

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. Provide labor, materials, and equipment necessary to construct the exterior water system complete, including connections to existing pipelines and testing, all as indicated on the Drawings and as specified, 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, install new gate valves, remove existing gate valves, install 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, 24 inches and larger shall be butterfly valves. All abandoned pipes shall be cut and capped at the main.
 - 4. In accordance with 528 CMR 11.00, 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. Unless otherwise indicated on the Drawings, exterior water lines shall be installed from a point 10 feet outside the building foundation walls to the potable water source
- C. 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 soil materials, excavating, backfilling, and site grading and removal of site utilities.
 - 2. Section 211000 – FIRE PROTECTION for fire protection service piping.
 - 3. Section 221000 – PLUMBING for potable water service piping.

1.3 SUBMITTALS

- A. Refer to Section 013300 – SUBMITTAL PROCEDURES, for submitted 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, valves, 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. 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 be stamped and signed by a Massachusetts Licensed Land Surveyor or Licensed Professional Engineer. The as-built plans shall also be submitted electronically as an AutoCAD drawing file (release 2010 or higher).
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. MassDOT, 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. Town/City Water Department 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 potable 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 potable 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.

1.7 PROJECT CONDITIONS

- A. **Site Information:** Perform site inspection and survey, research utility records, and verify existing utility locations and elevations. Verify that water system piping may be installed in compliance with Contract Drawings and referenced standards.
- B. **Interruption of Existing Water Distribution System:** Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to the requirements indicated:
 - 1. Notify Architect no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Architect's written permission.

1.8 SEQUENCING AND SCHEDULING

- A. Coordinate with interior building domestic water and fire protection system piping.
- B. Coordinate with other utility work.
- C. The Contractor is responsible for developing a sequence of work to maintain existing services in operation until the new services are operational.
- D. The Contractor is responsible for coordinating and scheduling the inspection of the work by the jurisdictional authority. All permits and inspection costs and fees shall be included in the bid prices and no additional costs will be paid to the Contractor.

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 requirements. 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 bronze 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 C151. 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 ASTM A-536 ductile iron with mechanical joint fittings. All fittings 3 inches through 48 inches in diameter shall meet or exceed the requirements of AWWA C110. Compact fittings shall be ductile iron meeting or exceeding the requirements of AWWA C153. 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. All fittings 4 through 24 inches shall be Class 350. All fittings greater than 24 inches shall be as specified above except they shall be Class 250. Compact fittings shall only be used in sizes 4 through 24 inches. Fittings shall conform to the weights, excluding accessories, and dimension shown in the latest edition of the Handbook of Ductile Iron Pipe and come complete with all joint accessories as required. All accessories (gland, gaskets, T-bolts, and nuts) shall be in accordance with AWWA C111. All mechanical joint bolts (T-bolts) shall be Cor-Ten or equal.
 8. In order to provide positive joint restraint, valve anchor tees/valves and restrained joints shall be used on fire services and on the 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 restraint. In the event that the use of thrust blocks is not practical or allowed, 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 manufacturer'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 ensure 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 ensure 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. Insulation shall be manufactured by Thermal Pipe Systems, Atlas Insulation, or Insulated Piping Systems Inc., or other approved manufacturer. Insulation shall be factory foamed-in-place polyurethane foam insulation having nominal thickness of 1 1/2-inch, with an in-place density of 2.5 pcf, and a "K" factor of 0.16 BTU*in./hr.*°F*sq. ft. Straight joints between insulated pipe lengths, and the end sections of non-insulated pipe shall be sealed with heat shrinkable wrap-around polyethylene as supplied by manufacturer and installed in field by Contractor. Insulation jacket shall be 20-gauge corrugated aluminum preformed to be fastened with stainless steel screws and bands. Jacket shall have one layer of one mil polyethylene film with a protective coat of 40-pound virgin Kraft paper to act as a moisture and galvanic corrosion barrier.
15. 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

16. 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 ensure 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 12-inches in diameter and smaller shall be 1/16-inch thick, gaskets larger than 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 PVC WATER PIPE

- A. General: Provide pipes of the following materials of class indicated. 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.
- B. PVC pipe used for water mains shall be polyvinyl chloride (PVC) pipe, Class 150 with integral thickened wall bells, as manufactured by Manville Corporation, Certain Teed Corporation, Capco or approved equal. Pipe shall be made from clean, virgin approved Class 12454 B PVC compound conforming to AWWA Specification C900.
- C. All pipe shall meet with cast iron pipe equivalent outside diameters.
- D. All pipe and fittings shall be marked with size, class, material, grade, and initials of the manufacturer. The pipe shall be furnished in standard 20-foot lengths.
- E. All pipes shall be suitable for use as a pressure conduit for potable water.
- F. Each pipe length shall be hydrostatic proof tested to four times the class pressure of the pipe for a minimum of five seconds.
- G. The pipe shall withstand without failure an impact of 100 ft./lb. for pipe sizes 8 inches and smaller from a freely falling missile; with a 2-inch radius nose at 70°F., as per ASTM D2444. There shall be no visible evidence of shattering, cracking or splitting when energy is imposed.
- H. Randomly selected samples shall be quick burst tested in accordance with ASTM D1599. The pipe shall withstand without failure a pressure of 755 psi applied in 60 to 70 seconds at 73°F.
- I. The pipe shall not balloon, burst or weep as defined in ASTM D1598 when tested at a sustained pressure of 500 psi applied for 1,000 hours as specified in ASTM D2241.
- J. The inside surface of each length of pipe shall be free from nicks, scratches and other surface defects and blemishes. The pipe shall be homogeneous throughout free of any bubbles, voids or inclusions.
- K. If requested, the manufacturer shall supply the Engineer with certificates of compliance with specifications and certifications that each piece of PVC pipe conforms to AWWA Specification C900 and has been tested with the Drop Impact Test in accordance with ASTM D2444.

- L. The integral socket bell of the PVC pipe shall meet the same strength requirements as that of the pipe. The bell shall have grooves into which an elastomeric gasket with solid cross section is inserted. This joint shall conform to the requirements of ASTM D3139 and shall provide for expansion and contraction of the pipe.
- M. Removable elastomeric gaskets for PVC pipe and fittings shall meet the requirements of ASTM F477 and shall be capable of withstanding pH's as high as 9.5. The elastomeric gasket shall provide a tight seal that protects the line from shock and vibration, and compensates for expansion and contraction of pipe lengths. The elastomeric gasket shall not support the growth of bacteria.
- N. Lubricant used for joint assembly shall be non-toxic, shall not support the growth of bacteria and shall have no deteriorating effect on the gasket material.
- O. Restrained joints shall be furnished for installation where shown on the Contract Drawings. Restraints for mechanical joint fittings shall be Series 1100 PV Megalug as manufactured by EBAA Iron Sales Co. or approved equal. Restraints for push-on joints shall be Series 2000PV as manufactured by EBAA Iron Sales Co. 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 in the standard direction for the City of Fitchburg.
- 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, American Flow Control Model AFC2500, or Mueller Resilient Wedge Gate Valves.
- F. Valve boxes shall be cast iron, asphalt coated, sliding, heavy pattern type, consisting of three pieces; a flanged bottom piece, a flanged top piece, and a cover with two 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 POST INDICATOR VALVE

- A. Post indicating valve assembly shall consist of a buried butterfly valve and above-grade indicator actuator of the traveling nut type with a tamper-proof switch.
- B. Posts shall have two large window openings that shall be fitted with a heavy clear Plexiglas. Aluminum target plates, with large words OPEN and SHUT cast in large, easy-to-read, raised letters shall be located directly behind each window in such a position that the appropriate words appear as the valve is opened.
- C. The target mechanism shall consist of an internal rotating member that contains a 2³/₄-inch hole on four sides.
- D. The outer member is stationary and shall contain similar holes.
- E. A fail-safe spring shall be included on the post to preclude accidental closing.
- F. Stem, indicators, and all working parts shall be fully protected from moisture and weather damage.
- G. The butterfly valve and post assembly shall be Underwriters Laboratory listed and Factory Mutual approved.
- H. Valves shall be manufactured in accordance with AWWA C504, Class 150B.

2.6 HYDRANTS

- A. General: Provide Hydrants as indicated. The Hydrants 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 hydrant.
 - 1. Fire hydrants shall meet or exceed AWWA C-502, latest revision and shall comply with Factory Mutual Research Corporation and Underwriters'

- Laboratories UL 246 Standard. Rated water working pressure shall be 200 psi, test pressure shall be 400 psi.
2. The main valve closure shall be of the compression type, opening against the pressure and closing with the pressure.
 3. Hydrants shall be of the breakaway type: The upper barrel shall connect to the lower barrel with a breakable traffic flange and 8 bolts and nuts. This connection shall allow 360° rotation of the upper nozzle section.
 4. The main valve opening shall be 5-1/4 inch and be designed so that removal of seat, drain valve mechanism, internal rod and all working parts can be removed through top of hydrant. These parts shall be removable without disturbing the ground line joint or the nozzle section of the hydrant. The bronze seat shall be threaded into mating threads of bronze for easy field removal.
 5. The draining system of the hydrant shall be bronze and activated by the main stem without use of auxiliary rod, toggles, pins, etc. The drain mechanism shall be completely closed after no more than three turns of the operating nut in the opening direction. There should be a minimum of two inside ports and four drain port outlets to the exterior of the hydrant. Drain shut off to be by direct compression closure.
 6. The operating nut, main stem, coupling and main valve assembly shall be capable of withstanding input torque of 200 ft. lbs. in opening or closing directions. There shall be an internal top housing with triple O-Rings to seal operating threads from the waterway and accommodate an anti-friction washer.
 7. Fire hydrants shall have 6-inch mechanical joint inlet connections to the main, two 2 ½-inch hose connections, 180-degrees apart, and one 4 ½-inch steamer connection. The hose and steamer connections shall have National Standard Thread. The standpipe shall have an 8 ½-inch minimum diameter. All nozzle caps shall be cast iron and shall be secured to the hydrant barrel with chains.
 8. Hydrant shall be marked with an arrow and the word "open" to indicate the direction to turn the stem to open the hydrant. Hydrants shall open in the standard direction for the City of Fitchburg and have a bronze operating nut that shall be pentagonal in shape, 1-1/2 inch from point to opposite flat.
 9. The upper barrel shall be ductile iron with markings identifying size, model and year of manufacture. The lower barrel shall be ductile iron.
 10. The hydrant shall have a minimum working pressure of 200 psi. Hydrant design shall be of positive automatic drain type to prevent freezing.
 11. Hydrants shall be thoroughly cleaned and given two shop or field coats of paint in accordance with AWWA C502 and the instruction of the paint manufacturer. Paint color shall be the standard hydrant color of the City of Fitchburg.
 12. If the hydrant is delivered with the manufacturer's standard color, the hydrant shall be given one matching field coat of alkyd gloss enamel. If the hydrant is delivered with no standard color, the hydrant shall be given two coats of alkyd gloss enamel according to the colors specified by the City of Fitchburg.
 13. All exposed metal surfaces will be painted.
 14. Hydrant paint shall be as manufactured by Sherman-Williams, PPG Industries, Pittsburgh, PA; Koppers Company, Inc., Pittsburgh, PA; Tnemec Company, Inc. Kansas City, MO; or approved equal.

15. Alkyd gloss enamel shall be Series 54-300 by PPG; Glamortex by Koppers; 2H-Tneme by Tnemec or approved equal.
 16. Hydrants shall be American Darling (American Flow Control) Model B-62 B, Mueller Centurion, Kennedy Guardian, U. S. Pipe Metropolitan, Waterous WB-67 or others as acceptable to the jurisdictional authority.
- B. HYDRANT SAFETY FLANGE REPAIR KIT
1. Safety flange repair kits shall come complete with stem coupling, safety flange, flange gasket, replacement bolts and nuts and hydrant lubricating oil.
 2. Safety flange repair kits shall be compatible with hydrant furnished.
- C. HYDRANT EXTENSION KITS
1. Extension kits shall come complete with extension barrel, extension stem, stem coupling and hardware, flange, flange gasket, 8 bolts and nuts and hydrant lubricating oil.
 2. Extension kits shall be compatible with hydrant furnished.
- 2.7 SERVICE TUBING, CORPORATIONS, STOPS, SADDLES, AND VALVE BOXES
- A. Service tubing shall meet the requirements of Federal Specification WW-T 7996 and shall conform to ASTM specification B75, B68 and B88 as they apply to Type K Copper Tubing. Copper Tube Size (CTS) Polyethylene Tubing for domestic water uses shall conform to AWWA C901, ASTM D3350, and ASTM D2737 and shall have a working pressure rating of 200 psi. Tracer wire shall be attached to the tubing and connected to upstream piping of the associated water meter for the water service, as applicable.
- B. The Contractor shall furnish and install, including necessary taps and connections, corporation stops, CTS Polyethylene Tubing, curb stops and wastes.
- C. The corporation stops shall meet the most recent revision of the AWWA standard "Threads for Underground Service Line Fittings." (AWWA C800).
- D. Corporation stops shall be sized as shown on the drawings and be brass compression-type with CC thread (Mueller Brand with compression nut with set screw). Corporation stops shall open in the standard direction for the City of Fitchburg.
- E. Curb Stops: Curb stops shall be sized as shown on the drawings and be brass compression-type with drain (Mueller Brand with compression nut with set screw). Curb stops shall open in the standard direction for the City of Fitchburg.
- F. Tapping Saddles: Service connections shall be tapped with Size 2" X 8" double strap service saddles.
- G. Fittings and Boxes: Service boxes shall be cast iron. Extension service boxes of the required length and having slide-type adjustment shall be installed at all service box locations. The boxes shall have housings of sufficient size to completely cover the curb stop and shall be complete with identifying covers

- H. Service boxes shall be 2 ½" Buffalo Style, heavy cast iron, tar coated, sliding type, consisting of three pieces; a flanged bottom piece, a flanged top piece and bolted cover with the word "water" cast on the top. A minimum 6-inch overlap is required between sliding sections. The boxes lengths shall be as necessary to suit ground elevation.

2.8 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

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 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 18 inches above the top of sewer. Where the horizontal clearance is less than 10 feet or the vertical clearance is less than 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 10-feet on either side of the crossing. One 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 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 potable 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 re-mortared 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 ensure 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. 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 APPURTENANCES

- 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 does 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 within 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 ½” 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.

F. Corporation Cocks

1. The tapping machine shall be rigidly fastened to the pipe as near the horizontal diameter as possible. The length of travel of the tap should be so established that when the stop is inserted and tightened with at 14” wrench, not more than one to three threads will be exposed on the outside. When a wet tapping machine is used, the corporation stop shall be inserted and tightened in accordance with the manufacturer’s specifications.

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 excavation and backfill operations for utility installations in accordance with Section 312000 – EARTH MOVING/Section, 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 ensure 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. A minimum of two 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 of 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 hydrants 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 ensure that no debris or other contaminants are present. If necessary, the Contractor shall clean 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.

END OF SECTION 331000