

POTABLE WATER DISTRIBUTION SYSTEMS

SECTION 02556

1. GENERAL

1.1. GENERAL DESCRIPTION OF WORK

- 1.1.1. The Contractor shall furnish and install all pipes, fittings, structures and accessories required for water transmission, distribution and/or service lines in accordance with the requirements of the Construction Plans and related Contract Documents.

1.2. COMMONLY USED ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
CA	Concrete Asbestos
CI	Cast Iron
DI	Ductile Iron
DIPS	Ductile Iron Pipe Standard
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FLG	Flange
HDPE	High-Density Polyethylene
MJ	Mechanical Joint
MSS	Manufacturer's Standardization Society
NSF	National Standards Foundation
OD	Outside Diameter
PVC	Polyvinyl Chloride
SBR	Styrene Butadiene Rubber
SF	Suction Flange

1.3. QUALITY ASSURANCE

- 1.3.1. AWWA Standards - Construction materials and methods shall comply with the requirements of the latest published edition of American Water Works Association (AWWA) Standards. Applicable standards include, but may not be limited to, the following:

AWWA C104	Cement Mortar Lining for Ductile Iron Pipe and Fittings
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
AWWA C151	Ductile Iron Pipe, Centrifugally Cast
AWWA C153	Ductile Iron Compact Fittings, For Water Service
AWWA C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
AWWA C301	Pre-stressed Concrete Cylinder Pressure Pipe (PCCP), 16-in. and Larger
AWWA C502	Dry Barrel Fire Hydrants
AWWA C504	Rubber Seated Butterfly Valves 3-in. (75 mm) Through 72-in. (1,800 mm)
AWWA C509	Resilient Seated Gate Valves For Water Supply Service
AWWA C510	Double Check Valve Backflow Prevention Assembly
AWWA C511	Reduced-Pressure Principle Backflow Prevention Assembly
AWWA C515	Reduced-Wall, Resilient Seated Gate Valves For Water Supply Service
AWWA C550	Protective Interior Coatings for Valves and Hydrants
AWWA C600	Installation of Ductile Iron Water Mains & Their Appurtenances
AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) And Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
AWWA C651	Disinfecting Water Mains
AWWA C800	Underground Service Line Valves and Fittings
AWWA C900	PVC Pipe And Fabricated Fittings, 4-in. Through 12-in. (100 mm through 300 mm), For Water Transmission And Distribution
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing 1/2-in. (13 mm) through 3-in. (76 mm), For Water Service
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe & Fabricated Fittings, 14-in. through 48-in. (350 mm through 1200 mm)
AWWA C906	Polyethylene (PE) Pressure Pipe & Fittings, 4-in. (100 mm) through 63-in. (1600 mm) for Water Distribution And Transmission

- 1.3.2. ASTM and NSF Standards - In addition, construction materials and methods shall also comply with the requirements of the latest published editions of the American Society for Testing and Materials (ASTM) Standards, and the National Sanitation Foundation (NSF) Standard 61.

ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM B584	Standard Specification for Copper Allow Sand Castings for General Applications
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B88	Standard Specification for Seamless Copper Water Tube
ASTM D1248	Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D1598	Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
ASTM D1599	Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D1693	Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2737	Standard Specification for Polyethylene (PE) Plastic Tubing
ASTM D3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM D429	Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates
ASTM F477	Standards Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

- 1.3.3. ASME and ANSI Standards - In addition, construction materials and methods shall also comply with the requirements of the latest published editions of the American Society of Mechanical Engineers (ASME) Standards, and the American National Standards Institute (ANSI).

ASME/ANSI B16.20	Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed
ASME/ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
ASME/ANSI B 1.1	Unified Inch Screw Threads, UN and UNR Thread Form
ASME/ANSI B 1.20.1	Pipe Threads, General Purpose (Inch)
ASME/ANSI B 1.20.3	Dryseal Pipe Threads (Inch)

2. MATERIALS AND EQUIPMENT

2.1. GENERAL

- 2.1.1. All pipe, fittings and accessories shall be new, and shall be suitable and rated for potable water use. All pipe, fittings and accessories shall be rated for a pressure of 160 psi or greater. All water pipe and fittings shall be color coded blue in accordance with FDEP and AWWA requirements, and FAC 62-555.320.

2.2. DELIVERY, STORAGE, AND HANDLING

- 2.2.1. Certificates of Compliance with the Specifications may be required for all materials used on the Project. All materials are to be transported, stored, handled, and installed in accordance with the Manufacturer's recommendations to avoid physical damage. All materials shall be stored to prevent physical deterioration due to sun and weather. The Owner or its representative reserves the right to reject material which in any way does not meet the requirements of these Specifications.

2.3. WATER MAINS

- 2.3.1. Polyvinyl Chloride Pipe (PVC) - PVC pipe shall meet the designations on the table below and shall be provided with push-on joints with the bell integrally cast into the pipe. PVC pipe shall be installed with elastomeric gaskets meeting ASTM Standard F477 and meet the requirements of the following table.

PVC PIPE STANDARDS				
Standard	Nominal Size	Dimension Ratio	OD Classification	Pressure Rating (Psi)
ASTM 2241	2" – 3"	SDR 21	IPS	200
AWWA C900	4" – 12"	DR 25	DIPS	165
AWWA C905	14" – 36"	DR 18	DIPS	200

- 2.3.1.1. Markings - PVC pipe shall be marked to indicate the following:

- 2.3.1.1.1. Nominal pipe size and OD base
- 2.3.1.1.2. Material Code Designation
- 2.3.1.1.3. Dimension Ratio
- 2.3.1.1.4. Pressure Class or Pressure Rating
- 2.3.1.1.5. Manufacture's Name or Trademark
- 2.3.1.1.6. National Sanitation Foundation Approved Marking
- 2.3.1.1.7. Appropriate AWWA or ASTM Standard Number
- 2.3.1.1.8. Date Pipe Was Manufactured

- 2.3.1.2. Color Coding - Entire pipe shall be colored with blue pigment.

- 2.3.2. Ductile Iron Pipe (DIP) - Ductile iron pipe shall meet the requirements of the table below and have a design operating pressure of up to 150 psi, installed in Class 2 Trenching conditions. Increase pressure class or

bedding class as required by AWWA C151 for surface loads greater than indicated or operating pressures greater than 150 psi. DIP shall be constructed with push-on joints using rubber gaskets in accordance with AWWA Standard C111. Other methods of joint construction, such as mechanical, flanged, restrained, or ball-and-socket, may be required in special applications as appropriate. All DIP shall meet the requirements of the following table.

DIP PIPE STANDARDS			
Standard	Nominal Size	OD Classification	Pressure Rating (Psi)
AWWA C151	3" – 12"	DIPS	350
AWWA C151	14" – 20"	DIPS	250
AWWA C151	24" – 64"	DIPS	200

2.3.2.1. Minimum Pipe Design Criteria –

- 2.3.2.1.1. The minimum internal design working pressure shall provide/ensure: (1) a 100-psi surge allowance, (2) a safety factor of 2, and (3) a total internal design pressure of 600 psi. No reduction of safety factor for transient pressures shall be allowed.
- 2.3.2.1.2. The external loads design criteria shall be a minimum of 4-foot depth of cover at 120 lbs. per cubic foot soil weight, and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150.
- 2.3.2.1.3. The horizontal deflection of ductile iron pipe resulting from external load conditions shall not exceed three percent of the pipe diameter.

2.3.2.2. Joint Design –

- 2.3.2.2.1. General – Ductile Iron pipe and fittings shall be furnished with push-on joints, push-on restrained joints, mechanical joints, and flanged joints, as required.
- 2.3.2.2.2. Push-on Joints – Push-on joints shall conform to AWWA C111. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR). Push-on joints shall be Fastite, as manufactured by American Cast Iron Pipe Company (ACIPCO), or equivalent. The pressure rating for push-on joints shall be a minimum of 350 psi or the specified pressure rating of the pipe, whichever is less.
- 2.3.2.2.3. Restrained Joints – Restrained joints shall be "Flex-Ring" restrained joints as manufactured by ACIPCO or equivalent. When restrained joints require factory welding, the Manufacturer shall qualify all welding procedures and welders used to produce the product per the requirements of a documented quality assurance system based on ANSI/AWS D11.2. Unless otherwise specified, gasket material shall be standard SBR. Restrained joints and restrained joint pipe shall have a working pressure rating of 350 psi for 3 to 16-inch sizes and 250 psi for 18 to 48-inch sizes. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes. If requested, the Manufacturer shall furnish test results showing that restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without

leakage or failure. Tests shall be performed on pipe with nominal metal thickness less than or equal to that specified for the project.

2.3.2.2.4. Flanged Joints – Ductile iron pipe and fittings 3 to 54 inches for above ground service or in below ground pits shall have flanged joints and meet the following requirements:

2.3.2.2.4.1. Flanged ductile-iron pipe shall conform to current AWWA/ANSI Specification C115/A21.15 and C110/A21.10 with factory-applied screwed long hub flanges except as otherwise specified hereinafter. Flanges shall be fully machined faced and drilled after being screwed tight on the pipe, with flanges true to 90 degrees with the pipe axis and shall be flush with end of pipe conforming to ANSI B161.1, 125 pound std. or Class 250, for the purpose intended. No welding of flanges or accessories in the field will be acceptable.

2.3.2.2.4.2. Full face type 1/16 inch thick red rubber ring gaskets shall conform to ANSI A21.11. Ring gaskets shall be of approved composition suitable for the required service.

2.3.2.3. Markings - Each ductile iron pipe section shall be marked to indicate the following:

2.3.2.3.1. Weight class or nominal thickness.

2.3.2.3.2. Letters DI or DUCTILE shall be cast or stamped on the pipe.

2.3.2.3.3. The Manufacturer's mark.

2.3.2.3.4. Country where cast.

2.3.2.3.5. Date in which the pipe was produced.

2.3.2.3.6. Date when pipe was lined.

2.3.2.3.7. All required markings shall be clear and legible; and all cast marks shall be on or near the bell. All letters and numerals on pipe sizes 14-inch and larger shall be not less than 0.5-inch in height.

2.3.2.4. Color Code -

2.3.2.4.1. Potable water pipe shall have 3 blue stripes (1/2 inch wide) with permanent ink along the entire length of pipe with the word "POTABLE" in 3/4-inch tall letters every 21 inches along each stripe.

2.3.2.5. Interior Coating of Ductile Pipe - DIP shall be lined in accordance with AWWA Standard C104, unless otherwise specified and approved.

2.3.2.6. Exterior Coating of Ductile Iron Pipe – The options for protection of the exterior of ductile iron pipe, fittings, etc. shall consist of one of the following: (1) standard shop coating and annealing oxide layer, (2) standard coating and annealing oxide layer plus polyethylene-encasement, (3) epoxy coating, or (4) epoxy coating plus heat shrink sleeves. Options (1) and (2) are typically used for buried pipe. Option (3) is typically used for pipe that is exposed, above grade. Option (4) is typically used in exposed locations where the presence of corrosive conditions may be present (e.g. ARV vaults).

2.3.2.6.1. Standard Coating – Coating type and amount per the requirements of the pipe and appurtenance Manufacturer.

2.3.2.6.2. Encasement – DIP shall be encased in the specified polyethylene material as indicated on the project plans. DIP shall be encased in 4 mil HDCL or 8 mil LLD polyethylene material in accordance with ANSI/AWWA Standard C105, using Encasement Method A (tube wrapped).

- 2.3.2.6.2.1. Location Information – The installed locations of polyethylene encasement of the DIP shall be documented on the final as-built project plans.

2.3.2.6.3. Epoxy Exterior Coating –

- 2.3.2.6.3.1. Shop Surface Preparation – Abrasive blast to remove loose annealing oxides, all rust and other contaminants. All surfaces shall have a minimum surface profile of 1.5 mils.
- 2.3.2.6.3.2. Field Surface Preparation – All abraded areas shall be abrasive blasted to remove all loose rust and shall result in a surface preparation equal to that listed above. All edges shall be feathered. All other surfaces shall be abraded to provide a sufficient surface profile for the proposed finish coat(s).
- 2.3.2.6.3.3. Coating – Utilize products by Sherwin Williams, SherGlass FF Epoxy for exposed piping, either above grade or within underground vaults, pits, etc. For pipe remaining exposed above ground, top-coating with a urethane (Acrolon Ultra) for color and gloss retention is required. The table below does not include the standard shop applied primer coating.

APPROVED COATING PRODUCTS			
Coat	Product	Color	Dft
1st	* SherGlass FF Epoxy **	White	10.0 – 20.0
2nd	* SherGlass FF Epoxy **	White	10.0 – 20.0
Final	* Acrolon Ultra **	Blue	2.0 – 3.0

* Lining to be applied in a single coat

** Or approved equivalent

- 2.3.2.6.3.4. Discontinuity Testing – After cure of the lining, all surfaces shall be high voltage holiday tested in accordance with NACE RPO 188 (latest edition) and the recommendations of the Manufacturer.

- 2.3.2.6.4. Heat Shrink Sleeves – Heat shrink sleeve shall consist of a cross-linked and pre-stretched sheet (coated with a protective heat-sensitive adhesive) which, upon heating, will shrink to its original length. The sleeve adhesive will achieve the corrosion protection by preventing moisture and air ingress to the pipe surface. Further, the adhesive shall act to hold and anchor the backing around the joint through adhesion to the substrate and the backing. Careful attention required concerning the compatibility of the sleeves with pipe coatings. AWWA C216 covers the material and application requirements of heat-shrinkable cross-linked polyolefin coatings for the exterior of special sections, connections, and fittings for steel pipelines.

- 2.3.3. Polyethylene Pipe (HDPE) - HDPE pipe shall meet the requirements of the table below and shall be high performance, high molecular weight, high density polyethylene pipe and shall conform to ASTM D 1248 (Type III C, Class C, Category 5). Minimum cell classification values shall be 345464C, as referenced in ASTM D 3350 - latest edition. All pipe resin shall be manufactured by the same company that manufactures the pipe itself in accordance with these specifications to ensure complete resin compatibility and total product accountability. The fittings shall be molded or manufactured from a polyethylene compound having a cell classification equal to or exceeding the compound used in the pipe. To ensure compatibility of polyethylene resins, all HDPE fittings supplied under this specification shall be of the same Manufacturer as the pipe being supplied.

HDPE PIPE STANDARDS				
Standard	Nominal Size	Dimension Ratio	OD Classification	Pressure Rating (Psi)
AWWA C901	1.5"	DR 9	CTS	200
AWWA C901	2"	DR 9	CTS	200
AWWA C901	3"	DR 11	IPS	200
AWWA C906	4"+	DR 11	DIPS	200

2.3.3.1. Quality Control - Refer to the following guidelines regarding quality control:

2.3.3.1.1. The resin used to manufacture the pipe shall be produced by the pipe Manufacturer, thus maintaining complete control of the pipe quality. The pipe shall contain no recycled compound except that generated in the Manufacturer's own plant from resin of the same specification and from the same raw material. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, and shall be identical in color, density, melt index, and other physical properties.

2.3.3.1.2. The Engineer may request, as part of the quality control records submittal, certification that the pipe produced is represented by the quality assurance testing. Additionally, test results from Manufacturer's testing or random Manufacturer's representation, may be cause for rejection of pipe represented by the testing. These tests may include density and flow rate measurements from samples taken at selected locations within the pipe wall and thermal stability determinations according to ASTM D 3350, 10.1.9.

2.3.3.1.2.1. Verification - The Owner or the specifying Engineer may request certified lab data to verify the physical properties of the materials supplied under this specification or may take random samples and have them tested by an independent laboratory.

2.3.3.1.2.2. Rejection - Polyethylene pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

2.3.3.2. Color Coding –

2.3.3.2.1. Potable water pipe shall have 3 blue stripes (1/2 inch wide) with permanent ink along the entire length of pipe.

2.3.3.2.2. Entire pipe shall be colored with blue pigment.

2.3.3.3. Alternate Pipe Materials - The Owner may consider other pipe materials as appropriate for the needs of the Project. Alternate pipe materials identified during design and approved for use on the Project shall be noted on the Construction Plans.

2.4. WATER MAIN APPURTENANCES

2.4.1. Water Main Fittings -

2.4.1.1. General – All water main fittings shall be blue in color in accordance with FDEP and AWWA requirements, and FAC 62-555.320.

2.4.1.2. PVC Or Ductile Iron Pipe Fittings - Water main fittings shall include Tees, Wyes, Bends, Reducers, and other appurtenances commonly used in pipe construction. Fittings shall be ductile iron meeting AWWA Standard C110 or C153 with pressure ratings of not less than that specified for adjacent pipe. Fittings shall be constructed with mechanical joints, unless otherwise specified, and shall be supplied complete with low alloy bolts and nuts, SBR gaskets and other necessary parts required for field assembly. Fittings shall be cement-mortar lined in accordance with AWWA Standard C104/A21.4.

2.4.2. HDPE Pipe Fittings -

2.4.2.1. Mechanical connections of HDPE pipe (4 inch and larger) to ductile Iron or PVC piping, mechanical joint fittings or valves, shall be through a self-restraining, fusible mechanical joint adapter. Mechanical joint adapter shall be the same SDR rating as the pipe. Provide the mechanical joint adapter, including but not limited to longer tee bolts and all thread rods with nuts at the mechanical joint bell.

2.4.2.2. Mechanical connections of HDPE pipe sized under 4 inches to ductile iron or PVC piping, mechanical joint fittings or valves, shall be through the use of the above specified mechanical joint adapter if available. As an alternate, transition fittings of HDPE by male iron pipe threaded end installed by butt fusion may be used.

2.4.3. Pipe Couplings -

2.4.3.1. Pipe couplings shall be solid sleeve type with mechanical joints at each end containing a compression gasket. Couplings shall be ductile iron, 12 inches minimum in length, with low alloy bolts and nuts, and SBR gaskets. Rings and gaskets shall be sized to conform exactly to the requirements of the pipe Manufacturer.

2.4.3.2. For transition between asbestos cement and PVC or DI pipe types, Hymax 2000 Series, Romac Macro HP, Couplings, or approved equal, shall be used.

2.4.3.3. Polyethylene pipe and fittings may be joined using approved electro fusion couplings. Fittings shall be PE3408 HDPE. Electro fusion fittings shall have a pressure rating equal to the pipe.

2.4.4. Pipe Cut-In Sleeves - Cut-in sleeves shall be solid ductile iron, one end plain for insertion to female fitting, the other end flanged mechanical joint, furnished with loose attaching flange and fastener, nominal length of 20-21 inches. Specify pipe main size and type of pipe fabrication.

APPROVED MANUFACTURERS - PIPE CUT-IN SLEEVES		
Manufacturer	Model	Application
Union Foundry	21-4520	MJ X PE
	21-4610	FLG X PE
	24-4800	MJ X FLG
Others as approved by Owner in writing.		

2.4.5. Repair Clamps - Repair clamps shall not be used in the installation of new pipe except with the written permission of the Engineer. Repair clamps shall be full circle and selected based on the table below.

REPAIR CLAMP SIZES	
Pipe Diameter	
Up to 12-inch	Single Band
14-inch and above	Double Band

- 2.4.5.1. Repair clamps shall be composed of stainless steel bands and bolts, DI lugs and full gridded virgin SBR compounded gasket.
- 2.4.5.2. Repair clamps shall be sized so that the OD of the existing pipe being repaired falls within the designated range for the clamp size. Repair clamps shall have ample length to give full gasketing at both ends.

APPROVED MANUFACTURERS	
Manufacturer	Model
Ford	FS series (all SS)
Smith Blair	226, 228
Others as approved by Owner in writing.	

** See Manufacturer's catalog to complete model numbers by size.*

2.4.6. Pipe and Fitting Restraints –

- 2.4.6.1. Joint restraints and thrust blocks are required for 90 degree bends, 45 degree bends, tees, tapping sleeves, dead-ends, and fire/flushing hydrants. Joint restraints shall be used in conjunction with all pipe, fittings and appurtenances. Joint restraints shall be used on pipe and fittings in each direction.
- 2.4.6.2. Restraints shall have set or anchor screws used to secure body to pipe with torque limit break away head design.

APPROVED MANUFACTURERS	
Manufacturer	Model
Smith Blair	Cam-Lock 111, 120
Sigma	One-Lok
Ebba Iron	MegaLug Series
Others as approved by Owner in writing.	

2.4.7. Expansion Joints -

- 2.4.7.1. Expansion joint fittings shall be used where specified on the Construction Plans. They shall be of the rigid or flexible type as specified and manufactured of ductile iron in accordance with the DIP specified herein. They shall be capable of expanding or contracting to the extent specified by the Engineer, but in no case less than 4-inches axially and designed to prevent separation beyond the maximum extension without the use of external tie rods.
- 2.4.7.2. Expansion joints shall be flanged or provided with restrained mechanical joints, individually pressure tested to a minimum of 350 psi against their own restraints, and internally coated on all exposed

surfaces with a minimum of 15 millimeters of fusion bonded epoxy conforming to AWWA C116. They shall be capable of deflecting at least 15 degrees by means of an integral ball at each joint in the case of flexible types.

APPROVED MANUFACTURERS		
Type	Manufacturer	Model
Rigid	EBAA Iron, Inc.	EX-TEND 200
Flexible	EBAA Iron, Inc.	Flex-Tend
Others as approved by Owner in writing.		

2.4.8. Tapping Sleeves -

2.4.8.1. The minimum size tapping sleeve shall be 4 inches. Connection of 3-inch lines to existing pipes 4 inches and larger shall be made by a 4-inch tapping sleeve with appropriate reducing fitting. Tapping saddles shall be used for smaller connections.

2.4.8.2. Tapping sleeves shall be designed for a working pressure of 200 psig without leakage. Tapping sleeves shall be all stainless steel including stainless steel or epoxy coated flange. The outlet branch connection shall have a recessed flanged face for connection of tapping valve with standard dimensions in accordance with Manufacturers Standardization Society (MSS) SP-60. A complete set of neoprene or other elastomer gaskets shall be furnished. Sleeves shall be furnished to fit ductile iron, cement-asbestos, Class 160/200 or C900/905 PVC pipe with side connection as shown on plans or specifications in standard pipe sizes. Sleeves shall be furnished with all necessary installation parts.

APPROVED MANUFACTURERS	
Manufacturer	Model
Ford	FAST
Mueller	H-304SS
JCM Industries	432
Romac	
Smith-Blair	663, 665
Others as approved by Owner in writing.	

Note: To specify exact fitting when ordering, confirm line outside diameter and material. Confirm compatibility of selected fitting with existing main material.

2.4.9. Pipe Hangers and Supports - Hangers and supports shall be in compliance with Federal Specification WW-H-171E, or Manufacturer's Standardization Society SP-69, or UL listed. Materials of construction shall be in accordance with the requirements outlined in the table below.

APPROVED MANUFACTURERS - PIPE HANGERS AND SUPPORTS		
Manufacturer	Part I.D.	Model No.
Utility Pipe Sales	Clevis Hanger	590
	Socket Clamp	224 246
	Concrete Inserts:	
	CB-Universal	282
	Screen Insert	152
	Rod Attachments:	
	Eye Nut	290
	Forged Clevis	299
	Forged Turnbuckle	230
	Carbon Steel	233
	Couplings	136
	Socket Eye	110R
	Extension	157
	Pipe Rolls:	
	Adjustable Swivel	174
	Adjustable Steel Yoke	181
	Pipe Roll with Base	274
	Pipe Roll and Plate	277
Others as approved by Owner in writing.		

2.4.10. Valves - All valves shall be manufactured in accordance with the current appropriate AWWA Standard and shall be NSF approved for use in potable water.

2.4.10.1. Resilient Seated Gate Valves - Resilient seated gate valves shall be designed and fabricated in accordance with the current AWWA Standard C-509 or C-515. The basic design of the gate valves shall have an iron body, elastomer encapsulated iron disc, bronze stem and operating nuts with non-rising stem design. Valves 16-inches and larger shall be equipped with right angle gears (bevel gearing) for horizontal installation. The valve working pressure for all sizes shall be a minimum of 250 psig with a test pressure of 500 psig.

2.4.10.1.1. Materials and Construction - Valves shall open counterclockwise with a 2-inch square iron operating nut secured to the valve stem by a corrosion resistant Type 304 stainless steel nut to threads on the valve stem. The valve stem shall be made of high tensile strength bronze and shall be of one-piece construction sealed by O-Rings. The thrust collar shall be secured in place by a stuffing box or bonnet cover with a thrust washer located above the thrust collar. Valve construction shall be so that upper O-Rings can be replaced with the valve in service. The disc shall be cast iron encapsulated with an elastomer material bonded in accordance with ASTM D429 and shall be secured to the threaded stem by a bronze nut. The disc shall effect a seal that is bubble-tight at-250 psig.

- 2.4.10.1.2. Body-Disc-Bonnet-Operating Nut Material - Cast ductile iron construction in accordance with current AWWA Standard C-509 and C-515 and AWWA Standard C-153. Body bolts shall be equipped with square or hex head bolts for easy removal.
- 2.4.10.1.3. Corrosion Resistant Coatings - All interior and exterior cast iron surfaces shall be coated with fusion bonded epoxy in accordance with AWWA Standard C-550.
- 2.4.10.1.4. Body Sizing - Valve body length shall be per ASME/ANSI B16.20 for the type of end connections specified. In the full open position, the valve internal bore shall be smooth and obstruction-free without cavities or projections that could accumulate solids. The internal cross-sectional area of the valve shall be approximately equal to the nominal cross-sectional area of the adjoining pipe.
- 2.4.10.1.5. End Connections -
- 2.4.10.1.5.1. Valves shall be furnished with mechanical joint end connections, complete with accessory kits, unless otherwise specified on the plans.
- 2.4.10.1.5.2. When flanged ends are specified they shall be flat face class 125, conforming to ASME/ANSI B16.1 with bolt holes straddling the vertical center line.

APPROVED MANUFACTURERS - RESILIENT SEATED GATE VALVES						
Manufacturer & Specs			Valve Body Connections			
			Mechanical Joint	Flange & Mechanical Joint	Flanged End	Mechanical Joint for Tapping
			(MJxMJ)	(FLGxMJ)	(FLGxFLG)	(MJxSF)
Mueller	C-509	Size:	2" - 12"	3" - 12"	2" - 12"	3" - 12"
		Model No.:	A-2362	A-2362	A-2362	A-2362
	C-515	Size:	4" - 48"	4" - 48"	4" - 48"	4" - 24"
		Model No.:	A-2361	A-2361	A-2361	A-2361
Kennedy	C-509	Size:	2" - 12"	3" - 12"	2" - 12"	4" - 12"
		Model No.:	8571SS	8572SS	8561ASS	8950SS
	C-515	Size:	2" - 12"	3" - 12"	2" - 12"	4" - 12"
		Model No.:	7571SS	7572SS	7561SS	7950SS
M&H	C-509	Size:	2" - 12"	3" - 12"	2" - 12"	4" - 12"
		Model No.:	4067-01	4067-13	4067-02	4751-01
	C-515	Size:	2" - 16"	3" - 16"	2" - 16"	4" - 16"
		Model No.:	7571	7572	7561	7950
AVK	C-509	Size:	2" - 12"	3" - 12"	2" - 12"	4" - 12"
		Model No.:	Series 45	Series 45	Series 45	Series 45
	C-515	Size:	2" - 16"	3" - 16"	2" - 16"	4" - 16"
		Model No.:	Series 65	Series 65	Series 65	Series 65
Others as approved by Owner in writing.						

- 2.4.10.2. Resilient Seated Tapping (Gate) Valves - Resilient seated tapping gate valves shall be designed and fabricated in accordance with the specifications for resilient seated gate valves noted above.

- 2.4.10.2.1. Body Sizing - Valve body length shall be per ASME/ANSI B16.20 for tapping valves. Tapping valves shall conform to Specification AWWA C509 or C515, latest revision, covering gate valves except as modified for passage and clearance of tapping machine cutters. The opening through the valve shall be at least 1/4-inch larger than nominal valve diameter. Tapping valves shall allow full size shell cutters to be used.
- 2.4.10.2.2. End Connections - Valves shall be furnished with one end of the body with projecting face flange in accordance with specification MSS SP-60 for tapping valve/saddle connections to bolt to a standard tapping sleeve and the other end for mechanical joint.

2.4.11. Valve Vaults and Boxes –

- 2.4.11.1. Valve boxes shall be provided for all direct buried valves. Use nominal (5 ¼) inch cast-iron, screw-type pipe shaft with cover and base casting. The box top shall be set at finished grade and encased with a concrete ring in unpaved areas. Each valve box shall be furnished with a drop-in cover marked “WATER”.
- 2.4.11.2. Valve Vaults or Chambers – All valves which are not designed for direct burial shall be installed in vaults, which shall be constructed from standard precast concrete. Valve vaults, chambers, and hatches shall be sized to allow sufficient room for maintenance and repair in situ.

2.4.12. Valve Insertions –

APPROVED MANUFACTURERS (MAIN SIZES 4-INCH - 42-INCH)	
Manufacturer	Contact
Hydra-Stop, Inc.	Phone: 800-538-7867
JCM 440	Phone: 800-527-8482
Romac	Phone: 800-426-9341
Others as approved by Owner in writing.	

- 2.4.13. Location Aids - All new water main and service line installations shall include an approved method for locating lines from the ground surface after completion.

- 2.4.13.1. Tracer Wire - Tracer wire for water lines shall be a minimum of 12-gauge solid copper with blue PVC insulation for open trench installation. For trenchless installation, 8-gauge solid copper with blue PVC insulation shall be used. Tracer wire systems shall be electrically continuous covering all mains and services within the project. Wire-to-wire connections shall be made with silicone-filled wire nuts. Wire-to-appurtenance attachments shall be made with lug-type terminals. Wire shall be secured to the top of every other pipe joint with blue nylon ties or blue colored PVC tape.

APPROVED MANUFACTURERS (TRACER WIRE SILICONE-FILLED WIRE NUT CONNECTORS)	
Manufacturer	Model
Ideal Industries	Twister® DB Plus
King Technology, Inc.	Failsafe™
Others as approved by Owner in writing.	

- 2.4.13.2. Tracer Tape - Tracer tape shall be approximately 3" wide indicator tape with aluminum inner foil sandwiched between plastic layers printed with appropriate warning; wording to be approved by the City. Tracer tape shall be Terra-Tape, or equivalent, and shall be buried directly above all non-metallic pipes no deeper than 18" below ground.
- 2.4.13.3. Curb Markers – Curb marker base material must be 30 ml. non-yellowing UVI plastic. UV resistant inks with a minimum 7-year rating will be used to decorate the marker surface. A clear urethane dome no less than 60 mil shall be applied to the surface. The dome must not yellow or pit. It must be self-healing and have a Durometer hardness of D-60. Marker must have a 12-year written warranty. Copy to be supplied with submittal. Marker must meet ADA minimum recommendations for slip resistance. Markers shall be as manufactured by DAS Manufacturing, Inc. or approved equal.

- 2.4.13.3.1. Curb Marker Adhesive - Adhesive must permanently affix markers to concrete, asphalt and cast iron. Adhesive must be ready to use requiring no special surface preparation. Adhesive must have a shelf life of at least one year. Adhesive must be black in color and remain resilient for a minimum of twelve years. Adhesive must be available in a 5 oz. Re-sealable Squeeze Tube.

- 2.4.13.3.2. Provide curb markers per the following table:

CURB MARKER SPECIFICS			
TYPE	Nominal Size	Color	Designation
Potable Water Valve	2.5"	Blue	#2.5 NVA
Potable Water Meter	2.5"	Blue	#2.5 NMT

- 2.4.13.4. Composite Utility Marker

- 2.4.13.4.1. The Composite Utility Marker shall be a single piece marker capable of simple, permanent installation by one person using a manual driving tool. Upon proper installation, it shall resist displacement from wind and vehicle impact forces. The marker shall be of a constant flat "T" cross sectional design with reinforcing support ribs incorporated longitudinally along each edge to provide sheeting protection and structural rigidity. The bottom end of the marker shall be pointed for ease of ground penetration.
- 2.4.13.4.2. The Marker shall be constructed of a durable, UV resistant, continuous glass fiber and resin reinforced, thermosetting composite material which is resistant to impact, ozone, and hydrocarbons within a service temperature range of -40°F to +140°F.
- 2.4.13.4.3. The marker shall be pigmented throughout the entire cross-section so as to produce a uniform color, which is an integral part of the material. Ultraviolet resistant materials shall be incorporated in the construction to inhibit fading or cracking of the delineator upon field exposure. Color shall coincide with utility it is marking (i.e. blue for water, green for sewer, etc.).
- 2.4.13.4.4. Composite utility markers shall be as manufactured by Carsonite International Corporation, or approved equal. All markers shall be installed with a decal as noted on the typical details.

2.5. HYDRANTS AND FLUSHING EQUIPMENT

- 2.5.1. Fire Hydrants - Fire Hydrants shall be in compliance with the AWWA Standard C-502, with rated working pressure of 250 psig. The basic design of the fire hydrant shall be of the dry barrel type of breakaway traffic design. Use 304 stainless steel bolting below grade, and use fusion bond epoxy coating on mechanical joint inlet shoe, per AWWA C-550. Hydrant shall be coated in SIG yellow, RAL# 1003, or equivalent.

2.5.1.1. Hydrant Construction -

- 2.5.1.1.1. The hydrant inlet connection shall be 6-inch mechanical joint type complete with Accessory kit.
- 2.5.1.1.2. The hydrant shall be designed with a safety feature incorporating a break-away flanged design. Split ring retainer-type breakaway design with pinch bolts is not acceptable. The hydrant design shall allow the upper barrel to be rotated 360 degrees in order to assure proper nozzle orientation.
- 2.5.1.1.3. The drain valve shall assure quick and complete drainage of the hydrant and the drain hole shall be brushed with bronze if passing through ductile iron. The drain valve sealing facing shall be made of Buna N, nylon or urethane. If the valve top plate comes in contact with the bronze seat ring to facilitate draining of the hydrant, the valve top plate shall be made of bronze.

2.5.1.2. Main Hydrant Valve -

- 2.5.1.2.1. The main hydrant valve shall be compression type, opening counterclockwise against system pressure and closing clockwise with system pressure. The main valve connection opening shall not be less than 5¼-inches. The main valve shall have a resilient seat.
- 2.5.1.2.2. The hydrant shall be designed such that the operating threads on the stem are prevented from coming in contact with potable water and shall be enclosed in an operating chamber and sealed by O-Rings at the top and bottom of the chamber. The chamber shall be constructed for grease or oil lubrication with an installed grease fitting for maintenance.
- 2.5.1.2.3. The operating nut shall be 1½-inches in size and pentagon in shape and of one-piece construction.
- 2.5.1.2.4. The hydrant shall have one 4½-inch pumper nozzle, and two 2½-inch pumper nozzles having National Standard Hose coupling threads. The nozzles shall be field replaceable utilizing either a threaded or quarter-turn fitting with an O-Ring seal.

2.5.1.3. Operation and Maintenance Features -

- 2.5.1.3.1. The hydrant shall not incorporate parts requiring field adjustment for proper operation.
- 2.5.1.3.2. The hydrant shall be designed to permit the removal of all working parts from the hydrant through the barrel without disturbing the earth around the hydrant.
- 2.5.1.3.3. Removal of the working parts of the hydrant shall be accomplished by use of a seat removal wrench. Hydrants requiring other special tools to perform removal of interior parts will not be accepted.

- 2.5.1.4. Materials - All operating parts including operating nut, hold-down nut, drain ring and seat ring shall be bronze. The valve seat ring shall thread into a bronze insert or drain ring to provide bronze-to-bronze seating. Breakaway stem coupling is to have bronze or stainless steel bolts or pins.

2.5.1.5. Markings - The fire hydrant shall have permanent markings identifying the Manufacturer by name, initials or insignia, the size of the main valve opening, and the year of manufacture.

2.5.1.6. Approved Manufacturers –

APPROVED MANUFACTURERS	
Manufacturer	Model No.
M & H	129T
Mueller	A423
AVK	S27
Others as approved by Owner in writing.	

2.5.2. Fire Hydrant Appurtenances -

2.5.2.1. Extensions Kits

2.5.2.1.1. Where required, hydrants shall be installed using original Manufacturer hydrant extension kits as necessary to position the hydrant breakaway flange above finish grade.

2.5.2.1.2. Stand extension shall be in standard lengths of 12, 24, 36, 48, and 60 inches.

2.5.2.2. Hydrant Connectors

2.5.2.2.1. Hydrant connector spools shall be ductile iron per AWWA C151 used for connection between the hydrant and lead valve, and shall incorporate joint restraints. One end of the connector spool shall have swivel flange.

2.5.2.2.2. Standard hydrant connector sizes shall be as follows:

2.5.2.2.2.1. 6-inch X 12-inch long

2.5.2.2.2.2. 6-inch X 24-inch long

2.5.2.2.2.3. 6-inch X 36-inch long

2.5.2.2.2.4. 6-inch X 48-inch long

2.5.2.2.2.5. 6-inch X 60-inch long

2.5.2.2.3. Hydrant Offset Connectors - When a height adjustment is required to avoid an obstruction between the hydrant shut-off valve and the hydrant, an offset fitting shall be used. Material to be ductile iron per ANSI/AWWA C153/A21.53. Sizes shall be as follows:

2.5.2.2.3.1. 6-inch X 18-inch long with 6-inch offset

2.5.2.2.3.2. 6-inch X 30-inch long with 12-inch offset

2.5.2.2.3.3. 6-inch X 41-inch long with 24-inch offset

2.5.2.3. Approved Manufacturers –

APPROVED MANUFACTURERS		
Manufacturer	Straight Hydrant Connector	Offset Connector
Assured Flow Sales, Inc.	N/A	GRADELOK
Others as approved by Owner in writing.		

2.5.3. Flushing Hydrants - Flushing hydrants shall be in general compliance with AWWA Standard C-502, with rated working pressure of 200 psig. A fully restrained gate valve shall be installed at each flushing hydrant per the typical details.

2.5.3.1. Hydrant Construction - Flushing hydrants shall meet the requirements of a standard hydrant, except the breakaway feature is not required.

2.5.3.2. Main Valve – Generally the same as the standard hydrant, except main valve opening shall be not less than 2-1/8 inches and the flushing hydrant shall have one (1) 2½-inch nozzle having national standard hose coupling threads.

2.5.3.3. Operation And Maintenance Features - Unless otherwise specified, the hydrant bury length shall be 30-36 inches. The bury length is the distance measured to the nearest 1/2 foot, from the bottom of the connecting pipe to the ground line of the hydrant.

2.5.3.4. Materials -All operating parts including operating nut, hold-down nut, drain ring and seat ring shall be bronze. The valve seat ring shall thread into a bronze insert or drain ring to provide bronze-to-bronze seating.

2.5.3.5. Markings - Flushing hydrant markings shall meet the requirements of the standard hydrant above for fire hydrants.

2.5.3.6. Approved Manufacturers –

APPROVED MANUFACTURERS	
Manufacturer	Model
M & H	Style 33
Mueller	A-411
AVK	S67
Others as approved by Owner in writing.	

2.6. WATER SERVICE LINES

2.6.1. General – No galvanized pipe or fittings will be allowed. All fittings shall meet or exceed the requirements of NSF/ANSI Standard 61.

2.6.2. Polyethylene Tubing (HDPE) - Polyethylene service tubing shall meet the designations of the table below. However, only sizes up to 2 inch will be allowed. Services above 2 inch shall be PVC (refer to section 2.3 for service lines greater than 2 inches in diameter). All tubing must have a minimum cell classification of 445574 with code letter for blue colored tubing. PE tubing dimensions shall conform to ASTM D2737 with Copper Tubing OD base. Tubing shall have the NSF approval designation stamped on the tubing.

HDPE TUBING STANDARDS				
Standard	Nominal Size	Dimension Ratio	OD Classification	Pressure Rating (Psi)
AWWA C901	3/4" – 2"	DR 9	DIPS/CTS	200

2.6.2.1. Markings -

2.6.2.1.1. Nominal Size

- 2.6.2.1.2. Standard PE Code: 4710
- 2.6.2.1.3. Tubing Dimension Ratio
- 2.6.2.1.4. Pressure Class: PC200
- 2.6.2.1.5. Manufacturer's Name or Trademark
- 2.6.2.1.6. Tubing Shall Be Blue
- 2.6.2.1.7. Date Manufactured
- 2.6.2.1.8. NSF Approval Designation
- 2.6.2.2. Approved Manufacturers –

APPROVED MANUFACTURERS	
Manufacturer	Model
Endot Industries	Endopoly, Endopure
Chevron – Phillips Performance Pipe	Driscoplex 5100 Series Ultra-Line
Others as approved by Owner in writing.	

- 2.6.3. Pipe Sleeves For Long Water Services - Long water services shall be sleeved in PVC or PE pipe color coded blue or black with blue stripes. The sleeves shall be a minimum of 2-inch diameter with no fittings and shall extend a minimum of five-feet either side of the paved surface. The sleeve shall be one continuous leak free piece which is open on each end. The long service shall be sized according to the table shown below.

PIPE SLEEVE SIZING FOR LONG WATER SERVICES	
Service Size (inches)	Sleeve Size (inches)
1	2
2	4

2.7. SERVICE LINE APPURTENANCES

- 2.7.1. Fittings And Valves - Fittings and valves shall be manufactured in accordance with AWWA C-800 and be listed and approved by NSF for underground use in potable water service.
 - 2.7.1.1. Material -
 - 2.7.1.1.1. Fitting and valve bodies, plugs, and compression nuts shall be bronze, copper alloy no. C83600 and meet chemical and mechanical requirements of ASTM B62 or ASTM B584.
 - 2.7.1.1.2. Component parts such as fasteners, seals, and packing may be of other materials selected for adequate endurance, corrosion resistance and strength in accordance with AWWA C-800.
 - 2.7.1.2. Pressure - Fittings and valves shall be high pressure type for maximum allowable pressure of 150 PSIG, nominal operating pressure 100 psig.
 - 2.7.1.3. Markings - Fittings and valves shall be marked as appropriate with the following information: Manufacturer's name or logo; pressure rating; direction of flow; and size.
 - 2.7.1.4. Thread Specifications - Refer to the following table regarding thread specifications:

THREAD SPECIFICATIONS	
Thread Type	Standard
Unified Inch	ANSI/ASME B1.1
General Purpose Pipe	ANSI/ASME B1.20.1
Dryseal	ANSI/ASME B1.20.3

2.7.1.5. Pack Joint Couplings - Refer to the following table regarding pack joint couplings:

PACKJOINT COUPLINGS		
Type	Manufacturer	Model
Joint Couplings: Copper or Plastic Tube X MPT	Ford Mueller	C84-XX H-15428-X
Copper or Plastic Tube X FPT	Ford Mueller	C14-XX H-15451-X
Copper or Plastic Tube to Tube	Ford Mueller	C44-XX H-15403-X
Female Copper Pipe (replaces flare nut) X Copper or Plastic Tubing	Ford Mueller	CO4-XX H-15071-X
Others as approved by Owner in writing.		

** XX: See Manufacturer's catalog to complete model numbers by size.*

2.7.1.6. Tapping Saddles - Tapping saddles shall be either bronze or ductile iron with shop coat, with the exception of saddles for PE pipe. Saddles used to tap Class 160 PVC pipe shall be designed with mechanical features or stops to prevent over-tightening.

2.7.1.6.1. Materials And Construction - Tapping saddles shall have 360-degree clamping on the main. All tapping saddles shall be fabricated of 304 Stainless Steel. All bolts and fasteners are to be 304 Stainless Steel, and the saddle shall be installed with Buna-N or neoprene rubber full facing gasket. Epoxy coated body will be allowable.

2.7.1.6.2. Saddle Sizes -

2.7.1.6.2.1. Main Pipe: 2-inch and above

2.7.1.6.2.2. Tap Size: 1-inch, or 2-inch

2.7.1.6.3. Refer to the following table regarding saddle sizes.

ACCEPTABLE MANUFACTURERS		
Manufacturer	Application	Model
Ford	1-inch tap on PVC/steel OD pipe	S70 and S90
	1-inch tap on DI and CI Pipe	F-202
Mueller		H-105 DR2A
Smith Blair		313
JCM	C900 / C905 or DI	402
Romac	C900 / C905 or DI	202U
Others as approved by Owner in writing.		

2.7.1.7. Water Tubing Couplings - Water tubing couplings in sizes ¾-inch, 1-inch, 1 ½-inch, and 2-inch only shall be bronze compression-type, inlet and outlet for PE or copper tubing. Crimp-type couplings are not acceptable. Refer to table below for acceptable manufacturers.

ACCEPTABLE MANUFACTURERS	
Manufacturer	Model
Ford	C44-XX*
Mueller	H-15403-XX*

* XX: See Manufacturer's catalog to complete model numbers by size.

2.7.1.8. Meter Couplings - Meter couplings shall be bronze and sized as appropriate to accommodate the relevant meter. Inlet shall have male pipe thread. Refer to table below for acceptable manufacturers.

ACCEPTABLE MANUFACTURERS	
Manufacturer	Model
Ford	C84-XX*
Mueller	H-15428-XX*

* XX: See Manufacturer's catalog to complete model numbers by size.

2.7.2. Service Line Valves

2.7.2.1. Corporation Stops - Corporation stops shall be brass, high-pressure class, ball type, with AWWA/CC taper thread inlet. Outlet shall be compression-type grip joint for copy or plastic tubing (CTS). Corporation stops shall be sized for ¾-inch, 1-inch, or 2-inch tubing as appropriate. Refer to table below for acceptable manufacturers.

ACCEPTABLE MANUFACTURERS	
Manufacturer	Model
Ford	FB1000-X-G-NL
Others as approved by Owner in writing.	

- 2.7.2.2. Curb Stops (Residential) - Curb stops shall be brass, high pressure, ball-type with locking wings. Inlet shall be compression-type grip joint for plastic tubing (CTS). Outlet shall be meter swivel nut. Curb stops shall be sized for 1-inch tubing as appropriate. Refer to table below for acceptable manufacturers.

ACCEPTABLE MANUFACTURERS		
Manufacturer	Size	Model
Ford	1-inch	B43-342W-G-NL
Others as approved by Owner in writing.		

- 2.7.2.3. Curb Stops (Commercial) – Curb stops shall be brass, high pressure, ball-type with locking wings. For meter assemblies 1" and smaller, inlet shall be compression-type grip joint for plastic tubing (CTS) and outlet shall be meter swivel. For 1-1/2" meter assemblies, inlet shall be compression-type grip joint for PVC pipe and outlet shall be meter flange. Curb stops shall be sized by EOR as appropriate.

ACCEPTABLE MANUFACTURERS		
Manufacturer	Size	Model
Ford	3/4-inch or 1-inch	B43-XXXW-NL
Ford	1-1/2-inch	B43-666W-NL
Others as approved by Owner in writing.		

2.8. WATER METERS

- 2.8.1. Water meters 2" and greater shall be Sensus Omni C2.
- 2.8.2. Water meters less than 2" shall be Sensus iPERL.
- 2.8.3. MXU shall be Sensus FlexNet 2W 520M Single Port.
- 2.8.4. The Developer/Contractor is responsible for furnishing all items associated with the meter assembly on commercial development projects, including the meter and the MXU.
- 2.8.5. See Part 1 General Requirements of the HNWS Guidelines for provision and installation responsibilities.

2.9. BACKFLOW PREVENTION ASSEMBLIES

- 2.9.1. Backflow prevention assemblies shall be manufactured in accordance with applicable AWWA standards and shall also be approved by ASSE and/or approved by NSF for use in potable water systems with a maximum continuous operating pressure of 150 psig, and capable of sustaining a hydrostatic test pressure of 300 psig. Backflow prevention devices shall be located immediately downstream of the Owner's control valve.
- 2.9.1.1. Double-Check Valve - A double check valve assembly (DC) is a mechanical backflow preventer that consists of two independently acting, spring-loaded check valves. It includes shutoff valves at each end of the assembly and is equipped with test cocks. A DC is effective against backpressure backflow and back-siphonage but should be used to isolate only non-health hazards. All fire line double check assemblies shall be provided with leak detection assembly.

- 2.9.1.2. Reduced Pressure Assembly - A reduced pressure valve assembly (RP) is a mechanical backflow preventer that consists of two independently acting, spring-loaded check valves with a hydraulically operating, mechanically independent, spring-load pressure differential relief valve between the check valves and below the first check valve.
- 2.9.1.3. Appurtenances - All backflow assemblies shall be provided and installed as a complete assembly with all necessary fittings to enable testing in place. Tapped test ports shall be fitted with test petcocks in each body cavity. Inlet and outlet gate or ball valve shall be of the same line size as that of the body.
- 2.9.1.4. Approved Assemblies - The word “approved” when used with reference to a backflow prevention assembly, is an assembly which has been manufactured in full conformance with the standards established by the American Water Works Association titled: *AWWA C510-89 Standard for Double Check Valve Backflow Prevention Assembly*, or *AWWA C511-89 Standard for Reduced-Pressure Principle Backflow Prevention Assembly*, as such standards may be amended from time to time, and which comply with the laboratory and field performance specifications of the Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California established by “Specification of Backflow-Prevention Assemblies: - Section 10 of the most current issue of the Manual of Cross-Connection Control.

2.10. METER BOX

- 2.10.1. Meter boxes shall be supplied to the Owner for installation. Provided meter boxes shall be OldCastle with solid lids as approved by HNWS.

3. EXECUTION

3.1. GENERAL

- 3.1.1. The Contractor shall provide all labor, equipment and materials as required to install all pipes, valves, fittings, and other appurtenances as indicated on the construction plans or as specified in the Contract documents.

3.2. PIPE INSTALLATION

- 3.2.1. The Contractor shall utilize equipment and methods in accordance with pipe Manufacturer’s requirements and standard construction practices to insure pipe installation to line and grade as indicated.
- 3.2.2. Trench Excavation - Contractor shall maintain a minimum of 30 inches and maximum of 36 inches of cover below finished grade unless otherwise approved by the Owner or its representative in writing.
- 3.2.3. Alignment - Pipe shall be installed along the alignment indicated by the construction plans. Accomplish horizontal and vertical changes in alignment of pipe with bends or other appropriate fittings. Joint deflection shall not exceed the recommendations of the pipe Manufacturer.
- 3.2.4. Pipe Preparation -The Contractor shall clean the interior of all pipes, fittings, and joints prior to installation. Pipes shall be inspected for defects prior to installation. Damaged pipe shall be rejected and removed from the project.
- 3.2.5. Pipe Installation -
 - 3.2.5.1. Install pipe only when weather and trench conditions are suitable. Do not lay pipe in water. Join pipe in accordance with Manufacturer’s recommendations.

- 3.2.5.2. Provide initial backfill or anchoring as necessary to prevent displacement and preserve alignment after establishing final position.
- 3.2.5.3. Encase water pipe in steel casing or use ductile iron pipe when crossing under pipe, conduit, or structure when a 6-inch separation distance cannot be maintained. This protection shall meet FDEP requirements.
- 3.2.6. Crossings - Where the crossing of a roadway, water body, rail, or other obstacle requires trenchless installation, the materials and installation methods shall conform to Section 02300-“Horizontal Directional Drilling” or Section 02310-“Jack and Bore”, as applicable.
- 3.2.7. Protection - Prevent the introduction of foreign matter into the pipe at all times. Close open ends of pipe with water tight fitting closures or plugs. Do not let water fill trench, but include provisions to prevent flotation should water control measures prove inadequate. Remove water, sand, mud and other undesirable materials from trench before removal of pipe closure piece.
- 3.2.8. Cutting - PVC or PE pipe shall be cut in a neat workmanlike manner, and the spigot end shall be beveled per Manufacturer's recommendation. Ductile iron pipe shall be cut in accordance with Manufacturer's recommendation. Do not allow excessive heat to develop. Smooth and bevel cut end as per Manufacturer's recommendations. Use of pipe with damaged lining is unacceptable.
- 3.2.9. Closure Pieces - Closure pieces shall only be used where called for on plans. Closure may be accomplished with sleeve coupling as long as its length is such that gaskets are not less than 3 inches from pipe ends.
- 3.2.10. Restraints and Thrust Blocking - Mechanical joint restraints shall be furnished and installed for all water line fittings and appurtenances. Restraints and thrust blocks are required-for 11.25, 22.5, 45 and 90 degree bends, tapping sleeves, tees, dead-ends, behind fire hydrants, and flushing hydrants.

3.3. APPURTENANCE INSTALLATION

- 3.3.1. Valves - Valves shall be installed with operating stems vertical for valves 16 inch and smaller. For valves larger than 16 inches, the valve may be installed horizontally. Horizontal valves shall be provided with a right-angle gear drive and flush port piping to the lower clean-out. Extensions shall be provided if the valve operating nut is greater than 24 inches below finish grade. Valves shall be installed on a suitable bearing surface as shown on the project plan details, to prevent vertical displacement.
 - 3.3.1.1. Air release valves shall be located and installed at the down-stream end of all high points as shown in the details and on the approved construction plans.
 - 3.3.1.2. Check valves, complete with vaults if applicable, shall be installed at locations shown in the approved construction plans in accordance with the Manufacturer's instructions.
- 3.3.2. Valve Boxes - Valve boxes shall be centered on the valve. The earth shall be compacted around each valve box to a distance of 4 feet on all sides of box, or to undisturbed trench face if less than 4 feet. An 18-inch diameter by 4-inch thick concrete collar shall be constructed and sloped to direct water away from the valve box. In lieu of the constructed collar, a 24-inch by 4-inch thick pre-cast, sloped, concrete collar may be used.
- 3.3.3. Tracer Wire - Tracer wire shall be installed on all new water mains and on all new water service lines. The tracer wire shall be placed directly above the pipe and electrically continuous throughout the project. Tracer wire shall be secured to the pipe with PVC tape the same color as the wire insulation, at a maximum of 10-feet on center between tapings. The tracer wire shall be brought to the ground surface at each valve location

in accordance with the details. Splices and/or connections in the tracer wire shall be installed with silicone-filled wire nuts designed for direct burial.

3.4. SERVICE LINE INSTALLATION

- 3.4.1. General - The Contractor shall install individual services with tracer wire from the new main to a convenient point on the right-of-way or property line for each house, building or unit that is currently served through a meter. New services for undeveloped lots shall be located 1 foot from the common property line.
 - 3.4.1.1. This section will deal with service line tubing ¾-inch, 1-inch and 2-inches in diameter, to serve 3/4-inch, 1-inch, 1 ½-inch, and 2-inch meters. The installation of service lines for 3-inch meters and larger shall be in accordance with the requirements for water main installation, (See Section 3.3 above).
- 3.4.2. Service Line Connections - Service lines shall be installed in accordance with the details. Tubing shall be installed in one continuous length from corporation stop to curb stop with no intermediate fittings. Service lines damaged after initial installation but before acceptance may be repaired by means of a single splice, except that no repair fittings will be permitted under any paving. The tap location shall be at least 10 feet from any sanitary sewer joint with less than 18 inches vertical clearance. Service taps shall be made with a tapping machine designed for the pipe material being tapped. Other types of tapping machines may be used upon prior approval by the Owner or its representative.
- 3.4.3. Long Service Lines - Unless otherwise noted on plans, HDPE pipe and tubing shall be installed at the shallowest depth that can safely and reasonably be achieved (but no less than 36 inches minimum). Depth shall consider all utility conflicts, bend radius of the pipe, and bend radius of the drill stem. Where utilities cross under DOT, county and/or city roads, depth of cover shall comply with applicable permits and shall be adequate to provide reasonable measures to avoid damage to the road surface and/or road base.

3.5. TAPS ON PRESSURIZED LINES

- 3.5.1. Taps for service lines of 2-inch and smaller PE tubing shall be made using a tapping saddle. The Contractor shall perform taps on pressurized lines for the installation of pipes other than service lines of 2-inch and smaller PE tubing in accordance with these requirements:
- 3.5.2. Materials - All materials used for taps on pressurized lines shall meet the requirements of these specifications. Tapping sleeves shall be properly sized for the pipe being tapped. Resilient seated tapping valves shall be furnished with special end connections. All other material used to accomplish the tap shall meet the standards set forth by the AWWA for potable water construction.
- 3.5.3. Procedure - The Contractor shall notify the Owner or its representative three working days in advance of work. The Contractor shall in the presence of the Owner or its representative:
 - 3.5.3.1. Expose the existing pipe at the location shown on the plans, and clean the section of the pipe to receive the tapping sleeve.
 - 3.5.3.2. Check the tapping sleeve and valve for defects and make sure the gate fully retracts in the valve to allow the shell cutter free passage.
 - 3.5.3.3. Assemble the tapping sleeve on the pipe, then install the tapping valve.
 - 3.5.3.4. Hydrostatically pressure test the tapping sleeve and valve after it has been assembled on the water main using the test plug on the sleeve. The test shall be 150 psi minimum. The duration of the test shall be 2 hours.

- 3.5.3.5. Pour a thrust block behind the tapping sleeve sufficient to withstand the pressure of the new line. Also, provide a concrete pad or suitable bearing surface sufficient to support the weight of the sleeve, valve, and tapping machine. Concrete shall be in place a minimum of 24 hours prior to testing the main installation.
- 3.5.3.6. Assemble an approved tapping machine and proceed to make the necessary cut in accordance with the recommendation of the tapping machine Manufacturer. Approved tapping machines shall be:
- 3.5.3.6.1. In good working condition.
 - 3.5.3.6.2. Designed for and have a cutting bit for the pipe material to be cut.
 - 3.5.3.6.3. Equipped with a depth of cut gauge.
 - 3.5.3.6.4. Designed to capture the coupon.
 - 3.5.3.6.5. Equipped with the Manufacturer's recommended diameter shell cutter for the tap to be made.
 - 3.5.3.6.6. Tapping machine power head to be hydraulic or pneumatic drive; use of electric motor drives expressly prohibited.
 - 3.5.3.6.7. Tapping machine shall be disinfected prior to each use for potable water taps.
- 3.5.3.7. The following tapping chart may be used for field reference only:

TAP SIZE REFERENCE CHART		
Nominal Main Size	Tapping Valve ID AWWA Standard	Tapping Machine Shell Cutter OD
2-inch	2 1/8-inch	1½ -inch
3-inch	3 1/8-inch	2½ -inch
4-inch	4 1/4-inch	3½ -inch
6-inch	6 1/4-inch	5½ -inch
8-inch	8 1/4-inch	7½ -inch
10-inch	10 1/4-inch	9½ -inch
12-inch	12 1/4-inch	11½ -inch
14-inch	14 1/4-inch	Per Manufacturer's Recommendation.
16-inch	16 1/4-inch	Contractor shall submit shop drawings for valves and tapping machine for approval, prior to use. Per Manufacturer's Recommendation.
18-inch	18 1/4-inch	
20-inch	20 1/4-inch	
24-inch	24 1/4-inch	

- 3.5.3.8. Tap coupon shall be given to the Owner or its representative. If the coupon is lost in the main, Contractor shall, at his expense, dismantle main to retrieve the coupon. Main will be reassembled, pressure tested and bacteriological tests retaken as required at Contractor's expense.

4. ACCEPTANCE REQUIREMENTS

4.1. INSPECTION

- 4.1.1. Upon completion of the installation, the system shall be inspected to ascertain that valves, fittings, fire hydrants, flush hydrants, etc. are located in conformance with the plans, and confirm that all 'as-built' measurements have been accurately taken. The Owner or its representative shall observe all appropriate activities related to properly placing the line in service including flushing, pressure and leakage testing, disinfection, and bacteriological sampling. Final connections and testing of fire hydrants shall be accomplished after final clearance of lines. Tracer wire shall be tested for continuity by the Contractor with the Owner or its representative present. The Contractor, with the Owner or its representative, shall make sure all main valves and hydrant valves are open.

4.2. NEW WATER MAIN CLEANING

- 4.2.1. All newly installed reclaimed water lines shall be flushed with potable water to remove any sediment, solids and/or foreign matter prior to testing. The Owner will make water available to the Contractor. Flushing shall be conducted at a sufficient velocity to clear the pipe. Discharge of flushing water must be through a 2-inch diameter pipe (or larger) and must be controlled so as not to cause any property damage. Chlorinated water must be disposed of in an acceptable manner. Flush water source connection shall incorporate backflow preventer and meter.
- 4.2.1.1. If flushing is unsuccessful in satisfactorily removing debris from the line or for larger diameter lines (12" or larger) if designated on the plans, cleaning shall be performed by swabbing (pigging). Pipes shall be flushed and swabbed a minimum of 3 passes until line is clear. To facilitate this process, pigging launch stations and receiving pits shall be installed and incorporated into the system as shown on the plans or as directed by the Engineer.

4.3. PRESSURE/LEAKAGE TEST

- 4.3.1. General - All newly installed water lines and appurtenances shall be pressure/leak tested to assure the strength of materials and quality of workmanship of the installation. Testing shall be conducted in accordance with the details and the requirements of AWWA Manual 23 for PVC and other flexible pipe or AWWA C600 for Ductile Iron Pipe. Leakage testing may be conducted concurrently with the pressure test.
- 4.3.2. Procedure -
- 4.3.2.1. Contractor shall notify the Owner or its representative three working days prior to a scheduled test. Tests are to be conducted in segments not to exceed three thousand (3,000) feet of pipe. Water in the new line shall be pumped up to a pressure of 150 psi minimum. This pressure shall be maintained for a minimum of two (2) hours by pumping a quantifiable amount of water into the line and recording the amount of water added during the test period. This represents the leakage.
- 4.3.2.2. Procedure: Each section of pipe shall be slowly filled with water and the specified test pressure, measured at the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, gauges, meter and all necessary apparatus shall be furnished by the Contractor. The test shall be applied to each valved section in order to check the leakage through all valves.
- 4.3.2.3. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at appoints of highest elevation, and afterwards tightly plugged.

- 4.3.2.4. Pressure/leakage tests shall be deemed acceptable when leakage does not exceed that determined by the following formula:

$$L = \frac{SD \text{ vP}}{133,200} \quad \text{or} \quad L = \frac{ND \text{ vP}}{7,400} \quad \text{or} \quad L = \frac{ND \text{ vP}}{6,600}$$

(or 11.65 gpd/mi/inch/dia) for DI pipe 18' lengths for PVC pipe 20' lengths

Where:

L = Maximum leakage, in gallons per hour.

S = Length of pipe under test, in feet.

N = Number of pipe joints in segment under test.

D = Nominal internal diameter of pipe, in inches.

P = Average actual leakage test pressure, psig.

- 4.3.2.5. Record all data for submission with as-built plans.
- 4.3.2.6. The Owner or its representative shall be present during test.
- 4.3.2.7. Refit and replace all pipe not meeting the leakage requirements. Repair clamps are not permitted.
- 4.3.2.8. Repair all visible leaks regardless of the amount of leakage.
- 4.3.2.9. When a satisfactory pressure/leakage test has been completed, reduce the pressure at or below normal line pressure, and continue on with line disinfection.

4.4. DISINFECTION

- 4.4.1. General - The Contractor shall provide all equipment, materials and testing apparatus required to perform disinfection in accordance with AWWA C651 and the typical details.
- 4.4.2. Procedure -
- 4.4.2.1. Method of disinfection shall be the continuous feed method as described in AWWA-C651. Add chlorine to attain an initial concentration of 25 mg/l chlorine with 10 mg/l remaining after 24 hours.
- 4.4.2.2. Initial concentration is to be obtained by mixing proper amount of HTH granules (65 percent Cl) into auxiliary tank, then pump/meter into regulated flow into or through the pipe section.
- 4.4.2.3. Check the chlorine concentration at all sampling points after the line has been filled and air expelled. Check residual chlorine concentration at the end of 24 hours to confirm that 10 ppm (minimum) is present.
- 4.4.2.4. Alternate methods of disinfection such as "tablet" and "slug" methods as described in AWWA C651 will not be allowed.
- 4.4.3. Water Supply for Cleaning, Flushing and Disinfection - The Owner shall supply water for testing from the nearest available source. Flush main until chlorine concentration is 2 mg/l or less prior to taking bacteriological samples. Water source connection shall incorporate a backflow preventer.
- 4.4.3.1. Check concentration at all sample point locations.

4.4.3.2. Disposal of chlorinated water shall be the Contractor's responsibility and shall be done without damage to public or private property. Chlorinated water disposal shall meet all State, Federal and local regulations.

4.4.4. Collection Of Samples - Two (2) satisfactory bacterial sample sets taken 24 hours apart must meet State requirements before placing the main into service.

4.4.5. Repeat Testing - Repeat flushing and disinfection procedure should initial disinfection fail to yield acceptable bacteriological results at no additional cost to the Owner.

4.5. OTHER CONNECTIONS

4.5.1. After new system piping has been satisfactorily tested and cleared for use, make any approved additional connections to the pre-existing distribution system. Exercise care in making connection and disinfect as needed. When total system is approved for use, the Owner or its representative shall verify that the Contractor has opened all interior valves as required. Valves connecting new installations to Owner's existing distribution system shall then be opened by the Owner or its representative.

END OF SECTION