034 kPa 150 pounds and threaded ends, designed to close at 1.83 m 6 foot pressure head with positive seal at 21 kPa 3 psi pressure or greater and be open to drain at less than 21 kPa 3 psi pressure.

]2.3.6 Backflow Preventers

****
NOTE: The purpose of a backflow preventer is to keep contaminated water from flowing back into a potable water distribution system when some abnormality in system causes pressure to be temporarily higher in contaminated part of system than in potable water piping.
****

[2.3.6.1 Reduced Pressure Type Backflow Preventers

****
NOTE: The purpose of reduced pressure type backflow preventer is to prevent either back siphonage or back pressure from causing a reverse flow and subsequent contamination of potable water supply.
****

****
NOTE: Delete this requirement when system is connected to non-potable water supply system, or when sewage is injected into sprinkler system. When effluent pumps are down, add a fresh water connection with a reduced pressure backflow preventer.
****

AWWA C511. Provide backflow preventers complete with 1034 kPa 150 psi rated flanged [cast iron], [bronze] [brass] mounted [gate] [ball] valve [and strainer], [304] [_____] stainless steel or bronze, internal parts. Total pressure drop through complete assembly shall be a maximum of 69 kPa 10 psi at rated flow. Listing of particular make, model/design, and size in FCCCHR List will be acceptable as required proof for testing and certification.

a. Piping Assembly: [Red brass pipe and fittings] [Galvanized steel pipe and fittings].

b. Strainers: Bronze or brass construction with gasket caps. Equip units with 75 micrometers No. 200 mesh stainless steel screen elements.

][2.3.6.2 Pressure Type Vacuum Breaker

****
NOTE: Vacuum breakers are designed to prevent back siphonage only, and are not effective against backflow due to back pressure. A vacuum breaker is adequate when it is located aboveground higher than highest irrigation head and its elevation is above areas which may be flooded.
****

ASSE 1020 [bronze] [brass] construction, with one or two check valves, vacuum relief, inlet and discharge shut-offs valves, and field test cocks, and with vacuum relief opening of greater diameter than unit.

][2.3.6.3 Atmospheric Vacuum Breaker

****

NOTE: Atmospheric Vacuum breakers are designed to prevent back siphonage only, and are not effective against backflow due to back pressure. A atmospheric vacuum breaker is adequate when it is located aboveground higher than highest irrigation head and its elevation is above areas which may be flooded. Locate atmospheric vacuum breaker downstream of the control valve.

****

AWWA M14, vacuum relief, inlet and discharge openings, and with vacuum relief opening of greater diameter than unit.

]2.4 ACCESSORIES AND APPURTENANCES

2.4.1 Tapping Tee

Bronze flat, double strap, with neoprene gasket or "O"-ring seal.

2.4.2 Water Meter

****

NOTE: ASHRAE 189.1 – 2014 requires a water meter with remote communication capabilities. Select the first bracketed option if total irrigated landscape area with controllers exceeds 2322.5 square meters 25,000 square feet.

****

[Provide a submeter in accordance with ASHRAE 189.1.]Meter to include roll sealed register, magnetic drive, straight reading (odometer shall indicate in liters gallons, large numerals, glass lens for legibility,) low flow indicator to detect leaks, tamper proof seal pin to detect theft; sturdy durable, corrosion resistant main case, electrical grounding continuity; nutating disc measuring chamber with minimum head loss.

2.4.3 Drip Head Accessories

2.4.3.1 Strainer

Provide strainer at inlet to each drip control valve assembly. Provide polyester fabric screen attached to a PVC frame having the equivalent of [56] [75] [_____] micrometers [150] [200] [_____] mesh filtration capacity. Compact "Y" body and cap configuration. Incorporate flush valves within strainer to clean screen without disassembling unit.

2.4.3.2 Riser Adapters

PVC material, [threaded] [barbed] [soldered] to attached drip heads to tubing, pop-up irrigation body, or rigid piping and tubing to rigid piping.

2.4.3.3 Tubing Stakes

Plastic, plastic coated steel, or other non-corrosive strong material to secure tubing.

2.4.3.4 Bug Cap

Provide check valves at end of each emitter outlet distribution line. Valves shall permit free flow of water with minimum restriction; prevent back siphoning, entry of insects, and contamination into outlet ports.

2.4.3.5 Subterranean Drip Box and Cover

Construct of ultra-violet resistant PVC. Two slots in bottom of box to allow for installation of distribution tubing onto the emission device.

2.4.3.6 Line Flushing Valve

Construct of PVC with maximum flow rate of 0.95 L/s 15 gpm with minimum flushing water volume of 3.79 liters one gallon at a minimum 28 kPa 4 psi to a maximum 172 kPa 25 psi at a point of discharge.

2.4.3.7 Valve Boxes

[Cast-iron] [precast concrete [manufactured in accordance with Section 03 42 13.00 10 PLANT-PRECAST CONCRETE PRODUCTS FOR BELOW GRADE CONSTRUCTION]] [plastic] valve box for each isolation valve, control valve, [quick coupling valve] [and] [drain valve]. Provide box sizes that are suitable and adjustable for valve used.

a. Cast the word "IRRIGATION" on cover.

b. Stencil, engrave, or brand controller and valve sequence on remote control valve cover. Letters minimum 10 mm 4 inches height.

2.4.4 Backflow Preventer Accessories

2.4.4.1 Pressure Gages

ASME B40.100, single style pressure gage for water with 113 mm 4 1/2 inch dial, brass or aluminum case, bronze tube, gage cock, pressure snubber, and siphon. Provide scale range suitable for irrigation systems.

2.4.4.2 Water Hammer Arresters

ASSE 1010; stainless steel construction with an encased and sealed bellows compression chamber.

2.4.4.3 Backflow Preventer Enclosure

Frame to be constructed of 4.76 mm 3/16 inch [stainless steel] [steel] angle iron with 38.10 mm 1 1/2 inch No. 9 expanded metal covering. Construct in a [one piece single swing] [two piece double] hinge configuration. Provisions for pad locking and lighting handles. Size to fit backflow assembly to installed. [Color to be [green] [_____].] Lock for enclosure provided by others.

2.4.4.4 Concrete Pads

Cast-in-place reinforced concrete construction for reduced pressure type backflow preventers.

2.4.5 Moisture Sensing Device

2.4.5.1 Automatic Rain Shut-Off Device

One piece, maintenance and adjustment free, reacts to a minimum 3.18 mm 1/8 inch of rain water, unaffected by humidity levels, commercial grade materials, no exposed mechanical switch or electrodes, solid state construction with internal relay operating voltage of 24 to 30 VAC, static charge pretested, maximum switch current of one amp.

2.4.5.2 Automatic Freeze Shut-Off Device

Construct of a PVC cylinder with a sensing element mounted at top of cylinder capable of interrupting the control valve common wire as temperatures approach 0 degrees C 32 degrees F. Operating voltage 24 VAC, maximum current one amp. Static charge protection with snubber network.

2.4.5.3 Soil Moisture Sensor Device

24 VAC, field adjustable and capable of interrupting irrigation cycles for pre-determined moisture level at moisture probe location. Waterproof field adjustment module with bypass switch.

2.4.6 Air/Vacuum Relief

Construct of PVC with a maximum operating pressure of 965 kPa 140 psi.

[2.4.7 Water Booster Package

Booster pump package to be a prefabricated system, pre-piped, pre-wired and mounted on a steel skid base minimum 75 mm 3 inch welded angle iron or channel brackets, hot dipped galvanized, with a minimum 14 mm 9/16 inch holes at each corner for bolting to concrete with anchors. Field assembled pump systems are not acceptable.

2.4.7.1 Pump

Pump to be end suction close coupled or in-line type, bronze impeller and wear rings, bronze shaft sleeve, mechanical seal with high-resist seat, integral flanged suction and discharge connections, keyed motor shaft, back pull-out type, with centerline discharge for automatic venting and Type 304 stainless steel internal parts and fittings.

2.4.7.2 Motor

Motor to be [_____] rpm, [_____] hp, [_____] phase, ball bearing design, stainless steel shaft, non-over loading on full range of the impeller curve without use of the service factor and including rodent and insect screens over the openings. Single phase motors to be totally enclosed fan cooled and open drip-proof with a minimum 1.15 service factor. Three phase motors to be totally enclosed fan cooled, open drip-proof with a minimum 1.15 service factor.

2.4.7.3 Piping and Fittings

Piping and fittings to be flanged spools of Schedule 40 steel and Class 150 weld flanges, hot dipped galvanized after fabrication. Spacer spools to be welded and galvanized. Companion flanges at suction and discharge header connections to be Schedule 40 steel and galvanized.

2.4.7.4 Gages

Gages shall be 65 mm 2 1/2 inch diameter, liquid filled for vibration dampering, 0-200 pounds, stainless steel casing, with brass needle valve shut-off cocks.

2.4.7.5 Butterfly Valve

Butterfly valves and adjustable handles to be sandblasted and epoxy coated, nuts and bolts to be cad plated, shut off valves to be centerline butterfly lug type, wafer style, drilled and tapped, with bronze disc, capable of remaining installed in the piping.

2.4.7.6 Check Valves

A combination pressure reducing and non-slam check valve to be installed with booster pump package to reduce effect of varying suction pressure.

[2.4.7.7 Pump Control Panels

Pump control panels to be 14 gage type UF, type 304 stainless steel with continuous welded seams, door with continuous hinge, all welds passivated to eliminate corrosion, UL listed, NEMA 3R enclosure with holes in bottom to allow for all inlet wiring for main power control accessories and louvers with insect screens on opposite sides for cross ventilation, deadfront, keylockable and padlockable, with main disconnect switch, circuit breaker with adjustable overloads on all legs and adjustable inrush current trip setting on units exceeding 41 amps, heavy duty contactor, 115 volt control circuit transformer with circuit breaker disconnect. A plug-in module type pump start relay shall be mounted and hard wired in the pump panel. A electronic flow switch with 0-60 seconds adjustable time delay relay, mounted and hard wired in the pump panel, to operate as a no-flow safety shut down. NEMA 3R non-fused main disconnect switch, mounted on exterior of pump panel, hard wired to panel circuit breaker.

]][2.4.8 Flow Meter

[25.40] [31] [38] [50] [75] mm[one] [1.25] [1.5] [2] [3] inch flow meter with a minimum [_____] L/s gpm, female national pipe threaded ends and replaceable metering insert. 9 volt direct current output with a pulse rate which is proportional to the L/s gpm, a 0.067 amperes fuse link to protect metering insert and 14 gage output feeder wire to be powered by the controller. Provide [brass] [plastic] meter housing suitable for service at 1034 kPa 150 psi operating pressure.

]2.5 AUTOMATIC CONTROLLER [ELECTRICAL] [SOLAR] [BATTERY]

****

NOTE: ASHRAE 189.1 requires that PERMANENT irrigation systems be controlled by smart controllers that use evapotranspiration (ET) and

weather data to adjust irrigation schedules or utilize an on-site rain or moisture sensor that automatically shuts off the system after a predetermined amount of rainfall or moisture is sensed in the soil utlimately meeting the 80 percentminimum ETc for Irrigation Adequacy and not to exceed 10 percent for Irrigation Excess.

EXCEPTION: A temporary irrigation system used exclusively for the establishment of new landscape shall be exempt from this requirement. Temporary irrigation systems shall be removed or permanently disabled at such time that the plant materials are established.

****

Controller must be[as indicated on the Drawings]commercially/industrially rated, [hybid type] [solid state type], for [indoor location] [outdoor location] with [120-volt single phase service with surge protection] [24 VAC solar] [24 VDC solar] [24 VDC battery], operating with indicated stations, and grounded chassis. Provide in an enclosure with locking hinge cover.

2.5.1 Controller Features

a. [_____]-station controller with [_____] independent programs that can run concurrently.

b. Allows an [infinite] [4 to 8] [____] number of cycles per day by placing the program in a looping mode.

c. Ability to be programmed in one second increments, from [one second to 12 hours] [____].

d. A water budgeting capability in all stations within a program in one percent increments from [one percent to 255 percent] [____].

e. A programmable watering calendar ranging from [one to 16] [365 day calendar][[_____] to [_____] days].

f. A single-station timed manual feature that allows a station to be turned on manually for its programmed watering time.

g. A semi-automatic manual cycle feature.

h. A true manual operation with safety shut-off at midnight and indicate which station is on by means of L.E.D.S.i. UL listed, having a re-settable circuit breaker, cadmium plated, weatherproof steel case, and keyed lock.

[j. A qualifying smart controller utilizing [Evapotranspiration (ET) [with no service fees] and weather data to adjust watering schedules] [moisture sensors in the soil].

][k. Provide control for master valve or irrigation pump start up

][l. Have central computer control capability with [the existing central control system on the Base] [the Region's central control system] [_____].

]2.5.2 Controller Enclosure

Controller Enclosure must be [NEMA ICS 2] [NEMA ICS 6 Type 3R] [_____] mounted [as indicated on the Drawings] [on a concrete pad] [_____]. Enclosure must be [indoor wall mounted plastic cabinet] [outdoor pedestal mounted [plastic] [powder-coated metal, color to be [beige] [___]] [stainless steel][____]].

2.6 ELECTRICAL CIRCUITS

2.6.1 Control Wiring for Electrically Operated Valves

NFPA 70, copper conductor [1.8] [_____] mm [14] [_____] gage wire, Type UF.

2.6.2 Conduit

UL 651, rigid polyvinyl chloride conduit, Schedule 40.

2.7 CONCRETE MATERIALS

[20] [_____] MPa[2500] [_____] psi compressive concrete strength at 28 days as specified under Section 03 30 00 CAST-IN-PLACE CONCRETE.

PART 3 EXECUTION

3.1 INSTALLATION

Install sprinkler system after site grading has been completed.

3.1.1 Trenching

Hand trench around roots to pipe grade when roots of 50 mm 2 inches diameter or greater are encountered. Make width of trench 100 mm 4 inches minimum or 1 1/2 times diameter of pipe, whichever is wider. Backfill and hand tamp over excavation. When rock is encountered, excavate 100 mm 4 inches deeper and backfill with silty sand (SM) or well-graded sand (SW) to pipe grade. Keep trenches free of obstructions and debris that would damage pipe. Do not mix subsoil with topsoil. Bore under existing concrete walks, drives and other obstacles at a depth conforming to bottom of adjacent trenches. Install pipe sleeve, two pipe diameters larger than sprinkler pipe, to fill bore.[Rock will be encountered. Excavate 100 mm 4 inches deeper and backfill with silty sand (SM) or well graded sand (SW) to pipe grade.] Prior to backfilling of trench, Contracting Officer shall verify and approve location of all irrigation heads.

3.1.2 Piping System

3.1.2.1 Clearances

a. Minimum horizontal clearances between lines: 100 mm for 50 mm 4 inches for 2 inch pipe and less; 300 mm for 50 mm 12 inches for 2 inch pipe and more.

b. Minimum vertical clearances between lines: 25 mm one inch.

3.1.2.2 Minimum Pitch

Down 150 mm per 30 m 6 inches per 100 feet in direction of drain valves.

[3.1.2.3 Thrust Blocks

Install thrust blocks at bends, tees, plugs and valves or [63] [_____] mm [2 1/2] [_____] inches and larger mainline piping. Place concrete so that sides subject to thrust or load are against undisturbed earth, and valves and fittings are serviceable after concrete has set.

]3.1.2.4 Minimum Backfill Cover

a. [450] [_____] mm [18] [_____] inches for pressure mainline pipe and valve control wire.

b. [300] [_____] mm [12] [_____] inches for non-pressure lateral pipe.

c. [600] [_____] mm [24] [_____] inches for all piping under paved or non-paved pedestrian paths.

d. [900] [_____] mm [36] [_____] inches for all piping under traffic loads, [farm operations], [freezing temperatures].

e. Install pipe sleeves at depths indicated in "c" and "d".

[Rock will be encountered. Provide minimum 100 mm 4 inches of silty sand (SM) or well graded sand (SW) cover on top of all piping.] Fill remainder of trench or pipe cover to within 75 mm 3 inches of top with excavated soil, and compact soil with plate hand-held compactors to same density as undisturbed adjacent soil.

3.1.2.5 Restoration

****
NOTE: Fill the section number and title for the restoration of pavements in the blank below using proper format per UFC 1-300-02, "Unified Facilities Guide Specifications (UFGS) Format Standard".
****

Fill top 75 mm 3 inches with topsoil and compact with same density as surrounding soil. Restore [turf] and [plants] according to [Section 32 92 19 SEEDING,][Section 32 92 23 SODDING,][Section 32 92 26 SPRIGGING,] [and] [Section 32 93 00 EXTERIOR PLANTS]. [Restore pavements according to [_____]].

3.1.2.6 Sterilization

Sprinkler system fed from a potable water system sterilized upstream of backflow preventer in accordance with AWWA C651. Sterilize new water lines for a minimum of 24 hours to meet [local] [state] [federal] health test requirements before placing in service. Minimum retention period shall be 3 hours.

3.1.3 Piping Installation

3.1.3.1 Polyvinyl Chloride (PVC) Pipe

a. Solvent-Cemented Joints: ASTM D2855.

b. Threaded Joints: full cut with a maximum of three threads remain

exposed on pipe and nipples. Make threaded joints tight without recourse to wicks or fillers, other than polytetrafluoroethylene thread tape.

c. Piping: ASTM D2774 or ASTM D2855, and pipe manufacturer's instructions. Install pipe in a serpentine (snaked) manner to allow for expansion and contraction in trench before backfilling. Install pipes at temperatures over 4.5 degrees C 40 degrees F.

3.1.3.2 Soldered Copper Tubing

Ream pipe and remove burrs. Clean and polish contact surfaces of joint. Flux both male and female ends. Insert end of tube into fittings full depth of socket. After soldering, a solder bead shall show continuously around entire joint circumference. Remove excess acid flux from tubings and fittings.

3.1.3.3 Threaded Brass or Galvanized Steel Pipe

Prior to installation ream pipe. Cut threads as specified in ASME B1.2. Make joints with pipe joint compound applied to male end only.

3.1.3.4 Polyethylene (PE) Pipe and Drip Tubing

Bury [drip tubing] [and] [PE pipe] 300 mm 12 inches deep. [Solvent weld] [compression connection] [barbed connection] in accordance with manufacturers recommendation. Install hose in serpentine manner. When cutting hose, use a shearing tool such as a pipe cutter, knife or shears. Use only manufacturer's recommended tool and procedure when installing drip heads.

3.1.3.5 Dielectric Protection

Where pipes of dissimilar metal are joined, make connection with dielectric fitting.

3.1.4 Irrigation Heads

Install plumb and level with terrain. Irrigation heads must not spray directly on or within 1 meter 3-feet of building.

3.1.4.1 Fixed Riser Irrigation Heads

****
NOTE: Fixed risers allowed in planter beds only.
****

Nozzle mounted on fixed riser minimum 150 mm 6 inches above grade in mulched planter beds, 300 mm 12 inches above grade in planter beds with groundcover. Provide swing joint assembly attachment between lateral lines and fixed risers.

3.1.4.2 Pop-Up Irrigation Head

****
NOTE: Pop-ups required along all pedestrian and vehicular and turf edges. Pop-ups required in all turf areas.
****

Install plumb and level with terrain. Provide swing joint assembly attachment between lateral line and pop-up body. Top of irrigation head shall be flush wit surrounding finish grade.[In recreational fields, install all pop-up rotors with stainless steel risers 125 mm 5 inches below finish grade per manufacturer's recommendations.]

3.1.4.3 Drip Heads

****

NOTE: Actual water emission points of drip irrigation system installed above soil surface accomplishes two objectives. It aids visual checking of system for proper operation and it reduces system clogging that can be caused by root intrusion.

****

Install drip heads [in plastic drip box]. Connect drip head to a [rigid PVC nipple] [drip head stake] [directly to tubing]. Attach tubing to barbed fitting and daylight distribution tubing at rootball secured with stake. Add bug cap at end of secured distribution tubing. After installing drip heads and before operating system, open end of drop lateral and flush lines clean. The number of drip heads on a line shall not exceed manufacturer's recommendations for that hose or distribution tubing size and length.

3.1.5 Valves

3.1.5.1 Isolation Valves

Install in a valve box extending from grade to below valve body, with a minimum of 100 mm 4 inches cover measured from finish grade to top of valve stem.

3.1.5.2 Control Valves

Plumb valve in a valve box extending from grade to below valve body, with minimum of 100 mm 4 inch cover measured from grade to top of valve. Install automatic valves beside sprinkler heads with a valve box.

3.1.5.3 Quick Coupling Valves

[Install in a valve box extending from grade to below valve body, with a minimum of 100 mm 4 inches cover measured from finish grade to top of valve stem.][Install 50 mm 2 inches above finish grade in planter bed, level with finish grade in turf areas.]

3.1.5.4 Hose Bibb

Install [above grade] [below grade in valve box] with support.

3.1.5.5 Drain Valves

Entire system shall be manually or automatically drainable. Equip low point of each underground line with drain valve draining into an excavation containing gravel. Cover gravel with building paper. Backfill with excavated material and 150 mm 6 inches of topsoil.

3.1.6 Backflow Preventers

a. Install backflow preventer in new connection to existing water distribution system, between connection and control valves. Install with concrete pads. [Install with concrete pads in turf only.]

b. Flush pipe lines prior to installing device.

c. Device shall not be installed in pits or where any part of the device could become submerged in standing water

d. Install device a minimum of 300 mm 12 inches from trees, walls, fences, structures and other obstructions.

3.1.6.1 Reduced Pressure Backflow Preventer

a. Protect device by a strainer located upstream.

b. Install device a minimum of 300 mm 12 inches between finish grade and bottom of relief port.

[c. Where freezing conditions occur, locate device inside a building and pipe the relief valve port through an air gap to a drain.

][d. Install water meter above grade, upstream of unit of unit as a part of assembly. Provide galvanized steel support with concrete footing.

]3.1.6.2 Pressure Vacuum Breaker

****

NOTE: Install device in an accessible location to facilitate inspection and servicing. The device can be installed on a main line to irrigation system upstream of shut-off valves (valves may be located downstream from device).

****

a. Install device a minimum of 300 mm 12 inches between highest irrigation head and bottom of air relief valve.

[b. Where freezing conditions occur, locate device inside a building and pipe the relief valve port through an air gap to a drain.

]3.1.6.3 Atmospheric Vacuum Breaker

Install device minimum of 300 mm 12 inches between highest irrigation head and bottom of relief valve located downstream of irrigation control valve.

3.1.7 Accessories

3.1.7.1 Connection To Existing Water Supply Systems (Tapping Tee)

Use tapping or drilling machine valve and mechanical joint type sleeves for connections to be made under pressure. Bolt sleeves around mains; bolt valve conforming to AWWA C500 to the branch. Open valve, attach drilling machine, make tap, close valve, and remove drilling machine, without interruption of service. Notify Contracting Officer in writing at least 15 days prior to the date the connections are required; receive approval before any service is interrupted. Provide materials required to

make connections into the existing water supply systems and perform excavating, backfilling, and other incidental labor as required. Furnish the labor and the tapping or drilling machine for making the actual connections to the existing systems.

3.1.7.2 Water Meter

Install meter upstream of backflow preventer per manufacturer's recommendations and local PWC Utility Department Instructions.[Plumb meter in a valve box extending from grade to below meter body, with a minimum of 100 mm 4 inch cover measured from top of grade to top of meter.]

3.1.7.3 Valve Boxes and Lids

a. Install with [0.0283] [_____] cubic meters [one] [_____] cu ft pea gravel sump below valve.

b. Support valve box with [brick] [concrete block] [_____].

[c. Provide wire screen between gravel sump and bottom of valve body for rodent protection.

] d. For turf areas, install flush with finish grade.

e. For planter beds, install 50 mm 2 inches above finish grade.

f. For sloped conditions, install valve box level with terrain.

3.1.7.4 Backflow Preventer Enclosure

a. Install with concrete pad.

b. Place hinges so direction of swing will not conflict with other site features.

3.1.7.5 Rain [and] [Freeze] Shut-Off Device[s]

a. Install as per manufacturer's recommendations.

b. For wall mounted controllers, attach device[s] to side of building or eave, minimum 2400 mm 8 feet above finish grade and a minimum of 300 mm 12 inches from building wall or eave.

c. For pedestal mounted controllers, mount [to side of controller housing] [on top of minimum [1050] [_____] mm [42] [_____] inches high pole outside of irrigation coverage in vandal-resistant enclosure].

3.1.7.6 Soil Moisture Sensing Device

a. Bury the device at depth per manufacturer's recommendation in the effective root zone of hydrozone to be monitored.

b. Place a sensor-protection [plate] [indicator] [valve box with cover] above the device.

c. Provide waterproof connection to all field splices in valve boxes.

3.1.7.7 Air/Vacuum Relief Valve

****
NOTE: Provide air relief/vacuum valve at highest point of all pressurized mainline systems. For drip systems, locate at highest point on drip lateral.
****

Locate at highest point in piping system.

3.1.8 Electrical Circuits

Bury wires beside mainline pipe in same trench. Provide gray electrical conduit where wires run under paved or non-paved pedestrian paths and vehicular roads. Tag wires at controller and control valve location with plastic tie wrapped tags. Provide one control wire to each control valve location and one common wire looped from controller to each control valve. Provide one separate control valve wire of a different color from controller to each control valve cluster.

3.1.8.1 Loops

Provide a 300 mm 12 inch loop of wire at each valve where controls are connected.

3.1.8.2 Expansion and Contraction

Bundle multiple tubes or wires and tape together at [3] [6] m [10] [20] foot intervals with 300 mm 12 inch loop for expansion and contraction.

3.1.8.3 Splices

Make electrical splices waterproof. Locate all field electrical splices in valve boxes.

3.1.9 Automatic Controller

Determine exact location of controllers in field before installation. Coordinate the electrical service to these locations. Install in accordance with manufacturer's recommendations and NFPA 70.

3.1.10 Flushing

After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads and valves, flush piping system under a full head of water. Maintain flushing for 3 minutes.

3.1.11 Adjustment

After grading, plant installation, and rolling of planted areas, adjust sprinkler heads flush with finished grade. Make adjustments by providing new nipples of proper length or by use of heads having an approved device, integral with head, which will permit adjustment in height of head without changing piping.

3.1.12 Sterilization

Sprinkler system fed from a potable water system shall be sterilized upstream of backflow preventer in accordance with AWWA C651. Sterilize new

waterlines for a minimum of 24-hours, to meet [local], [state], [federal], health test requirements before placing in service. Minimum retention period shall be 3 hours.

3.2 FIELD QUALITY CONTROL

The Contractor will conduct and the Contracting Officer and the QC representative will witness field inspections and field tests specified in this section. Perform field tests, and provide labor, equipment, and incidentals required for testing.

3.2.1 Pressure Test

3.2.1.1 Duration

During pressure test, maintain a hydrostatic pressure of 1034 kPa 150 psi without pumping for a period of one hour with an allowable pressure drop of 35 kPa 5 psi before backfilling system.

3.2.1.2 Leaks

Correct leaks. Make necessary corrections to stop leakage.

3.2.1.3 Retest

Retest system twice until pressure can be maintained for duration of test.

3.2.2 Operation Test

3.2.2.1 Accessories

At conclusion of pressure test, install irrigation heads or drip heads, quick coupling assemblies, and hose bib, and test entire system for operation under normal operating pressure. Make necessary corrections or adjustments to raise or lower pressure for each system if tests results do not match pressure requirements.

3.2.2.2 Acceptance

Operation test is acceptable if system operates through at least one complete cycle for areas to be irrigated.

3.2.3 Controller Charts

Provide one chart for each controller supplied. Indicate in chart area controlled by automatic controller. The chart is a reduction of the actual plan[s] that will fit the maximum dimensions inside controller housing. Use black line print for chart and a different pastel or transparent color to indicate each station area of coverage. After chart is completed and approved for final acceptance, seal chart between two 0.5 mm 20 mil pieces of clear plastic.

-- End of Section --