

SECTION 331000

WATER UTILITIES

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all SECTIONS within DIVISION 1 – GENERAL REQUIREMENTS, which are hereby made a part of this Section of Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Installation of ductile iron pipe, fittings, accessories, and appurtenant work, at the locations and to the lines and grades indicated on the Contract Drawings.
 2. The installation of hydrants, gate valves and boxes and concrete thrust blocks.
 3. Furnishing and installation of all materials required to connect to existing water mains, replace existing services, new gate valves, tapping sleeves, removal of existing gate valves, corporation cocks, saddles, curb stops, service boxes, and abandoning of the existing water system (if applicable), all as shown on the Contract Drawings. All valves, twelve (12) inches and larger shall be butterfly valves. All abandoned pipes shall be plugged and capped with concrete.
 4. In accordance with 528 CMR 12.00, work on the fire protection system, including hydrants and exterior underground piping, shall be performed by a Licensed Fire Protection Sprinkler Systems Contractor. The fire protection exterior underground piping will terminate at the valved tee connection to the water distribution system. The tee and valve will not be considered part of the fire protection system work.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections.
1. Section 312000 – EARTH MOVING for excavation, backfill, and compaction requirements.

1.3 SUBMITTALS

- A. Refer to Section 013300 – SUBMITTAL PROCEDURES for submittal provisions and procedures.
1. Descriptive literature showing pipe dimensions, pipe and joint materials and dimensions, and other details for each class or type of pipe or product to be furnished for this contract.

All pipe furnished under the contract shall be manufactured in accordance with these Specifications.

2. Product Data: Submit manufacturer's technical product data and installation instructions for potable water system materials and products.
3. Shop Drawings: The Contractor shall submit for review shop drawings or descriptive literature for potable water system, showing piping, fittings, couplings, valve, hydrants, materials, dimensions, restrained joint calculations, joints and other details, blocks, and anchors. All hydrants and valves furnished under the Contract shall be manufactured only in accordance with the Specifications and the approved Shop Drawings.
4. Record Drawings: At project closeout, submit record drawings of installed potable water system piping and products, in accordance with requirements of Division 1. As-Built Drawings shall be complete and shall indicate the true measurement and location, horizontal and vertical, of all new construction. As-Built Drawings shall include a minimum of three (3) ties to each valve cover from fixed permanent objects. As-Built drawings shall be stamped and signed by a Massachusetts Licensed Land Surveyor and Licensed Professional Engineer. The as-built plans shall also be submitted electronically as an AutoCAD drawing file (release 2010 or higher) within 90 days of project completion.
5. Maintenance Data: Submit maintenance data and parts lists for water system materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 1.

1.4 REFERENCE STANDARDS

- A. The following standards are applicable to the work of this Section to the extent referenced herein:
 1. ASTM: American Society for Testing and Materials.
 2. ANSI: American National Standards Institute.
 3. AWWA: American Water Works Association.
 4. AASHTO: American Association of State Highway and Transportation Officials.
 5. Reference is made herein to the Commonwealth of Massachusetts, Department of Transportation (MassDOT), Formerly Massachusetts Highway Department (MHD) *Standard Specifications for Highways and Bridges*, latest edition, hereinafter referred to as the "Standard Specifications". All references to method of measurement, basis of payment, and payment items in the "Standard Specifications" are hereby deleted. References made to particular sections or paragraphs in the "Standard Specifications" shall include all related articles mentioned therein.
 6. Commonwealth of Massachusetts, Department of Transportation, Construction Standards, latest Edition with amendments, hereinafter referred to as the "Construction Standards."

7. Commonwealth of Massachusetts State Plumbing Code, latest edition.
8. Commonwealth of Massachusetts Regulations 528 CMR 12.00 Sprinkler Contractor Licensing Regulations.
9. City of Lowell Engineering Department Regulations.
10. Lowell Regional Water Utility Regulations.

1.5 EXAMINATION OF SITE AND DOCUMENTS

- A. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of a lack of knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation of the site.
- B. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of portable water systems materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.
- B. Installer's Qualifications: Firm with at least three years of successful installation experience on projects with portable water piping work similar to that required for this project.
- C. Water Purveyor Compliance: Comply with requirements of Purveyor supplying water to project, obtain required permits and inspections.
- D. A Certificate of Substantial Completion shall be issued upon acceptance of this work.

PART 2 – PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

- A. General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Engineer to comply with installation requirement. Provide pipe fittings and accessories of same materials and class as pipes with joining method, as indicated. The piping shall be manufactured by an established manufacturer of good reputation in the industry and in a permanent plant adapted to meet all the design requirements of the pipe.
 1. Ductile iron pipe shall be that of a manufacturer who can demonstrate at least five years of successful experience in manufacturing ductile iron pipe. The pipe shall be equipped with push-on type, restrained joint, or mechanical joints, as required.

2. All ductile iron water pipe shall conform to American Water Works Association (AWWA) C150 and AWWA C151.
3. The ductile iron pipe shall be Class 52 and furnished in minimum nominal 18-foot lengths, with Push-on or Mechanical Joints as manufactured by U.S. Pipe and Foundry Company, Atlantic States Cast Iron Pipe Co., Clow Corporation, or approved equal with gaskets conforming to AWWA C111 "Rubber Gasket Joints". A minimum of two brass wedges per joint shall be used to maintain conductivity and facilitate lock-on.
4. All ductile iron pipes shall be rated for a minimum operating pressure of 350 psi.
5. The ductile iron water pipe shall be double cement lined inside and then asphalt seal coated in accordance with AWWA C104 and AWWA 203. The pipe shall be furnished along with necessary materials and equipment recommended by the manufacturer for use in joining pipe lengths and fittings.
6. All water pipe shall be encased in polyethylene film when the trench is backfilled with control density fill.
7. Fittings shall be short body ductile iron Class 350 Mechanical Joint, conforming to ANSI Specification AWWA C153, latest edition, for pipe sizes 16-inches and smaller, and Class 350 standard Mechanical Joint fittings conforming to AWWA C110, latest edition, for pipe sizes 16 through 24-inches, unless specifically stated otherwise in the Specifications or on the Contract Drawings. Fittings shall have the same lining and coating as the pipe specified above. All fittings shall be marked with the weight and shall have distinctly cast upon them the pressure rating, the manufacturer's identification, nominal diameter of openings and the number of degrees or fraction of the circle on all bends. Fittings greater than 24-inches shall be as specified above except they shall be Class 250. All nuts and bolts shall be of a type equal to ductile iron or KOR-10 steel T-bolts and nuts or an approved equal.
8. In order to provide positive joint restraint, valve anchor tees/valves and restrained joints shall be used on fire services and the on 6-inch branch connections for hydrants.
9. Caps and plugs installed in all new work as indicated on the Contract Drawings shall be provided with a threaded corporation or bleeder valve so that air and water pressure can be relieved prior to future connection.
10. Contractor shall provide all adapters and fittings such as transition couplings, as determined in the field, necessary to complete all cross-connections, whether or not specifically stated in the Contract Drawings and Specifications.
11. All pipe shall be marked with the class, thickness designation and initials of the manufacturer.
12. If required the manufacturer shall supply the Engineer with certificates of compliance with these Specifications and certification that each piece of ductile iron pipe has been tested at the foundry with the Ball Impression Test, Ring Bending, or equal.

13. Thrust blocks shall be used at all bends and fittings as shown on the details. In addition, all bends and fittings shall be restrained with Megalug Series 1100 mechanical joint restrained. In the event that the use of thrust blocks is not practical, the Contractor shall provide an alternate method of joint restraint, at no additional cost to the owner, as approved and/or as directed by the Engineer. Restraint length calculations and restrained joint locations shall be provided by the contractor and submitted to the engineer for review. Restraint length values shall be calculated per the manufacture's standards.
- a. Restraint for standardized mechanical joints shall be incorporated in the design of the follower gland and shall impart multiple wedging action against the pipe, increasing its resistance as the pressure increases. The assembled joint shall maintain its flexibility after burial and shall maintain its integrity by a controlled and limited expansion of each joint during the wedging action. Restraining glands shall be manufactured of high strength ductile iron conforming to the requirements of ASTM A536, Grade 65-45-12. Wedging mechanisms shall be manufactured of ductile iron, heat treated to a hardness of 370 BHN minimum. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee head bolts conforming to the requirements of ANSI/AWWA A21.11/C111 and ANSI/AWWA A21.53/C153 of latest revision. Twist-off nuts shall be incorporated in the design of the wedge activation screws to insure proper torque. The mechanical joint restraining device shall have a water working pressure rating of 350 psi minimum (in sizes 4" thru 16") with a safety factor of at least 2:1 against separation when tested in a dead-end situation.
- b. Restraint for push-on ductile iron pipe shall consist of a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell. The restraint ring shall have individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The restraint ring and its wedging components shall be made of minimum grade 65-45-12 ductile iron conforming to ASTM A536. The wedges shall be heat treated to a minimum hardness of 370 BHN. Torque limiting twist off nuts shall be used to insure proper actuation of the restraining wedges. The split ring shall be made of a minimum grade of 65-45-12 ductile iron conforming to ASTM A536. The connecting tie rods that join the two rings shall be made of low alloy steel that conforms to ANSI/AWWA C111/A21.11. The assembly shall have a rated pressure with a minimum two to one safety factor of 350 PSI in the sixteen inch size and below 250 PSI in the eighteen through thirty-six inch sizes. Push on joints on ductile iron pipe shall be restrained with Megalug Series 1700 restraint harness.
14. Pipe for use with split couplings shall be as specified except that the ends shall not have bells or beads but shall have cast or machined shoulders or grooves as necessary for the couplings to be used and shall conform to the specifications of the manufacturer of the couplings. If split couplings are used with grooved ductile-iron pipe, the minimum pipe wall thickness shall be as follows:

Nominal Pipe Size (In.)	Thickness Class
4-12	53
14-18	54
20	55

24

56

15. Pipe for use with sleeve-type couplings shall be as specified except that the ends shall be plain (without bells or beads). The ends shall be cast or machined at right angles to the axis.

B. COUPLINGS AND ADAPTERS FOR DUCTILE IRON PIPE

1. Sleeve-type couplings for plain-end pipe shall be provided with plain rubber gaskets and steel, tee-head bolts with nuts. Couplings shall be Dresser style 38 or 138, furnished preassembled, as manufactured by Dresser Industries, Inc., Smith-Blair, Coupling Systems, Inc., or equal.
2. Couplings or adapters as required for connecting existing pipe to new pipe or new pipe to new pipe shall be furnished as required and designed for compatibility with the pipe and operating pressures encountered. Couplings shall be Dresser Style 162 as manufactured by Dresser Industries Inc., or equal. Flanged adapters shall be Dresser Style 128, or equal. Couplings for ductile iron to cast iron pipe shall be Style 53, and for ductile iron to transite pipe shall be style 153, as manufactured by Dresser Industries, Inc., or as manufactured by Smith-Blair, Coupling Systems, Inc. or equal. Transition couplings shall be style 162 as manufactured by Dresser Industries, Inc. or approved equal.
3. Split couplings may be used for connecting gray cast iron or ductile iron. If split couplings are used with grooved ductile iron pipe, the minimum pipe wall thickness shall be as specified. Split couplings shall be made of malleable iron and shall be suitable for use with grooved-end or shouldered-end, cast iron pipe. They shall be Victaulic couplings made by the Victaulic Company of America, Elizabeth, New Jersey; Gruvagrip couplings made by Gustin-Bacon Manufacturing Company, Kansas City, Missouri; Groove couplings made by Eastern Malleable Iron Company, Pittsburgh, Pennsylvania; or equal products.
4. Flexible Couplings: Sleeve-type couplings for plain-end ductile iron pipe shall be provided with plain rubber gaskets and steel, track-head bolts with nuts.
5. Couplings shall be furnished pre-assembled by the manufacturer.
6. Couplings shall be given a shop coat compatible with the same outside coating as the pipe specified above.
7. All couplings shall be furnished with the pipe stop removed.
8. Couplings shall be provided with gaskets of a composition suitable for exposure to the liquid within the pipe. The gaskets shall have metallic tips to provide electrical continuity through the joint.
9. The Contractor shall provide suitable filling rings where the layout of the flanged piping is such as to necessitate their use. In materials, workmanship, facing, and drilling, such rings shall conform to the 125 pound ANSI Standard. Filling rings shall be of suitable length with nonparallel faces and corresponding drilling, if necessary, to endure correct assembly of the adjoining piping or equipment.

10. Couplings for exposed pipe shall be of steel and shall be Dresser Style 38, Smith-Blair Style 411, Baker Allsteel, or equal. The couplings shall be provided with steel bolts and nuts.
11. At the Contractor's option, flexible connections in the piping shall be sleeve-type couplings, split couplings or mechanical joint pipe as herein specified.

C. INSPECTION, TESTS AND ACCEPTANCE FOR DUCTILE IRON PIPE

1. All pipe delivered to the job site shall be accompanied by test reports certifying that the pipe and fittings conform to "AWWA Standard for Ductile Iron Pipe, for Water and Other Liquids" (AWWA H3) and (AWWA C151).
2. All tests shall be made in accordance with the methods prescribed by the above mentioned AWWA Standards, and the acceptance or rejection shall be based on the test results.
3. Pipe which does not conform to the requirements of this contract shall be immediately removed and replaced by the Contractor.
4. All ductile iron pipe to be installed under this Contract may be inspected at the foundry for compliance with these Specifications by an independent testing laboratory selected by the Owner. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of foundry inspection of all pipe approved for this Contract, plus the cost of the inspection of a reasonable amount of disapproved pipe, will be borne by the Owner.

D. FLANGED JOINTS FOR DUCTILE IRON PIPE

1. For flanged joints, gaskets shall be ring gaskets of rubber with cloth insertion. Gaskets twelve (12)-inches in diameter and smaller shall be 1/16-inch thick, gaskets larger than twelve (12)-inch shall be 3/32-inch thick.
2. Flanged joints shall be made with bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges. Bolts and nuts shall, except as otherwise specified or noted on the Contract Drawings, be Grade B conforming to the ASTM Standard Specification for Carbon Steel, Externally and Internally Threaded Standard Fasteners, Designation A307. Bolts and studs shall be of the same quality as machine bolts. Flanged ductile iron pipe from 3 to 48-inches in diameter shall be classified by Underwriters Laboratories Inc. in accordance with AWWA C115.

2.2 BUTTERFLY VALVES

- A. Butterfly valves shall be cast iron ASTM A-126 Class B body and shall have integrally cast mechanical joint ends, and Type 304 stainless steel body seat made integral with the valve body. Valves and components shall meet all requirements of AWWA C504.

- B. Valve vane shall be constructed of high strength cast iron ASTM A48 Class 40.
- C. Valve shafts for sizes up to and including 12-inch shall be one piece stainless steel extending full size through the disc and bearings. Valve shafts for 14-inch and larger shall be 18-8 stainless steel stub shaft design keyed to the vane with stainless steel taper pins.
- D. Valve seats shall be Buna N vulcanized mechanically secured to the vane with an integral stainless steel seat-retaining ring and self-locking Series 300 stainless steel screw fasteners. Valve seats located in the body on the valve shall be retained by mechanical means without rings, screws, etc. All seats shall provide full 360-degree coverage and be field adjustable and replaceable.
- E. Valve bearings shall be sleeve type, corrosion resistant, and self-lubricating with load not to exceed 2,500 pounds per square inch.
- F. Valve operator shall be traveling nut type suited for buried service. Operator shall produce required operating torque to seat, unseat or hold the vane steady in any intermediate position. Operator shall produce required operating torque with a maximum input of 150 ft-lbs. on the wrench nut. All actuator components between input and stops shall withstand without damage an input torque of 300 ft-lbs. minimum. It must be fully gasketed and grease packed and designed to withstand submersion in water to 10 pounds per square inch. Valves shall have 2-inch standard AWWA operating nuts. All valves shall open right.
- G. Valves shall have hydrostatic and leakage tests conducted in accordance with AWWA C504. Valves 12-inch and less shall be tested bubble-tight at a rated working pressure of 200 psi. Valves 14-inch and larger shall have a rated working pressure of 150 psi.
- H. Butterfly valves shall be as manufactured by M & H Valve Company, Dresser, Clow, or approved equal.

2.3 RESILIENT WEDGE GATE VALVES

- A. Resilient wedge gate valves shall be iron body, resilient seated type. The valves shall be designed for 250 psi working pressure and 400 psi test pressure.
- B. Valves are to have O-ring seals and a nonrising stem. Valves shall have a 2-inch operating nut. Valves shall open right.
- C. Resilient gate valves shall meet the most recent version of the AWWA standard specification AWWA C509.
- D. Resilient wedge valves shall have mechanical joint ends.
- E. Valves shall be as manufactured by U.S. Pipe and Foundry Company Metroseal 250 or American Flow Control Model AFC2500.
- F. Valve boxes shall be cast iron, asphalt coated, sliding, heavy pattern type, consisting of three (3) pieces; a flanged bottom piece, a flanged top piece, and a cover with two (2) lifting holes and the word "water" cast on the top. A minimum 6-inch overlap is required between sliding sections. The valve box shall be designed and constructed to prevent direct transmission of traffic loads to the pipe or valve. The inside diameter of boxes shall be at least 4 1/2-inches and lengths shall be

as necessary to suit ground elevation. The top of the cover shall be flush with the top of the box rim. Box covers shall be round frame and cover.

- G. Valves shall be connected directly to valve anchor tees at all hydrant branches.

2.4 TAPPING SLEEVES AND VALVES

- A. Tapping sleeves shall be of ductile iron construction, meeting ASTM A536 Grade 65-45-12. Side flange seals shall be O-Ring type of round, oval or rectangular cross-section shape. Sizes 12” and smaller must be capable of working on Class ABCD pipe diameters without changing either half of sleeve. Sizes 14” and larger must be specified to which class is needed. All sleeves are to include the end joint accessories and split glands necessary to assemble sleeve to pipe. Sleeve shall be coated with asphaltic varnish in compliance with NSF-61.
- B. Tapping valves shall conform to the requirements specified above for gate valves except that all Tapping sleeves and valves shall consist of a ductile iron flanged by mechanical joint sleeves and a tapping-type gate valve with one flange and one mechanical joint end. The Contractor shall be responsible for verifying the outside diameter of the pipe to be tapped.
- C. The valve shall be provided with an oversized seat to permit the use of full size cutters. Before backfilling, all exposed portions of any bolts used to hold the two halves of the sleeves together shall be heavily coated with two coats of bituminous paint comparable to Inertol No. 66 Special Heavy. Sleeves shall be of ductile iron furnished with O-ring gaskets.
- D. Bolts on bonnet and stuffing box shall be stainless steel (316 stainless steel), stuffing boxes shall be “O” ring type as indicated. Gaskets shall cover the entire flange surface.

2.5 IDENTIFICATION

- A. Detectable Underground Warning Tapes: Acid and alkali-resistant polyethylene plastic film warning tape, 6-inches wide by 4-mils minimum thickness, with continuously printed caption in black letters "CAUTION - xxxxx LINE BURIED BELOW." The text and color of the tape shall be as shown in the table below. The tape shall have a metallic core encased in a protective jacket for corrosion protection and be detectable by a metal detector when the tape is buried up to 2.5-feet deep.

Color	Utility
Safety Red	Electric
High Visibility Safety Yellow	Gas, Oil, Steam
Safety Alert Orange	Telephone, Communications, Cable Television
Safety Precaution Blue	Water System, Irrigation
Safety Green	Sanitary Sewer, Storm Sewer
White	Proposed Excavation

PART 3 – EXECUTION

3.1 INSPECTION

- A. General: Examine areas and conditions under which potable water system's materials and products are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.
- B. The Contractor is responsible for the provisions and all test requirements specified in herein. In addition, all pipe and appurtenances may be inspected at the plant for compliance with these specifications by an independent testing laboratory.
- C. All tests shall be made in accordance with the methods prescribed by the above-mentioned AWWA Standards, and the acceptance or rejection shall be based on the test results.
- D. Inspection of the pipe and appurtenances may also be made after delivery. The pipe and appurtenances shall be subject to rejections at any time on account of failure to meet any of the specifications requirements, even though samples may have been accepted as satisfactory at the place of manufacture.
- E. Pipe which does not conform to the requirements of this contract shall be immediately removed and replaced by the Contractor at no cost to the Owner.

3.2 HANDLING PIPE

- A. The Contractor shall take care not to damage pipe by impact, bending, compression, or abrasion during handling, and installation. Joint ends of pipe especially shall be kept clean.
- B. Pipe shall be stored above ground at a height no greater than 5-feet, and with even support for the pipe barrel.
- C. Only nylon-protected slings shall be used for handling the pipe. No hooks, chains or bare cables will be permitted.
- D. Gaskets shall be shipped in cartons and stored in a clean area, away from grease, oil, heat, direct sunlight and ozone producing electric motors.

3.3 INSTALLATION OF PIPE AND PIPE FITTINGS

- A. The Contractor shall provide all adapters and fittings such as transition couplings, as determined in the field, necessary to complete all cross-connections, whether or not specifically stated in the Contract Drawings and Specifications.
- B. Care shall be taken in loading, transportation, and unloading to prevent injury to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe and fittings shall be examined before placement, and no piece shall be installed which is found to be defective. Any damage to the pipe coatings shall be repaired as directed by the Engineer or Owner's Representative.

- C. If any defective pipe is discovered after it has been placed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at his own expense. All pipe and fittings shall be kept clean until they are used in the work, be thoroughly cleaned before placement, and when placed, shall conform to the lines and grades required. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA Standard Specification C600 except as otherwise provided herein. A firm even bearing throughout the length of the pipe shall be constructed by compacting sand gravel borrow around the pipe and up to 18 inches above the pipe.
- D. Blocking will not be permitted.
- E. A minimum horizontal separation of ten (10) feet shall be maintained between and existing, proposed or relocated sewer and the new water main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten foot separation, it is permitted to install a water main closer to a sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located eighteen (18) inches above the top of sewer. Where the horizontal clearance is less than ten (10) feet or the vertical clearance is less than eighteen (18) inches and the sewer crosses under the water main, both water main and sewer main shall be constructed of mechanical joint cement lined ductile iron pipe for a distance of 10-feet on either side of the crossing. One (1) full length of water pipe shall be centered over the sewer at the crossing. If the sewer crosses over the water main, regardless of the vertical separation, both pipes shall be concrete encased for a distance of ten (10) feet to either side of the respective centerline.
- F. Provide minimum cover over piping of 5-feet below finished grade.
- G. Extend water systems from the water main located within the public way and terminate portable water piping 10-feet 0-inches from the building foundation. Provide temporary pipe plug for piping extension into building if required by construction progress.
- H. All pipes shall be sound and clean before placement. When pipe laying is not in progress, including lunchtime, the open ends of the pipe shall be temporarily closed by watertight plug or other acceptable means. Alignment shall be maintained during placement. The deflection at joints shall not exceed sixty percent of that recommended by the manufacturer. Fittings, in addition to those shown on the plans, shall be provided, if required, in crossing utilities, which may be encountered upon opening the trench. Solid sleeves shall be used only where allowed by the Engineer.
- I. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a push-on type bell shall be beveled to conform to the manufactured spigot end. Cement lining shall be inspected for damage and shall be remortared as required to ensure a continuous lining.
- J. Mechanical joint restraints shall be used for all valves, bends, hydrants and piping section less than 50 feet. The contractor shall restrain all pipe runs to the lengths indicated on the approved restrained joint calculation shop drawings.
- K. Jointing of ductile iron push-on pipe and fittings shall be done in accordance with the printed recommendations of the manufacturer and as specified. The last 8-inches of the outside of the spigot end of pipe and the inside of the bell end of pipe shall be thoroughly cleaned. The joint

surfaces and the gasket shall be painted with a lubricant just prior to making up the joint. The spigot end shall then be gently pushed home into the bell. The position of the gasket shall be checked to insure that the joint has been properly made and is watertight. Care shall be taken not to exceed the manufacturer's recommended maximum deflection allowed for each joint.

1. Jointing Ductile Iron Pipe (Push-On Type): Push-on joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe, and the joint surfaces cleaned and lubricated. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be joined, and pushed home with a jack or by other means. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is correctly located.
 2. Jointing Mechanical Joint Fittings: Mechanical joints at valves, fittings, and where designated shall be installed in accordance with the "Notes on Method of Installation" under ANSI Specification A 21.11 and the instructions of the manufacturer. To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tight to the specified torque. Under no condition shall extension wrenches or pipes over handles or ordinary ratchet wrenches be used to secure greater leverage.
- L. Installation and jointing of ductile iron pipe shall be in accordance with AWWA C600, Sections 9b and 9c, latest revision, as applicable.
- M. Ductile iron pipe installed within 5-feet of gas lines shall be fully encased with polyethylene material. Polyethylene shall be 8-millimeters thick and comply with AWWA C-105.
- N. Service tubing shall be installed with minimum 6-inches of sand bedding and 12-inches sand cover. Service tubing shall have a minimum total cover of 5 feet.

3.4 INSTALLATION OF VALVES AND APPURTANCES

- A. Cleaning And Prime Coating Valves And Appurtenances (Except Epoxy Coated Valves)
1. Prior to shop prime coating, all surfaces of the valves and appurtenances shall be thoroughly clean, dry, and free from all mill-scale, rust, grease, dirt, paint and other foreign substances to the satisfaction of the Engineer or Owner's Representative.
 2. All ferrous surfaces shall be sand blasted or pickled according to SSPC-SP6 or SSPC-SP8, respectively.
 3. All gears, bearing surfaces and other surfaces not to be painted shall be given a heavy coat of grease or other suitable rust resistant coating unless otherwise specified herein. This coating shall be maintained as required to prevent corrosion during any period of storage and installation and shall be satisfactory through the time of final acceptance.
- B. INSTALLATION

1. All valves and appurtenances shall be installed in the location shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired before they are installed.
2. Care shall be taken to prevent damage to valves and appurtenances during handling and installation. All materials shall be carefully inspected for defects in workmanship and materials, all debris and foreign material cleaned out of valve openings, etc., and all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves and other equipment that do not operate easily, or are otherwise defective, shall be repaired or replaced.

C. SHOP PAINTING VALVES AND APPURTENANCES

1. Interior and exterior surfaces of all valves which are not factory epoxy coated shall be given two coats of shop finish of an asphalt varnish conforming to AWWA C504 for Varnish Asphalt. The pipe connection openings shall be capped to prevent the entry of foreign matter prior to installation.

D. BURIED VALVES

1. Install valves as indicated with stems pointing up. Provide valve box over underground valves. Buried valves and boxes shall be set with the operating stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping selected excavated material under and at the sides of the valve.

E. VALVE BOXES

1. Valve boxes shall be installed vertically, centered over the operating nut, and if they are in the limits of the roadway or within limits where the plowing of snow will take place in the winter, the tops of the boxes shall be set $\frac{1}{2}$ " below the top of the finished grade. In locations where these boxes are not likely to be disturbed, the tops shall be set flush with the adjoining ground. Boxes shall be adequately supported during backfilling to maintain vertical alignment.

3.5 INSTALLATION OF HYDRANTS

- A. Hydrants and hydrant branches shall be tested at 175 psi and chlorinated as specified in this specification.
- B. Hydrants shall be installed in conformance to AWWA C 600, Section 11, latest revision, using thrust blocks and restrained joints in accordance with the details shown on the Contract Drawings.
- C. Hydrants as detailed on the Contract Drawings shall be set at the locations designated by the Engineer and shall be bedded on a firm foundation. A drainage pit 2-feet 6-inches in diameter and to the limits shown on the Contract Drawings shall be filled with crushed stone and satisfactorily compacted. During backfilling, additional crushed stone shall be brought up around, and 6-inch over the drain port. Each hydrant shall be set in true vertical alignment and shall be properly braced. Thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at

the end of the trench. Hydrant shall be set upon a slab of concrete not less than 4-in thick and 15-in square.

- D. Hydrants shall be set plumb with the steamer nozzle facing the roadway and the center of the operating nut located 18-inches back from the face of curb or edge of pavement.
- E. Hydrants shall be set such that the bottom of the breakaway feature shall be a minimum of 2-inches and a maximum of 4-inches above finish grade.
- F. Once installed, hydrants shall be painted once again by the Contractor. Hydrants shall be painted in accordance with the Owner's requirements.
- G. All iron work to be set below ground, after being thoroughly cleaned, shall be painted with two coats of asphalt varnish as specified in AWWA C502, latest revision and iron work to be left above ground shall be shop painted with two coats of paint.
- H. Thrust Blocks: Concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the Contract Drawings. Felt paper shall be placed as shown on the Contract Drawings. Care must be taken to ensure that concrete does not plug the drain ports.

3.6 BACKFILLING

- A. General: Conduct backfill operations of open-cut trenches closely following laying, jointing, and bedding of pipe, and after initial inspection and testing are completed, all in accordance with local requirements and the contract documents.
- B. Initial backfill shall be placed evenly on both sides of the pipe to distribute the load and not to cause movement or deflection of the pipe.

3.7 FIELD QUALITY CONTROL

- A. Testing of Water Main/Service:
 - 1. Prior to pressure testing, the entire line shall be water jetted to remove any rocks or debris that may have inadvertently entered the pipe during construction.
 - 2. The Contractor in accordance with AWWA C651-99 specifications or latest revision will make pressure and leakage tests thereof, to determine that the ductile iron pipe is structurally safe and free of excess leakage. Pipeline shall be subject to a hydrostatic test of 150 pounds per square inch (psi) or 150% of the static pressure, whichever is greater. The Contractor shall furnish all equipment, materials and labor for testing. Testing shall be done between valved off sections in approximately 1000-foot maximum section of the main. The Contractor shall furnish at his own expense the water needed for all water main testing.

3. Once the pipeline section has been filled at normal pressure and all entrapped air removed from the line, the Contractor shall raise the pressure to the approved test pressure by a special pressure pump taking water from a small tank of proper dimensions for satisfactorily measuring the rate of pumpage into the pipeline. The pipe shall maintain this pressure, within 5 psi, for a minimum of two hours during which time the line shall be checked for leaks. The measured water leakage shall not exceed the maximum allowed leakage as determined by the following equation for the section under test:

$$L = SDP^{1/2} / (133,200)$$

Where:

L = Allowable leakage, gallons per hour
S = Length of pipe section tested, feet
(1,000-foot maximum)
D = Nominal pipe diameter, inches.
P=Average test pressure (psi)

Should leakage exceed this rate, the Contractor shall immediately locate the leak or leaks and repair same at his expense. Pipe shall be flushed and chlorinated when leakage does not exceed above standard. Approval does not absolve the Contractor from his responsibility if leaks develop within the new main or water services (to curb box) later within the period of warranty.

B. Testing of Fire protection service:

1. Testing of fire protection services shall conform to the most current NFPA requirements.

C. Chlorinating and Flushing:

1. Prior to chlorination, the Contractor shall properly flush mains. In general, flushing shall be performed at a flow rate required to achieve a minimum velocity of 2.5-feet per second (approximately 900 GPM in a 12-inch diameter main and 400 GPM in 8-inch diameter main). Flushing shall be performed for a sufficient period of time to allow for a minimum of 3 volume changes of water in the main (approximately 20 minutes per 1,000-foot of 8-inch main at the above flow rate).
2. Chlorinating shall be accomplished by pumping a chlorine solution into the mains. Water shall be allowed to enter the new water mains until the mains are full of a solution containing 25-ppm available chlorine. The valves shall then be closed and the chlorinated water allowed to stay in the mains for 24 hours. At the end of this period, the chlorine residual shall be at least 10 mg/l. If it is less than 10 mg/l measured, Contractor shall flush and rechlorinate the mains at no cost to the Owner. All valves and hydrants shall be operated to insure their proper disinfection and shall be manipulated to prevent superchlorinated water from entering the existing distribution system. After this period, the Contractor shall flush the mains until clear, clean water is being discharged.
3. Chlorinating and flushing shall be done in accordance with AWWA C651-99 Specifications.

4. Twenty-four hours after the main has been flushed of chlorinated water, bacteriological samples shall be taken. Water samples shall be taken from corporation stops along the length of the water main as designated by the Engineer. A minimum of two (2) samples shall be taken, per 3,000 foot of pipe or on each street, whichever is greater, each in duplicate, in sterile bottles and sent to a State approved private laboratory for analyses. The Contractor shall perform all necessary work including delivery of samples to a certified laboratory, and shall include the cost for sampling and analysis in his bid price. The results of the tests on these samples will determine the acceptance of the work and allow these new mains to be connected to the District's system. The failure of any sample to pass the laboratory tests shall require the Contractor to reflush and rechlorinate the mains and resample and test the water until acceptable results are obtained, all at no additional cost to the Owner.
5. The Contractor shall submit a Disinfection report detailing the following:
 - a. Type and form of disinfectant used.
 - b. Date and time of disinfectant injection start and time of completion.
 - c. Test locations.
 - d. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - e. Date and time of flushing start and completion.
 - f. Disinfectant residual after flushing in ppm for each outlet tested.
6. The Contractor shall submit a Bacteriological Report detailing the following:
 - a. Date issued, project name, and testing laboratory name, address, and telephone number.
 - b. Time and date of water sample collection.
 - c. Name of person collecting samples.
 - d. Test locations.
 - e. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
 - f. Coliform bacteria test results for each outlet tested.
 - g. Certification that water conforms, or fails to conform, to bacterial standards.
7. Contractor shall note that work under this Contract shall NOT be considered completed until satisfactory installation and testing of the water mains have been completed.

3.8 FINAL INSPECTION

- A. Final inspection and acceptance of pipe, valves, appurtenances, and precast concrete structures shall be made by the Owner's Representative and the utility owner having jurisdiction of the particular system. Prior to placing the systems in service all components shall be inspected, with the Owner's Representative present, to insure that no debris or other contaminants are present. If necessary, the Contractor shall clean the structures and flush piping.
- B. The Contractor is responsible for coordinating and scheduling the inspection of the work by local jurisdictional authorities. No additional payment will be made for inspections and permits required in the performance of the work.

ALTERANTE NO. 1
MARCH 26, 2014

MASS. STATE PROJECT NO. UML1203-DC1
NEW BUSINESS SCHOOL
UNIVERSITY OF MASSACHUSETTS LOWELL
LOWELL, MA

END OF SECTION 331000