

CONSTRUCTION STANDARD SPECIFICATION

SECTION 02665

UNDERGROUND WATER LINES FOR DOMESTIC AND FIRE PROTECTION SYSTEMS

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CONSTRUCTION STANDARD SPECIFICATION

SECTION 02665

UNDERGROUND WATER LINES FOR DOMESTIC AND FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section shall apply to the materials and operations required for the installation of underground water distribution lines and underground fire protection lines. The scope for fire protection lines begins at the connection to the water supply main and ends at the base of the building fire riser. The scope for non-fire protection lines ends 5 feet from the building foundation.
- B. The extent of the work is indicated on the contract drawings.
- C. Related Work: Refer to the following sections for related work:
 - Section 02200, "Earthwork".
 - Section 03300, "Cast-in-Place Concrete".
 - Section 09900, "Painting".
 - Section 15310, "Automatic Sprinklers and Water Based Fire Protection Systems".

1.02 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - B1.20.1 Pipe Threads, General Purpose (Inch)
 - B16.1 Cast Iron Pipe Flanges and Flanged Fittings
 - B16.3 Malleable Iron Threaded Fittings
 - B16.4 Gray Iron Threaded Fittings
- B. American Society of Testing Materials (ASTM)
 - A48 Specification for Gray Iron Castings
 - A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped Zinc - Coated Welded and Seamless (Replaces A120)
 - A536 Specification for Ductile Iron Castings

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B62	Specification for Composition Bronze or Ounce Metal Castings
B88	Specification for Seamless Copper Water Tubes
D2000	Standard Classification System for Rubber Products in Automotive Applications
D2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
F477	Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

C. American Water Works Association (AWWA)

C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
C105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
C110	Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids
C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C115	Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
C116	Standard for Protective Fusion-Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
C151	Ductile-Iron Pipe, Centrifugally Cast, for Water and Other Liquids
C153/A21.53	Ductile-Iron Compact Fittings, 3 in. Through 16 in., for Water and Other Liquids
C207	Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
C213	Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
C500	Metal-Seated Gate Valves for Water Supply Service
C502	Dry-Barrel Fire Hydrants
C504	Rubber-Seated Butterfly Valves
C509	Resilient-Seated Gate Valves for Water Supply Service
C512	Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
C515	Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
C550	Protective Epoxy Interior Coating for Valves and Hydrants
C600	Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
C605	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
C651	Disinfecting Water Mains
C800	Underground Service Line Valves and Fittings

C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. Through 12 in., for Water Distribution

- D. Copper Development Association (CDA)
- E. Copper Tube Handbook International Conference of Building Officials (ICBO)
- F. Code Council (ICC) – International Plumbing Code (IPC)
- G. National Fire Protection Association (NFPA) 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances

1.03 SUBMITTALS

- A. General: Submit the following in accordance with conditions of Contract and Division 1, Section "Descriptive Submittals".
- B. Product Data: Submit product data, or manufacturer's specifications including laboratory test reports and other data to show compliance with specifications (including specified standards).
- C. All pipe materials, valves, fittings, equipment, and accessories shall be submitted for approval. Product data shall indicate the maximum allowable operating pressure of each component and any related manufacturing standard as appropriate. Product data and certification for mechanical joint t-bolts is required.
- D. Test Reports: Submit test reports conducted on shop- and field-bolted and welded connections. Include data on type(s) of tests conducted and test results.

1.04 QUALITY ASSURANCE

- A. Codes and Standards: All work shall comply with the applicable portions of the most current edition of the AWWA Standards referenced in Section 1.03, and the most current edition of the Code Council (ICC) – International Plumbing Code (IPC).
- B. The materials and practices comprising the work shall conform to this and other referenced specifications. Where this specification conflicts with the requirements of another referenced specification, this specification shall prevail.
- C. All materials used shall not contain any asbestos fibers.
- D. All persons performing or supervising testing shall be qualified by either training or experience to perform such tests.

- E. Soldering shall conform to ASME B31.3, Process Piping and Copper Development Association recommended practices.
- F. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME B31.3, Process Piping, for shop and jobsite brazing of piping work.

PART 2 - PRODUCTS

2.01 PIPE AND JOINTS

- A. Lines 4" and larger shall be ductile iron pipe (DIP). All pipes shall be permanently marked to allow identification of type and class and Underwriters Laboratories (UL) listed or Factory Mutual (FM) approved if used for fire protection and shall conform to the following material requirements:

Ductile Iron Pipe (DIP) 4" and larger shall be as noted on the drawings but not less than pressure class 350, conforming to AWWA C151, with rubber-gasket joints conforming to AWWA C111, and cement-mortar lining conforming to AWWA C104. The pipe exterior shall have a bituminous outside coating conforming to AWWA C151.

Flanged Ductile Iron Pipe shall conform to AWWA C115.

- B. Service Lines 3" and smaller shall conform to the applicable provisions of AWWA C800, and shall conform to the material requirements for one of the following piping materials:

Copper Tubing: Type K, hard drawn or annealed, conforming to ASTM B88. Joints shall be AWS A5.8, BCuP silver braze.

Ductile Iron Pipe: Conforming to the requirements of article 2.01A for ductile iron pipe.

2.02 FITTINGS

- A. Fittings for mainlines 4" and larger shall be ductile iron, Class 350 pressure rating minimum, mechanical joint conforming to AWWA C153 Ductile Iron Compact Fittings, or Class 250 ductile iron flange joint / Class 350 mechanical joint conforming to AWWA C110 Ductile Iron or Grey Iron Fittings, with cement-mortar lining conforming to AWWA C104. Mechanical joint fittings, with rubber-gasket joints conforming to AWWA C111 shall be used in all buried installations. Flanged fittings shall be used in aboveground installations, and inside underground structures, such as valve pits and vaults.

1. All hardware shall be in full compliance with the requirements of AWWA C111 / ANSI A21.11. The bolts shall be manufactured from corrosion resistant low alloy steel, and shall comply fully with Public Law 1001-592, the "Fastener Quality Act".
- B. Fittings for service lines 3" and smaller shall conform to the applicable requirements of AWWA C800 and the following requirements:
1. Copper fittings shall conform to the following requirements: brass or bronze body with compression connections or flared compression joints at transition points or points of connection. Wrought copper solder type fittings conforming to ANSI B16.22, or cast copper alloy solder joint fittings conforming to ANSI B16.18.
 2. Fittings for ductile iron pipe shall be cast or ductile iron in accordance with AWWA C800.
- C. Special fittings, reducers, flares, saddles, rings, caps, wyes or other as specified on the drawings shall be ductile iron unless otherwise specified or shown, with a 350 psi minimum pressure rating, mechanical joints conforming to AWWA C153 or flange joints conforming to AWWA C110, and shall be coated with 2 coat fusion bonded epoxy coating per AWWA C-116.

2.03 COUPLINGS

Couplings 4" and larger shall only be used to join asbestos cement pipe to approved piping materials. The coupling shall have a 200-psi minimum working pressure rating; the body (middle ring) and followers shall be made from steel or ductile iron. The bolts and nuts shall be ANSI 304/303 Stainless Steel, or corrosion-resistant alloy bolts and nuts. The coupling shall have an NSF-61-registered fusion bonded powder epoxy coating, and shall meet all applicable requirements of AWWA C-219. The coupling shall be Dresser Style 253 Modular Cast Coupling, Total Piping Solutions – Hymax 2000, Smith Blair 413, or approved equal.

2.04 VALVES

Distribution, fire, and service line valves shall conform to the following requirements:

- A. Resilient seat gate valves 2" - 12" conforming to AWWA C509. The valve shall open when turning counterclockwise. The stem shall be the non-rising type with inside screw and shall contain "O"-ring seals. All valve end joints shall be mechanically connected and O-ring retainer shall be secured with nuts and bolts. Brass and bronze parts shall conform to AWWA C509. The resilient seat shall be mechanically retained or bonded to the gate or wedge. All Valves shall be UL listed in accordance with NFPA 24, and FM approved. Resilient seat gate valves shall be

Mueller A-2360, Kennedy KEN-SEAL II Resilient-Wedge Valves, M&H C509 Style 4067, or approved equal.

- B. Resilient seat gate valves 2" - 12" conforming to AWWA C515. The valve shall open when turning counterclockwise. The stem shall be the non-rising type with inside screw and shall contain "O"-ring seals. All valve end joints shall be mechanically connected and O-ring retainer shall be secured with nuts and bolts. Brass and bronze parts shall conform to AWWA C515. The resilient seat shall be mechanically retained or bonded to the gate or wedge. All Valves shall be UL listed in accordance with NFPA 24, and FM approved. Resilient seat gate valves shall be American Flow Control Series 2500 or M&H Style 7571.
- C. Resilient wedge tapping valves sizes 3" through 12" shall conform to AWWA C509. The valve shall be UL listed in accordance with NFPA 24 and FM approved. The stem shall be the non-rising type with inside screw and shall contain "O"-ring seals. The inlet flange shall comply with ANSI B16.1, Class 125, and the outlet shall be mechanical joint in compliance with AWWA C111. Valve shall be fully compatible with approved tapping sleeve. The resilient wedge tapping valves shall be Mueller T-2360 or approved equal.
- D. All valves smaller than 2" shall be of "O"-ring sealed ball or gate-operating, full-opening port type design. The valve shall have a cast bronze body, as per ASTM B62. The plug or key shall be cast bronze, as per ASTM B62, machined and/or deburred to create a smooth, true surface and assure a positive, durable seal. Valves shall be Mueller, Ford Meter Box Co. Inc, or approved equal.
 - 1. The inlet and outlet connections shall be tightened by a one-way gripper band or a compression nut. A positive seal shall be obtained by a replaceable "O"-ring for use with the gripper band system or a beveled Buna-N gasket, as per ASTM D2000, for use with the compression nut system.
 - 2. Curb boxes shall be installed with all valves smaller than 2" and shall be Mueller H-10306, Ford EA 2-25-50, or approved equal. Curb boxes shall be telescopic type with heavy cast-iron arch pattern base, steel upper section, and heavy cast-iron lid with a bronze bushed, bronze standard waterworks counter-sunk pentagon nut and shall be installed with a 12" x 12" x 4" concrete collar. Curb boxes shall be adjustable from 18" to 30" and held at the desired depth by a strong phosphor bronze opening. Upper sections of these boxes must be at least 1-1/4" to accept a shut-off rod. Boxes shall be coated inside and out with a tar-based enamel for corrosion resistance.
- E. Indicator posts shall have a cast-iron body, 1-1/4" square operating nut, lockable operating wrench, with "OPEN" and "SHUT" targets appearing in full view when the valve is fully open or closed. Base shall be flanged and shall bolt onto the indicator post flange provided on top of the valve. The indicator post shall be fully compatible with the approved valve, capable of accepting a tamper switch, and the bury depth shall govern post dimensions. The Indicator posts shall be UL listed in accordance

with NFPA 24 and FM approved. Indicator Posts shall be Mueller, No. A-20806, Kennedy Style 2945 or 2945A, American Flow Control IP-71, or approved equal.

- F. Butterfly valves 14" and larger shall be rubber-seated, iron body, short body flanged, Class 150B, conforming to AWWA C504 for valves 14" and larger. Valves shall be installed so that the disc rotates about a horizontal axis. Operator shall be manual, side-mounted, with standard 2" square operating nut, opening counterclockwise. Butterfly valves shall be Mueller Lineseal III, Keystone Figure 47 or 504, McWane M&H450, American Darling, Pratt, Kennedy or approved equal. Butterfly valves shall not be used on fire protection lines.
- G. Valve boxes shall have a gray cast-iron ring and cover with 5 1/4 inch shaft, screw type as designated on the standard drawing conforming to ASTM A48, Class 25C. The word "WATER" shall be cast onto the top of the cover in raised letters. Valve Boxes shall be installed with a concrete collar as shown in the drawings.

2.05 FIRE HYDRANTS

Fire hydrants shall have a cast or ductile iron body, traffic, dry barrel, post type, 150 psi working pressure, with two drain outlets constructed of bronze, conforming to AWWA C502. Main valve shall be compression type, 5-1/4" diameter. Hydrants shall have one 4-1/2" pumper connection and two 2-1/2" hose connections, with national standard fire hose coupling screw threads. Operating nut shall be pentagonal, 1-1/2" point to flat, opening counterclockwise. Indicate connection is 6" mechanical joint. Hydrants shall be capable of being field lubricated. Fire hydrants shall be Mueller A-423 Centurion, Kennedy Guardian K-81D, McWane M&H129T Model, or approved equal.

2.06 PRESSURE REDUCING VALVES

Pressure reducing valves (PRV) shall be cast-iron body, flanged end connections, globe pattern, single-seated, pilot-controlled, psi diaphragm type, Class 125 pressure rating, adjustable from 15 to 75 psi and shall operate hydraulically. PRV shall be a CLA-VAL Clayton Model 90-01 Series, size as designated on the contract drawings, or approved equal.

2.07 COMBINATION AIR VALVES

Combination Air valves shall have a cast-iron body, stainless steel float, with baffle, sizes 1/2" through 3", as designated on the contract drawings. Valves shall be APCO Model Series 140C, with NPT threaded outlet, or approved equal. Ring and cover for valve pit shall be gray cast-iron conforming to ASTM A48, Class 30 minimum, and shall be a NEENAH No. R-1910-A or an approved equal. Cover shall have the word "WATER" cast onto it in raised letters.

2.08 CONCRETE

Cast-in-place concrete for use in concrete thrust blocks, valve box and indicator post collars, and other concrete structures required by the contract drawings, shall conform to the requirements of Division 3, Section "Cast-in-Place Concrete".

2.09 TAPPING

A. Direct Tapping

Direct tapping is not allowed.

B. Tapping Saddles

Tapping saddles shall be used only when shown on the drawings and shall have a cast-iron, ductile iron, or bronze body with stainless steel or bronze straps, nuts, bolts and washers. Tapping Saddles shall be manufactured in conformance with AWWA C800. Gaskets shall be vulcanized elastomeric rubber or synthetic rubber compound. Saddles shall be compatible with Mueller threaded inlet or approved equal. Saddles used on PVC pipe shall be double-strap type. The tapping saddle model shall be rated for use on type specific piping material. Unless shown otherwise on the drawings the maximum allowable saddle tap shall be 2". Tapping Saddles shall be manufactured by the Ford Meter Box Company, Inc., the Mueller Co, or approved equal.

C. Tapping Sleeves

Tapping sleeves shall be used only when shown on the drawings and shall not exceed one-half the diameter of the line being tapped.

Heavy welded steel tapping sleeves shall be epoxy coated with stainless steel bolts and nuts, Buna-N rubber gaskets, flat face steel flange per AWWA C207 Class D, ANSI class150-outlet flange, and minimum150 psi working pressure rating. Tapping Sleeves shall be Ford FTSC, Smith-Blair 622, or Romac Industries, No. FTS 419.

Cast iron tapping sleeves shall be mechanical joint type with a working pressure of 200 psi, outlet flange to be Class 125, ASME B16.1, sleeves to include side and end gaskets of Buna-N rubber, eight high strength steel bolts and nuts to secure the halves of the sleeve to the pipe. Cast iron tapping sleeves shall be Mueller H-615.

2.10 CORPORATION STOPS

Corporation stops shall not be used directly on PVC pipe or Ductile Iron. Corporation stops shall have a bronze body, Mueller thread inlet by compression or flared outlet, 3/4"

to 2", conforming to the applicable requirements of AWWA C800. Compression connection outlets shall be provided with a stainless steel liner.

2.11 THRUST RESTRAINTS

- A. Cast-in-place concrete blocking, clamps and tie rods, shall conform to the requirements of Section 03300, "Cast-in-Place Concrete", SNL Standard Drawings, and construction drawings. Steel or cast-iron hardware shall be fully coated with asphalt or plastic varnish. A polyethylene liner, minimum thickness of 8 mils, shall be installed between the fitting and any concrete.
- B. Mechanical joint restraint, for ductile iron pipe shall be the Series 1100 Megalug restraint as produced by EBAA Iron, Inc. or approved equal. The restraint shall be incorporated into the design of the follower gland. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be made of grade 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of the latest revision. Torque limiting twist-off nuts shall be used to insure proper actuation of the restraining wedges. They shall have a rated working pressure of 350 psi in sizes sixteen inch and smaller and 250 psi in sizes eighteen inch through forty-eight inch. The devices shall be listed by Underwriters Laboratories up through the twenty-four inch size and approved by FM up through the twelve-inch size.
- C. Mechanical joint restraint, for PVC pipe, shall be incorporated into the design of the follower gland. The restraint mechanism shall consist of a plurality of individually-actuated gripping surfaces to maximize restraint capability. Glands shall be manufactured of ductile iron conforming to ASTM A536. The gland shall be such that it can replace the standardized mechanical joint gland and can be used with the standardized mechanical joint bell conforming to ANSI/AWWA C111/A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist off nuts, sized same as tee-head bolts, shall be used to insure proper actuating of restraining devices. The restraining gland shall have a pressure rating equal to that of the pipe on which it is used. The restraining glands shall be listed by UL, and be approved by Factory Mutual. The restraint shall be the EBAA Iron Series 2000PV.
- D. Restraint Harness for Ductile Iron Pipe push on bells size 4" and greater shall be made of ductile iron components. All ductile iron shall conform to ASTM A536. A split ring shall be used behind the bell and restraining ring shall have actuated wedges provide increased resistance to pull-out as pressure of external forces increase. The connecting tie rods that join the two rings shall be made of low alloy steel that

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conforms to ANSI/AWWA C111/A21.11. The assembly shall have a rated pressure of 350 psi for size sixteen inch and smaller and a rated pressure of 250 psi in sizes eighteen inch through thirty-six inch. The restraint shall be the Series 1700 Megalug Restraint Harness as produced by EBAA Iron, Inc or approved equal.

- E. Restraint for existing Ductile Iron Pipe push on bells shall be made of ductile iron components conforming to ASTM A536. The split rings shall incorporate individually actuated gripping surfaces on the pipe ring opposite of the bell. A sufficient number of bolts shall be used to connect the bell ring and the pipe ring. The combination shall have a minimum working pressure rating of 350 psi for sizes eight inches and less, 300 psi for sizes ten inches through 16 inches, and 200 psi sizes 18 inches through 36 inches. The restraint shall be the Series 1100HD Restraint for Existing Push-on Joints for Ductile Iron Pipe as manufactured by EBAA Iron, Inc or approved Equal.
- F. Restraint Harness for C900 PVC pipe bells size 4" – 12" shall be made of ductile iron components. All ductile iron shall conform to ASTM A536. A split ring shall be used behind the bell and a serrated restraint ring shall be used to grip the pipe. A sufficient number of bolts shall be used to connect the bell ring and the pipe ring. The combination shall have a minimum working pressure rating of 150 psi. The restraint shall be the Series 1600 as produced by the EBAA Iron, Inc.
- G. Restrained flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSIAWWA C115/A21.15. Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges. The flange adapters shall be capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6 in. gap between the end of the pipe and the mating flange without affecting the integrity of the seal. For PVC pipe, the flange adapters will have a pressure rating equal to the pipe. For Ductile Iron Pipe, the flange adapter shall have a safety factor of 2:1 minimum. The use of flange adapters must be approved by SNL System Engineering. The flange adapter shall be the Series 2100 Megaflange adapter as produced by EBAA Iron, Inc.

PART 3 - EXECUTION

3.01 PIPE LAYING

- A. General: Provide water pipe of the size, type and class specified and install at the locations and to the elevations and grades indicated on the contract drawings.
- B. Pipe installation shall be in accordance with the applicable provisions or requirements of the following specifications, drawings and references:

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UNDERGROUND WATER LINES FOR DOMESTIC AND FIRE PROTECTION SYSTEMS

Section 02200, "Earthwork".

Ductile iron pipe installation shall conform to AWWA C600. Where indicated on the contract drawings, pipe shall be encased in polyethylene film according to AWWA C105.

Plastic pipe installation shall conform to AWWA C605 "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water"

Install detectable warning tape that can be detected by a standard metal pipe locator on all water line per Section 02200, "Earthwork".

Copper tubing service lines shall conform to AWWA C800 and the CDA "Copper Tube Handbook".

- C. The installation of the fire protection line shall conform to NFPA 24, NFPA 13, and SNL Standard Drawing FX5003STD. Fire protection lines shall terminate inside the building with a flange and spigot piece. The spigot piece shall be plumb with the flange installed level, and set not less than 4" above the finished floor. A blank flange shall be temporarily installed on top of the flange and spigot piece to prevent the entrance of foreign matter into the supply line. Upon arrival at the job site, each section of pipe shall be inspected for damage and defects, and for compliance with the applicable piping materials products requirements listed in Part 2 of this specification. Defective sections of pipe may be marked by the Sandia Delegated Representative (SDR). Any sections of pipe found to be defective shall be immediately removed from the job site and shall be replaced by the Contractor.
- D. Immediately prior to laying, each pipe section shall be visually inspected for defects or damage. Any damaged or defective pipe section shall not be used. Each pipe section shall be cleaned so that the interior and joining surfaces of the pipe are free of soil and debris.
- E. Pipe shall be laid on a smoothly graded prepared subgrade soil foundation true to alignment and grade as indicated on the contract drawings. The allowable vertical and horizontal tolerance from drawing elevations and alignment shall be 2" . Bell holes shall be hand-excavated so that the bottom of the pipe is in continuous contact with the surface of the prepared subgrade material. Any pipe that has its grade or joints disturbed after laying shall be taken up and the pipe laid back in the trench. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug. Pipe shall not be laid in standing water or when trench or weather conditions are deemed unsuitable by the SDR. If conditions warrant, the inspector may require that the pipe be anchored to prevent floating.
- F. Trenching and Backfill

1. Trench Type 4: Unless otherwise shown on the drawings the trench for pipe installation shall be Type 4 as defined by AWWA C600. Pipe bedded in 4" of sand, gravel, or crushed stone. Maximum size of pipe bedding material shall not exceed 1/2" particle size and material shall be uniformly-graded, Backfill compacted to top of pipe to 80 percent.
2. Ductile Iron Pipe (DIP): The trench width from the bottom of pipe to 12" above top of pipe shall not exceed the outside diameter plus 24". The pipe haunch shall be backfilled so no voids exist and than backfilled in 8" maximum lifts. Unless otherwise specified, continue 8" lifts and 90 percent compaction in areas under roadways and paving. Compact to normal soil density in areas not supporting roadways or paving unless noted otherwise.
3. Polyvinyl Chloride Pipe (PVC): Proper placement of soils around existing PVC pipe is extremely important. Only hand tampers shall be used to compact backfill around the pipe. Care shall be taken not to damage or misalign the pipe during compaction. The trench width from the bottom of pipe to 12" above top of pipe shall not exceed the outside diameter plus 24". If trench width exceeds the maximum allowed or PVC pipe is placed in compacted backfill than the pipe embedment shall be compacted to 2.5 diameters on each side of the pipe. The pipe haunch shall be backfilled so no voids exist and than backfilled in 8" maximum lifts compacted to 90 percent density to the centerline of pipe. Unless otherwise specified continue 8" lifts and 90 percent compaction in areas under roadways and paving. Compact to normal soil density in areas not supporting roadways or paving unless noted otherwise.
4. Minimum depth of cover for water lines shall be 3 feet from the top of pipe to finished grade. Unless otherwise indicated on the contract drawings.
5. When it is necessary to deflect ductile iron pipe for changes in horizontal or vertical alignment, the amount of deflection shall not exceed 2/3 of the manufacturer's recommended maximum deflection. A fitting or several shorter lengths of pipe shall be used when necessary. PVC pipe shall not be deflected at the joints.

G. Joints

1. Push-on-Joints: Immediately prior to making the joint, the rubber gasket shall be removed and cleaned, the groove cleaned, the gasket replaced, and the bell and spigot ends thoroughly cleaned and lubricated with a suitable sterile soft vegetable soap compound. Field-cut plastic pipe sections shall be beveled for joining as recommended by the pipe manufacturer.
2. Mechanical Joints: The socket and plain ends shall be thoroughly cleaned immediately prior to making the joint. Wash the seating surfaces and the rubber gasket with a soapy solution. Seat the plain end fully in the socket before

slipping the gasket into the socket. The joint shall be kept straight during assembly. If a joint deflection is required, make the deflection after assembly, but before tightening bolts, tighten nuts 180 degrees apart in pairs. Alternate pairs until all nuts are within the manufacturer's recommended range of torque. The Contractor shall have a torque wrench on hand at the work site so that the Sandia National Laboratories (SNL) Inspector may verify tightening torque on any joint.

3. Flanged Joints: Clean the flanged ends to be joined immediately prior to joining. Only one gasket shall be permitted in a flange joint. Nuts shall be tightened similar to mechanical joints to within the torque range recommended by the pipe manufacturer.
4. Hardware: All nuts and bolts utilized in underground pipe connections shall be stainless steel, high-strength, cast-iron or high-strength, high-grade steel and shall be of the proper size and type for the application in which they are utilized. All iron or high-strength steel bolts shall be cadmium-zinc plated or coated with bituminous material prior to backfilling. Additionally, all other hardware shall be fully coated with an asphalt or plastic varnish prior to backfilling.

3.02 LOCATION OF WATER AND SEWER LINES

- A. Mains: Water and sewer mains running parallel shall be laid at least 10 feet apart horizontally, with the water main at a higher elevation than the top of the sewer line. Water and sewer mains shall be laid in separate trenches in all cases. Where water and sewer mains are laid closer than 10 feet or where they are crossing, the bottom of the water main shall be at least 12" higher than the top of the sewer line, otherwise, the sewer line shall be of pressure class pipe, or shall be encased in concrete, within 10 feet either side of the water main.
- B. Service Lines: Water and sewer service lines shall not be laid in the same trench, unless the bottom of the water line, at all points, is at least 12" above the top of the sewer line, and the water line shall be laid on a solid shelf excavated at one side of the common trench. Where water and sewer service lines cross, the water line shall be at least 12" higher than the sewer.

3.03 THRUST RESTRAINT

All thrust restraint shall be accomplished by mechanical means unless shown otherwise on the contract drawings. Provide mechanical joint restraints at all tees, plugs, caps, bends, reducers, valves, and other mechanical joint fittings. Concrete blocking shown at a point of connection to an existing does eliminate the requirement for restrained joints at the fitting in question unless specifically stated in the contract drawings. Restrained joints will be subject to the hydrostatic test pressure as specified under hydrostatic testing.

Restrained lengths shall be in accordance with the contract documents or applicable SNL Standard Drawings.

- A. Mechanical joint restraints shall be installed as shown in the contract drawings and per AWWA C600. The use of mechanical joint restraints for modifications to existing piping shall not constitute proper thrust restraint unless verification is made that the uncovered adjacent joints are properly restrained. Concrete blocking may be used in addition to required mechanical joint restraints as alternative to verification of existing joints. Prior to pressure testing the pipe must be properly restrained against movement, backfilled, and compacted between joints to prevent separation of the joints.
- B. Concrete blocking shall be installed in accordance to the requirements of Section 03300, "Cast-in-Place Concrete". Blocks shall be placed in the general shape and to the minimum dimensions indicated on the standard drawings, and shall be placed between the fitting and the undisturbed wall of the trench. Concrete shall be placed so that it does not make contact with any bolts or nuts on the fittings. A polyethylene film shall be placed between the fitting or valve and the thrust block. Pipe shall not be flushed, pressurized, or otherwise disturbed, until the new concrete blocking has reached its initial set and developed adequate strength. Prior to pressure testing the pipe must be properly restrained against movement, backfilled, and compacted between joints. All hardware shall be fully coated with asphalt or plastic varnish.
- C. Installation of Mechanical Joints per AWWA C600
 1. Clean the socket and plain end. Lubrication and additional cleaning should be provided by brushing both the gasket and plain end with soapy water or an approved pipe lubricant meeting the requirements of ANSI/AWWA C111/A21.11, just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
 2. Insert the pipe into the socket and press the gasket firmly into the gasket recess. Keep the joint straight during assembly.
 3. Push the gland toward the socket and center it around the pipe with the lip against the gasket. Insert bolts and hand tighten nuts. Make deflection after joint assembly but before tightening.
 4. Tighten the bolts to the normal range of bolt torque as indicated in the table below while at all times maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This can be accomplished by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, finally the remaining bolts. Repeat the process until all bolts are within the appropriate range of torque.

Pipe Size	Torque
3"	45-60 ft-lbs
4"-24"	75-90 ft-lbs
30"-36"	100-120 ft-lbs

3.04 VALVES

Gate and butterfly valves shall be installed at the locations indicated and as detailed on the contract drawings, and in accordance with AWWA C600. No change in the vertical or horizontal alignment of the pipe shall be allowed at connections to the valve. Valves shall be **INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.**

3.05 VALVE BOXES

Install valve boxes over all gate and butterfly valves as detailed on the contract drawings, and in accordance with AWWA C600. Boxes shall be installed plumb and true, and shall be centered on the valve operating nut. The weight of the valve box shall not bear upon the control valve or pipeline. The valve box shall be accompanied by an 18" X 18" X 6" concrete collar as detailed on the contract drawings or SNL Standard Drawing WW3001STD.

3.06 VALVE STEM EXTENSIONS

Where the valve operating nut is at a depth greater than 2 feet below the valve box cover, an extension stem shall be installed in the box with the required size square wrench nut. Extension stems shall be equipped with a minimum of one stem guide or stem guides at intervals not exceeding 10 feet, and shall be affixed to the interior of the valve box.

3.07 FIRE HYDRANTS

- A. Install fire hydrants at the locations indicated and as detailed on the contract drawing, and in accordance with AWWA C600. Hydrants shall be set plumb and true to the elevations indicated, with the center of the lowest nozzle at least 16" above surrounding finished grade. The traffic flange shall be a minimum of 2" above finished grade and maximum of 8". The 4-1/2" pumper nozzle shall face toward the nearest street, road, drive or parking area or as directed by the SDR. Not less than 8 cubic feet of crushed rock or gravel, 1/2" mean particle size, well-graded, not more than 5% by weight passing #100 sieve, shall be placed around the shoe of the hydrant

so that drainage from the hydrant shall run readily from the drain ports and into the rock. The concrete thrust block at the hydrant shall not block the flow of drainage water from the drain ports. Each hydrant shall be connected to the main by a 6" lateral pipe controlled by a 6" gate valve as indicated on the contract drawings. A concrete collar shall be placed around the hydrant barrel at ground level as indicated in the contract documents or the referenced SNL standard drawing. Hydrants shall be painted per SNL specification division 9 "Painting".

- B. Bollards shall be installed around fire hydrants as required by the construction drawings or per the SNL standard drawings referenced in the contract documents.

3.08 INDICATOR POSTS

- A. Install indicator posts over valves on fire protection lines and on non fire protection lines in remote areas. Posts shall be bolted to the flange at the top of the valve and shall be installed plumb and true to the elevations indicated. The bury line on the indicator post shall match the final grade at the location of the indicator post. Paint indicator posts per SNL specification division 9 "Painting". Indicator posts installed on fire protection mains shall be painted red, and on non fire protection lines shall be painted yellow. Indicator posts shall be installed such that grade mark is level with the finish grade. Indicator posts installed on fire protection mains shall be installed with the following provisions: a ¾" inch rigid metal conduit stubbed up through the concrete collar to facilitate the installation of an electric valve supervision switch in accordance with the contract documents. Refer to SNL Standard Drawing WW3002.
- B. Bollards shall be installed around post indicator valves as required by the construction drawings or per the SNL standard drawings referenced in the contract documents.

3.09 PRESSURE REDUCING VALVES

Install pressure-reducing valves in valve vaults at locations and elevations indicated and as detailed on the contract drawings.

3.10 COMBINATION AIR VALVES

Install combination air valves at high points on the water line where indicated and as detailed on the contract drawings. Combination valves shall be installed in precast reinforced concrete pipe vaults with appurtenant piping, fittings and valves as detailed in the drawings. Provide water meter type cover with vent and concrete collar as detailed.

3.11 CONNECTIONS TO SUPPLY MAINS

- A. Service connections to existing or new mains shall be made with fittings suitable for the particular conditions encountered and in a manner acceptable to the SDR. Connections shall be made by cutting the supply main and inserting a standard tee, by pressure-tapping using a tapping sleeve and valve, or by saddle and corporation stop. Provide non-conducting dielectric connections wherever jointing dissimilar metals on service lines.
- B. All equipment used for drilling, tapping and the installation of tapping saddles and tapping sleeves shall be subject to approval by the SDR.
- C. Direct-taps and multiple service saddle taps staggered around the circumference of the pipe or in a straight line are not allowed on the water main.
- D. Pipe coupons shall not be left inside the water main when the tapping method is used. All pipe coupons removed shall be turned over to the SDR.
- E. Connections 3" or larger to existing mains that are made with a tapping sleeve require the appropriate size thrust block behind the tapping sleeve.
- F. Connections to existing lines made with standard fittings shall require a thrust block at the fitting in locations where mechanical joint restraint requirements can not be confirmed.

3.12 SERVICE LINES

- A. Install service lines at the locations designated on the contract drawings. The installation of the plumbing systems shall conform to the International Plumbing Code (IPC) and this specification.
- B. Copper tubing shall be cut by using cutters designed for that purpose. Bends in copper tubing shall be made using fittings or by using proper tubing benders. Bends in polyethylene tubing shall be made only with the appropriate fittings, and shall not be made by deflecting the tubing.
- C. Brazed Joints:
 - 1. All underground joints shall be brazed.
 - 2. Cut tube ends square. Ream, remove burrs, and size.
 - 3. Brazed copper-to-copper joints shall be made with a silver-brazing alloy conforming to AWS A5.8, BCuP-5 (15% silver). Joints shall comply with ANSI/ASME B31.3 Process Piping.

4. Brazed copper to brass joints shall be made with a silver-brazing alloy conforming to AWS A5.8, BAg-7 (45% silver). Joints shall comply with ANSI/ASME B31.3 Process Piping.
5. Use sand cloth or a steel wire brush to clean surfaces to be joined. Steel wool is not permitted.

3.13 FLUSHING

Flushing shall be performed in accordance with SNL Specification 02516 Flushing and Disinfection.

3.14 HYDROSTATIC TESTING

- A. **WARNING:** The testing methods described in this section are specifically for water pressure testing. These procedures are not permitted for air pressure testing due to the serious safety hazards involved.
- B. New water line installations shall be hydrostatically tested in accordance with AWWA C600 for ductile-iron pipe. The SDR shall be present at all times for the duration of the test.
- C. All temporary plugs, taps, thrust restraints, gauges, and other necessary testing equipment must meet the same nationally recognized standards as listed in Part 2 - Products. They shall be provided by the Contractor and shall be subject to approval by SNL, except that SNL may elect to provide the gauges used in the test.
- D. New lines shall be tested without being connected to existing lines.
- E. Hydrostatic test pressure for new lines (excluding the section of fire protection line which runs from the Post Indicator Valve (PIV) to the sprinkler riser), shall be 150 psi or 1.5 times the normal working pressure of the line, whichever is greater. In addition, test pressure for new fire lines, as defined above, shall be a minimum of 200 psi or 50 psi in excess of static pressures greater than 150 psi, per NFPA 24. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged or left in place at the discretion of the SDR. Test duration shall be not less than 2 hours. During the test, the test pressure shall not drop for lines less than 1000 feet long. For lines greater than 1000 feet long, see article 3.14 F. Each section of the new line between valves shall be tested individually to demonstrate that each valve will hold the test pressure.

In cases where a new main is being connected to an existing main without the installation of a new valve, the end of the new main shall be temporarily capped and restrained, and the test shall be performed on the new line. Tests shall not be made with an existing main included in the test section.

- F. The allowable leakage rate for lines greater than 1000 feet long shall be 11.65 gpd, per mile, per inch nominal diameter while maintaining the test pressure. The new waterline may be accepted if the total test leakage is less than the calculated allowable leakage. If the actual leakage is greater than the allowable leakage, the Contractor shall locate the leakage and make repairs as necessary at no additional cost to SNL. The Contractor shall repeat the test until the leakage is within the specified allowance. All visible leaks, regardless of the amount of leakage, shall be repaired.
- G. The Contractor shall submit a calculation and the data sheet to SNL for each test, showing all data and measured quantities, including the actual leakage, the location of each test section, and a calculation of the allowable leakage for the test section. The test sheet shall be signed and dated by the Contractor's representative. For dedicated Fire Protection lines, complete and submit a Contractor's Material and Test Certificate for Underground Piping in accordance with the current NFPA 24.

3.15 DISINFECTING

Disinfection of the water system shall be performed in accordance with SNL Construction Standard Specification 02516, Flushing and Disinfection of Underground Water Lines for Domestic and Fire Protection Systems.

3.16 STORAGE

- A. All plastic pipe shall be protected from sunlight for long-term storage. Any plastic pipe showing discoloration shall be rejected.
- B. Joint materials for pipe shall be stored in as cool and shaded a place as practicable, preferably at 70 degrees F or less.

END OF SECTION