Kenosha Water Utility Standard Construction Specifications

Water Main

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Section 0100 –Water Main

1) Water Main Pipe (Open Cut)

1.1. Materials

a) Acceptable pipe barrel material is Polyvinyl Chloride (PVC) unless specified as ductile iron by the engineer in the contract documents and approved by the Director of Engineering. Minimum pipe barrel diameter shall be eight inches (8") for main line water main.

b) PVC water pipe shall conform to the requirements of AWWA C-900 for sizes four inch (4") through sixty inch (60") diameter. PVC pipe shall be furnished with integral elastomeric bell and spigot joints. PVC pipe provided shall be dimension ratio 18 (DR-18) with cast iron (CI) pipe equivalent outside diameters

c) All water pipe material and appurtenances shall be furnished by Contractor. All water main pipe and appurtenance materials shall be manufactured and installed in the current year unless prior written approval has been given by the KWU Director of Engineering. All water pipe and appurtenances shall be in accordance with the latest AWWA standards.

d) A copy of all shipping invoices shall be furnished with a sworn statement by manufacturer that the inspection and all specified tests have been made and the results comply with the requirements of the standards stipulated below. Any pipe or accessories found by the Engineer to be defective, damaged or not complying with the AWWA standard shall be rejected. The replacement of rejected materials shall be the responsibility of Contractor at no additional expense to Kenosha Water Utility.

e) All pipe and fittings shall be marked by the manufacturer showing the weight, class, manufacturer's name and year the pipe and fittings were manufactured.

f) If specified, all ductile iron pipe shall conform to AWWA C-151/ANSI A 21.51. Ductile iron pipe shall have a cement mortar lining and an internal seal coat in accordance with AWWA C-104/ANSI A 21.4. External seal coat shall be in accordance with AWWA C-151/ANSI A 21.51. The class and wall thickness shall conform to Table 1, below in accordance with AWWA C-150/ANSI A 21.5 Table 15:

Table 1.1 Ductile Iron Pipe Class and Thickness

Pipe Size	Class	Wall Thickness
4"	53	0.32"
6"	53	0.34"
8"	53	0.36"
12"	52	0.37"
16"	52	0.40"
20"	52	0.42"
24"	52	0.44"
30"	52	0.47"
36"	52	0.53"

2) Water Main Pipe (Directionally Drilled)

2.1. Materials

a) Directionally drilled water main pipe material shall be fusible polyvinyl chloride (PVC), high density polyethylene (HDPE), or restrained joint PVC pipe and shall conform to the below subsections. All water main piping shall be blue in color.

2.2. Fusible PVC Pipe

a) Fusible PVC pipe shall meet the requirements of AWWA C900, four inch (4") through forty-eight inch (48") diameter, with cast iron O.D. and thermal butt fused joints between pipe sections. Joint gaskets are not required. PVC material shall have a cell classification of 12454 as defined in ASTM D1784.

2.3. Fusible HDPE Pipe

a) HDPE water main four inch (4") through thirty-six inch (36") diameter shall meet the requirements of AWWA C906, DR-11, with cast iron O.D. Pipe material shall have a cell classification of PE 3408/PE 3608 (345464C) as specified in ASTM D3350.

b) HDPE pipe has thicker wall thickness than PVC and DI pipe resulting in a smaller inside diameter. Unless the plans specifically state HDPE pipe, the pipe installed shall be one pipe size larger than that shown on the plans so that the inside diameter is similar to that of the adjacent pipe sections.

2.4. Restrained Joint PVC Pipe

a) Restrained joint PVC pipe shall meet the requirements of AWWA C900 four inch (4") through twenty-four inch (24") diameter, DR-18, cast iron O.D. and restraining jointing systems with built-in sealing gaskets. PVC material shall have a cell classification of 12454 as defined in ASTM D1784.

2.5. Construction Methods

a) The maximum job site pull-in force shall not exceed the manufacturer's recommended safe pull-in force.

b) Directionally drilled pipe shall sit undisturbed for a minimum of 48-hours to allow for settlement of the directionally drilled pipe prior to extension of the pipe or installation of any fittings or appurtenances unless otherwise approved by the Director of Engineering.

c) If recommended by the manufacturer due to job site conditions and pull-in equipment, contractor may select a lesser DR rating *(stronger pipe)* with approval for the Director of Engineering at no additional cost to Kenosha Water Utility.

d) When recommended by the pipe manufacturer, the contractor shall install measures to protect against contraction or expansion of the pipe. Possible recommended measures may include, but are not limited to, concrete wall anchors and/or additional joint restraint beyond the completed directionally drilled pipe sections.

3) Joints

3.1. Materials

a) All pipes shall have bell and spigot ends designed for a rubber gasket push-on joint. All rubber gaskets for PVC pipe shall conform to ASTM F477. All rubber gaskets for ductile iron pressure pipe, fittings, and valves shall conform to AWWA C-111/ANSI 21.11 for rubber gasket joints.
b) Brass wedges shall not be used.
c) Joints on all ductile iron fittings or valves shall be mechanical joint conforming to the latest revision of AWWA C-111/ANSI A 21.11 with rubber gaskets and stainless steel bolts, nuts, and rods unless specified otherwise.

4) Fittings

4.1. Materials

a) Ductile iron fittings shall conform to the latest revision of AWWA C-110/ANSI A21.10, or ductile iron compact fittings conforming to the latest revision of AWWA C-153/ANSI A 21.53.
b) Fittings shall be cement mortar-lined and have an internal seal coat conforming to the latest revision of AWWA C-104/ANSI A21.4. Exterior seal coat shall conform to AWWA C-110/ANSI A21.10 or AWWA C-153/ANSI A 21.53.
c) All fittings shall be mechanical joint by mechanical joint (MJ x MJ) with rubber gaskets and stainless steel T-bolts and nuts, unless agreed upon otherwise by the Engineer in writing.
d) All fittings shall have a pressure rating of 250-psi, except compact fittings, which shall be rated at 350-psi for sizes three inch (3”) through twenty-four inch (24”).
e) The contractor shall only install 11.25, 22.5 or 45-degree bends. 90-degree bends shall not be used unless approved by the engineer.

4.2. Construction Methods

a) All fittings (including but not limited to valves, stops, reducers, bends, caps, plugs) shall be GPS located by the KWU Inspector prior to backfilling. Any fitting not GPS located by the inspector prior to backfilling shall be entirely uncovered at the discretion of the Inspector at no cost to KWU.

5) Valves and Valve Boxes

5.1. Materials

a) Resilient wedge seated gate valves shall conform to the latest revision of AWWA C-509 or C-515 and shall be used for four inch (4”), six inch (6”), and eight inch (8”) applications. Butterfly valves shall conform to the latest revision of AWWA C-504 and shall be used in all applications larger than eight inches (8”).

b) Resilient wedge seated gate valves shall be as manufactured by AFC (American Flow Control), Kennedy, or Mueller and shall be mechanical joint with a minimum pressure rating of 200-psi. All valves shall close in clockwise turning operation with non-rising stems and a two inch (2”) square, tapered operating nut. All packing gland to bonnet and bonnet to body nuts and bolts shall be stainless steel.

c) Butterfly valves shall be manufactured by Dresser, M&H, or Pratt for larger than eight inch (8”) applications. Valves shall be Class 150B cast iron or ductile iron body with o-ring shaft seals suitable for direct burial. The operator shall be self-locking and furnished with a permanent factory set stop at each end of travel. All valves shall close clockwise operating with two inch (2”) square, tapered operating nut. All nuts and bolts between the body and the actuator of the valve shall be stainless steel.

d) Valve boxes shall be a two-piece cast iron shaft screw type of adequate length to extend from the valve to the finished grade. Valve box covers shall be cast iron and clearly marked "Water". Refer to the detail sheet. The cost of the valve box shall be included in the cost of the valve.

e) Valve box adaptors shall be by Adaptor, Inc. or approved equal and shall be used to prevent settling or shifting of valve boxes and shall be installed in accordance with manufacturer’s instructions. The cost of the valve box adaptor shall be included in the cost of the valve.

f) Joints for valves shall be mechanical joint with rubber gaskets and stainless steel T-bolts and nuts.

5.2. Construction Methods

a) Valves in water mains shall be attached with a minimum three feet (3’) length of pipe to tees or crosses unless otherwise specified in the plans.

b) If the valve operating nut will be greater than six and a half feet (6.5’) deep, extension rods shall be added to raise the operating nut to within three to four feet (3’ to 4’) of the established ground elevation at the direction of the Engineer. The manufacturer and model type shall be approved by the Engineer prior to construction.

c) Valves shall be located as shown on the plans or as directed by the Engineer. The maximum spacing between valves shall be in accordance with the DNR Code NR 811.70 *(maximum 500’ in commercial districts or 800’ in residential districts).* Location of the operating nut for butterfly valves shall be to the North or East of the main.

d) Valve box and curb box extensions shall be used as required when raising the top of the box to finished grade. Valve boxes, extensions and curb boxes shall be considered incidental to the valve and curb stop installation.

e) A valve box shall be provided for every valve which has no gearing or operating mechanism or in which the gearing or operating mechanism is fully protected with a cast iron grease case. The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve with the box cover flush with the surface of the finished grade or such other level as may be directed by Engineer.

f) The valve box shall extend from the valve to finished grade. The valve box shall be installed upon the valve with the use of a valve adaptor, as manufactured by Adaptor, Inc. (or approved equal). Install adaptor in accordance with the manufacturer's instructions. Any valve box that becomes shifted or filled during backfilling shall be entirely uncovered and reset at no cost to KWU.

g) Valve boxes must have a foam plug inserted into the top of the inner barrel prior to paving. Any valve that doesn't have a plug and has pavement around the new valve nut, shall be corrected so it is clean and operational to the satisfaction of the Engineering Inspector at no cost to KWU. This could include removing pavement, cleaning the valve, resetting the box, and repaving.

6) Hydrants

6.1. Materials

a) Hydrants shall be Mueller A423 Super Centurion 250 or Kennedy Guardian.
b) Fire hydrants furnished under these specifications shall conform to AWWA C-502 for dry-barrel fire hydrants. Hydrants shall be compression type with five and a quarter inch (5.25") valve opening, two two-and-a-half-inch (2x 2.5") NST nozzle connections, and one five-inch (5") Integral Storz Connection on the steamer nozzle. The base shall have a six inch (6") mechanical joint connection with a rubber gasket and stainless steel T-bolts and nuts.
c) Hydrant top operating nut and nozzle cap nuts shall be one and a quarter inch (1.25") pentagon. All hydrants shall close in clockwise direction.
d) Barrel extension length shall be determined by Engineer after installation. The height of each individual hydrant is listed on the plans for reference only. Variations in the heights of the fire hydrants shall be considered incidental to the cost of the Contract and shall be included in the cost per hydrant.
e) Hydrant branch shall be a six inch (6") diameter ductile iron pipe, Class 53. Each hydrant shall have an auxiliary valve. Refer to detail sheet for location of valve.

6.2. Construction Methods

a) Hydrants shall be located at a maximum spacing of six hundred feet (600') in accordance with the DNR Code NR 811.64 and as shown on the plans.
b) The grade of the hydrant shall be set by Engineer. Nozzles shall be twenty-one inches plus-or-minus three inches (21" ± 3") above finished ground elevation.
c) The hydrant nozzle shall be set at a distance of three feet (3") from the back of curb and seven feet (7') from the perpendicular property line if near an intersection, unless specified otherwise in the plans. Refer to the detail sheet.
d) All hydrants shall stand vertically plumb and shall have their pumper nozzles parallel with the curb line.
e) All public hydrants shall be field painted "Fire Hydrant Red" at completion of testing. This shall apply to barrel extensions, nozzles, and flange bolts. All hydrants shall be completely painted at completion of all testing.
f) Private system pressure hydrants shall be field painted "Caution Blue" at completion of testing. This shall apply to barrel extensions, nozzles, and flange bolts. All hydrants shall be completely painted at completion of all testing. Private pressurized hydrants that are connected to a private pressurized system (i.e. fire pump) shall be field painted yellow at completion of testing.
g) Each hydrant shall be connected to the anchoring tee at the main with a six inch (6") gate valve, except as otherwise directed. Refer to the detail sheet. The hydrant lead from the main to the hydrant shall be six inch (6") ductile iron, Class 53.
h) Wherever a hydrant is set in soil that is permeable, drainage shall be provided at the base of the hydrant by placing coarse gravel or crushed stone mixed with coarse sand from the bottom of the trench to at least six inches (6") above the drain opening in the hydrant base. No drainage system shall be connected to a sewer.

i) Wherever a hydrant is set in clay or other impervious soil, a drainage pit two feet (2') in diameter and three feet (3') deep shall be excavated below each hydrant and filled completely with three-quarter inch (0.75") clear stone under and around the base of the hydrant and to a level of six inches (6") above the drain opening. No drainage pit shall be connected to a sewer. Refer to the detail sheet.

j) All hydrants shall be anchored to the main. Megalugs, tie rods, anchoring fittings, or an Engineer approved combination shall be used as field conditions dictate. Refer to the detail sheet.

k) Any hydrant leads that have a joint shall be restrained with the use of Megalugs, tie rods, anchoring fittings, or an Engineer approved combination. The contractor shall use whatever means necessary to eliminate the use of joints on hydrant leads.

l) If hydrants are tied to the main with tie rods, then they shall have two (2) tie rods with a diameter of three-quarter inch (0.75").

m) In addition to being anchored to the main, all hydrants shall have concrete block thrust blocking at the end of the hydrant trench, and under the base of the hydrant. Concrete blocking shall also be placed under the hydrant auxiliary valve.

n) Hydrant markers, if specified on the plan, should be provided by Kenosha Water Utility and installed by the Contractor. The cost of installation of the marker shall be included in the cost of the hydrant.

7) Tapping Valves and Sleeves

7.1. Materials

a) Tapping sleeves shall be Smith-Blair stainless steel epoxy coated Model 662 or JCM 459. All tapping sleeves shall have a mechanical joint outlet with stainless steel bolts and nuts. Seals shall be self-energizing rubber gaskets.

7.2. Construction Methods

a) A tapping sleeve and valve shall be used for all wet taps larger than two inches (2”).

b) Tapping of existing water mains for all water connections twelve inch (12”) and under shall be done by the Kenosha Water Utility. A minimum of 72-hour notice shall be provided to the Kenosha Water Utility. The Contractor shall complete all excavation, dewatering, shoring and preparations required by the Distribution Division prior to the tap. The Contractor shall provide all necessary supplies and materials to complete the tap, and shall have the main clean and prepared for the tap. The Contractor shall provide the labor and equipment to secure the tapping sleeve and valve to the existing main, per the manufacturer’s recommendations. KWU will complete the tap and remove the blank (“cookie”) from the main.

c) Taps greater than twelve inches (12”) shall be performed by the Contractor, while overseen by KWU.

8) Services and Curb boxes

8.1. Materials

a) Copper tubing shall be used for one inch to two inch (1" to 2") service connections and shall be type "K", soft annealed seamless and manufactured in the USA. Service connections shall be a minimum of one inch (1") in diameter. Service connections and fittings shall be in conformance with AWWA C-800. In select circumstances, service reconnections that are two inch (2") in size may be allowed to use Polyethylene (PE) Pressure Pipe conforming to AWWA C901. Use of Polyethylene material is subject to approval by the Director of Engineering.

b) Acceptable brass fittings include those manufactured by A. Y. McDonald, Mueller, or Ford. Corporation stops shall have AWWA taper or (CC) threads. All brass fittings for new service installation shall be flare type. All fittings shall be lead free.

c) All corporation stops for new installations shall be flared ball type Mueller 300TM, A.Y. McDonald 4701 B, or Ford FB 600. All curb stops shall be Mueller 300TM Ballcurb, A.Y. McDonald 6100Q, or Ford B22-XXXQ.

d) Rubber gasket compression fittings may be used to re-route or repair existing copper services. Corporation stops shall be Mueller 300 model B-25008, A.Y. McDonald 4701 BQ, Ford FB 1000Q. Curb stops shall be Mueller 300 model B-25209, A.Y. McDonald 6100Q, Ford B44-XXXQ.

e) Service saddles are required for all service taps. All service saddles shall be double strap and have an epoxy coated ductile iron body and stainless steel straps and nuts or they shall be 100% stainless steel. The saddles shall be Smith Blair 317, Mueller DR2S, Romac 202NS or Ford FC 202.

f) Services larger than two inches (2") shall be constructed in accordance with water main pipe and valve requirements, using a tapping valve and sleeve for the connection to the existing main. Service sizes may only be one inch, one-and-a-half inch, two inch, four inch, six inch, eight inch, twelve inch, and sixteen inch (1", 1.5", 2", 4", 6", 8", 12", and 16").

g) Curb boxes shall be an Ametek #110185-20 plastic curb box with a cast iron cover. Curb boxes shall have a shaft diameter of two-and-a-half inches (2.5") and clearly marked "Water".

8.2. Construction Methods

a) Services shall be installed complete by Contractor. The Contractor shall give 24-hour notice to customers prior to any disconnection and/or reconnection of their service. Immediately prior to the time of disconnection, the Contractor shall notify customers and allow them sufficient time to obtain any needed water. All water service customers shall have their water service restored within four hours of the shutdown, or by 5 PM, whichever comes first.

b) Tapping of the main for installation of services shall only be done after:

   i. The main has been properly flushed
   ii. 2 consecutive bacteriological "safe" samples have been taken
   iii. Hydrostatic tests have been successfully completed.

c) No service connection shall be backfilled until checked by Engineer for leaks while the main pressure is applied.

d) All taps for services shall be made while the main is turned on and is under pressure. The Contractor shall present the "cookie" to the inspector and blow off the service after the tap to allow for debris in the line to be flushed.

e) The depth of the service shall be between five-and-a-half feet and six-and-a-half-feet (5.5' to 6.5') of cover from the established grade as shown on the plans. Any curb stop operator deeper than six-and-a-half feet (6.5') shall have an extension rod added to raise the operator to a depth between three feet and four feet (3' to 4'), at the direction of the Engineer. The manufacturer and model type shall be approved by the Engineer prior to construction.

f) All curb boxes shall be set two inches (2") below grade and be GPS located by a Kenosha Water Utility Employee prior to covering. Any curb box not set to the proper grade or shot with a GPS shall be uncovered and reset by the Contractor at no charge to KWU.

g) All services that are to be reconnected shall be flushed prior to connecting to the existing to allow for debris and air to be removed. Service stubs shall be flushed and have a six inch to twelve inch (6" to 12") "tail piece" attached to the curb stop with the free end flattened (peened) before backfilling. Refer to the detail sheet.

h) All one inch (1") services shall have a curb box and all services one-and-a-half inch (1.5") or larger shall have a valve box. Curb box or valve box extensions shall be used as required to raise the box to finished grade.

i) The location of the curb stop shall be seven feet (7') from the property line and a minimum of one-and-a-half feet (1.5') from any sidewalk, unless otherwise indicated on the plans. Refer to the detail sheet.

j) All services not being connected immediately to the building shall be marked with a two-by-four (2" x 4") stake, eight feet (8') long, painted blue. The stake shall be placed vertically at the end of the curb stop box to locate the termination for future extension. Refer to the detail sheet.

k) Non-lead water services interrupted, disturbed, or severed by the Contractor shall be repaired and relocated at the Contractor's expense. Repairs shall be made with Type K copper and repair couplings of the same diameter as the existing service. All labor and material required for the repair and relocation shall be considered incidental to the cost of the Contract. The Contractor shall notify the Kenosha Water Utility at the time of the repair for inspection of the service.

l) Lead water services disturbed or severed by the Contractor shall be fully replaced from the main to the water meter by the Contractor at the Contractor's expense under the direction of KWU.

9) Laying Pipe

9.1. Construction Methods

a) Water main shall be installed in strict conformance with the drawings using a laser level. Deflections in the vertical plane are detailed on the profile view of the drawings. Pipe elevations, as shown, must be strictly followed in order to minimize insulation of the main and ensure proper vertical separation at sewer crossings. Any deviation from the drawings must be approved by the Engineer and Contractor shall accurately track changes on record drawings.

b) Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe laying crew cannot put the pipe into the trench and in place without getting earth into it, Engineer may require that before lowering the pipe into the trench, an acceptable covering shall be placed over each end and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. After placing a length of pipe in the trench, the spigot end shall be centered in the bell and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with approved backfill material tamped under it except at the bells. Pipe fittings that do not allow a sufficient and uniform space for joints shall be removed and replaced with pipe and fittings of proper dimensions to insure such uniform space. Precautions shall be taken to prevent dirt from entering the joint space.

c) At all times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Engineer. This provision shall apply during any breaks as well as overnight. If any water is in the trench, the plug shall remain in place until the trench is pumped completely dry.

d) Pipe shall be laid with proper vertical and horizontal separation distance from any contamination source in conformance with Department of Natural Resources (DNR) Code NR 811.67.

e) Ductile iron pipe shall be installed according to AWWA 600 – Installation of Ductile Iron Water Mains and Their Appurtenances. PVC pipe shall be installed according to AWWA 605 – Underground Installation of PVC Pressure Pipe and Fittings for Water Main.

f) The bottom of the trench shall be undercut to provide a minimum of four inches (4”) of bedding and cover material between the natural soil and the bottom outside barrel of the pipe to be installed. The pipe is to be entirely surrounded and covered to a height of at least one foot (1’) above the top with bedding and cover material. Bedding and cover material shall be carefully placed by hand to fill completely all spaces under and adjacent to the pipe. The first lift of granular backfill shall be two feet (2’) with each subsequent lift being no more than eighteen inches (18”). Refer to the detail sheet. Bedding, cover, and backfill shall be considered incidental to the cost of the water main installation.

g) The maximum width of the trench excavation at the top of the pipe shall be the outside diameter of the pipe used plus twenty-four inches (24”). This width may be increased to allow for stringers and sheathing or applicable shoring protection when required.

h) All pipe to be laid in open-cut trench shall have six inch (6”) minimum clearance between the outside face of the pipe barrel and the face of the sheathing or sidewall of the trench. Boulders, rocks, roots or other obstructions shall be removed entirely so as not to impede or interfere with the pipe. Trench shall be finished to provide a uniform and continuous bearing and support for the pipe.

i) The cutting of pipe for inserting valves, fittings or closure pieces shall be done at right angles to the axis of the pipe in a neat and workmanlike manner without damage to the pipe or cement lining and to leave a smooth filed beveled edge. The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed.

j) Whenever it is necessary to deflect pipe from a straight line, either in vertical or horizontal plane, to avoid obstructions or plumb stems, or where long radius curves are permitted, the maximum amount of deflection allowed shall be in accordance with pipe manufacturer's installation guide and shall be approved by Engineer.

k) At crossing locations of utilities such as storm sewer and sanitary sewer, the contractor shall center a full length of pipe at the crossing location in order to keep joints away from the sewer crossing.

l) All pipes shall be laid to depths shown on contract drawing, which shall normally be six feet (6’) of cover from finished grade to top of pipe. Where future grades are to be below existing grades, Contractor shall furnish sufficient cover of a minimum of five feet (5’) to the proposed grade for the water main unless specifically shown on the plans.

m) Not more than fifty feet (50’) of trench shall be open at any one time in advance of the completed water main except upon written permission of Engineer. In no case shall such excavation extend at the same time across more than two parallel streets that intersect the street in which the work is being done.

n) All dead ends on new mains or cuts to abandon old mains shall be closed with an end of the line valve, mechanical joint plug or cap and Megalug as shown on the detail sheet.

o) All plugs shall have thrust blocking. Thrust blocking shall consist of concrete blocks, placed tightly between the plug and undisturbed earth.

p) All high points constructed in the main shall have a hydrant or air release assembly as approved by the Director of Engineering.

10) Polyethylene Encasement

10.1 Materials

a) All ductile iron pipe and fittings, tees, crosses, saddles, valves, valve boxes, hydrants, etc., shall be polyethylene encased per AWWA C-105/ANSI A 21.5 specifications. The polyethylene shall be of the material, color, and size as listed in the AWWA standard. The method of polyethylene encasement shall be by the use of the polyethylene tube meeting Method "A" as detailed in the AWWA C-105 specifications. The polyethylene film supplied shall be clearly marked at a minimum of every two feet (2') along its length, containing information according to AWWA C-105. The encasement shall be free of defects such as holes, tears, blisters, or thinning out at folds.

b) The polyethylene encasement shall be secured with a thermoplastic tape with a pressure sensitive adhesive face capable of bonding to metal, bituminous coating and polyethylene. This work is considered incidental to the water main installation.

10.2 Construction Methods

a) Connecting pipe, tapping saddle and service lines shall be wrapped with polyethylene for a distance of three feet (3') away from the ductile iron pipe.

b) The polyethylene encasement shall be cut two feet (2') longer than the pipe section. The encasement shall overlap one foot (1') on the adjacent pipe. Tape shall be placed completely at around the pipe adjacent to the bell end sections.

c) The Contractor shall fold and tape the polyethylene wrap so that the wrap is snug to the pipe to reduce tearing or ripping. Tape shall be placed at two foot (2') intervals along the barrel of the pipe.

11) Thrust Blocking and Joint Restraint

11.1 Construction Methods

a) Tees and bends deflecting eleven-and-a-quarter degrees (11.25°) or more on all mains shall be provided with thrust blocking and either Megalugs or tie rods and bolts as specified in the Kenosha Water Utility Standard Detail and described below. Engineer shall have the authority to rule out the use of certain kinds of anchorage or thrust blocking depending on the situation.

b) Thrust blocking concrete shall be concrete of a mix not leaner than one (1) part cement, two and one-half (2.5) parts sand, five (5) parts stone and having a compressive strength of not less than 3,000 psi at 28-days. Backing shall be placed between solid ground and the fitting to be anchored. The area of bearing to be provided for 90 degree bends, tees, plugs and caps of various sizes are as shown in Table 2, below:

Table 11.1 *Area of bearing for 90 degree bends*

Pipe Diameter in Inches	Square Feet of Bearing
6	5
8	10
12	15
16	20
20	25
24	36

c) Bearing areas for fittings of less than 90 degrees may be less than those shown above if approved by Engineer.

d) Thrust blocking shall be poured against firm, natural ground and shall be formed in such a way that the water main joints will be kept free of concrete. All threaded fasteners and joints of the fitting being blocked shall be wrapped with polyethylene.

e) All concrete thrust blocking shall be approved by the Engineer before installation and prior to backfilling. Concrete thrust blocking shall be considered incidental to the water main.

f) Megalugs shall be used for all mechanical joints and shall be constructed of ductile iron with steel set screws. Setscrews shall be tightened to the torque recommended by the manufacturer. Ductile iron Megalugs shall be by EBAA Iron.

g) Tie rods shall be used in conjunction with Megalugs at locations where a direction or grade change is made and bends or tees are used, or at a dead end. Tie rods shall be stainless steel with a three-quarter inch (0.75”) minimum diameter. The number and size shall be based on the pipe diameter as shown in the table on the detail sheet. Tie rods shall be double bolted.

h) A Megalug Restraining Harness shall be used on the bell and spigot of push-on pipe joints within ten feet (10’) to all fittings or valves as required by the Engineer or shown on the plans and shall be manufactured by EBAA Iron. The number of rods used in the joint restraint shall be according to the manufacturer’s recommendation or the table in the detail sheet. Joint restraint shall be considered incidental to the water main installation.

i) Joint restraint may be used in conjunction with thrust blocking concrete as shown on the plans or directed by the Engineer.

12) Insulation

12.1 Materials

a) Water main insulation shall be closed-cell extruded polystyrene boards with minimum dimensions of two inches (2") thick and four feet (4") wide where water main cover is less than five-and-a-half feet (5.5') or where a storm sewer passes within two feet (2') of a water main or service. A minimum of two layers shall be used, four inches (4") total thickness.

b) Insulation for water services shall be Armacell Tundra Seal Pipe Insulation – Self-Seal, a minimum of one-and-a-half inch (1.5") thickness, or approved equal. Foam board type insulation will not be allowed as a service insulating material.

c) All insulation placed shall have a minimum "R" value of eight (R8).

d) Insulating concrete shall consist of 1 part Portland cement and eight (8) parts of perlite aggregate by volume.

12.2 Construction Methods

a) Insulation shall be placed in locations as shown on the plans or as directed by the Engineer. All insulation shall be considered included in the cost of the water main or service.

b) Prior to placement of the polystyrene boards, bedding material shall be placed to a height of six inches (6") over the top of the pipe, leveled, and compacted. The insulating boards shall be placed on the cover material with the long side parallel to the centerline of the water main for a minimum width of outer diameter, plus twenty-four inches (+24"). The boards shall be placed in a staggered arrangement to eliminate continuous transverse joints. Each layer should be placed to cover the joints of the layer immediately below.

c) The first lift of backfill material shall consist of six inches (6") of bedding material which shall be end or side dumped onto the insulation board and spread in such a manner that construction equipment does not operate directly on the insulation. This layer shall be compacted with equipment that exerts a contact pressure of 70-psi to 80-psi. Once this layer has been compacted to the specified density, the remaining layers of backfill may be constructed utilizing conventional procedures.

d) Insulating concrete shall be used to insulate the water main wherever water main cover is less than three-and-a-half feet (3.5'). The main shall be fully encased in polyethylene encasement prior to the placement of insulating concrete to prevent bonding and degradation of the pipe. Insulating concrete shall be placed around the entire main above the bedding material to a minimum thickness of six inches (6"). Clean water shall be added to the mixture in sufficient quantity to permit the mix to be workable.

13) Tracer Wire

13.1 Materials

a) Tracer wire shall be a #12-gauge THWN solid copper wire that is blue in color. The wire shall be centered over the top of the pipe and taped at ten foot (10') intervals, using thermoplastic tape with a pressure sensitive adhesive face.

b) The wire shall extend across all ductile iron fittings and valves. The wire shall be brought to three feet (3') above ground level behind each hydrant and coiled up in a piece of four inch (4") PVC sewer pipe extending from final grade to the bury flange along the length of the barrel, connecting to a metal plug on top. Refer to the detail sheet. Cost of wire, hardware access pipe, and labor shall be considered incidental to the water main installation.

c) Electrical conductivity shall be provided across all ductile iron pipe, fittings, valves, and hydrants by use of a cable bond welded to each end of the pipe and on each side of the fitting or valve. Cad welded areas shall be completely coated with an approved bituminous protective coating, Koppers 50, 505, or approved equal. Lead tipped gaskets shall NOT be used. This work is considered incidental to the water main installation.

13.2 Construction Methods

a) For installations on services, the wire shall be centered over the top of the pipe and shall extend from the building foundation to the main. The service tracer wire shall be connected to the water main pipe tracer wire via a Utility wire connector and affixed to the main with tape. The service tracer wire shall be brought to grade at the curb box. Refer to the detail sheet. For water service replacements, an additional four feet (4') of tracer wire shall be installed on the home-owner's side of the service, in the curb-box, to allow for future connection. Cost of wire and access pipe shall be considered incidental to the water service installation.

b) In locations where proposed pipe is being connected to existing water mains or services, and there is an existing tracer wire located on the existing pipe, the Contractor shall connect the two wires together by means locking connector hardware, which shall be approved by the Owner. The Contractor and Inspector shall check the tracing ability of the mains prior to backfilling.

c) In locations where proposed pipe is being connected to existing water main that is ductile iron pipe, the Contractor shall connect tracer wire by means of cad welding. The Contractor and Inspector shall check the tracing ability of the mains prior to backfilling.

14) Chlorination

14.1 Materials

a) Approved forms of chlorine shall be calcium hypochlorite granules or tablets, unless approved by the Director of Engineering. Granules or tablets shall have 65% available chlorine by weight. Do not use calcium hypochlorite intended for swimming pool disinfection. This material has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

b) All disinfection material, labor, and equipment shall be considered incidental to the water main installation.

14.2 Construction Methods

a) Approved disinfection procedures are the continuous feed method, and tablet method as described in detail in AWWA C-651.

b) The interior of all pipe and fittings shall be kept as free as possible from dirt and foreign matter.

c) The hydrostatic testing shall be completed after disinfection has been completed, if the new main has been connected to the Kenosha Water Utility system.

d) Disinfection Procedure:

i. Inspect all materials to be used to ensure the integrity of the materials.
ii. Prevent contaminating materials from entering the water main during storage and construction.
iii. Remove any materials that enter the water main.
iv. Chlorinate any residual contamination that may remain, and flush the chlorinated water from the main.
v. Protect the existing distribution system from backflow caused by hydrostatic pressure testing and disinfection procedures.
vi. Determine bacteriological quality by laboratory test after disinfection.

14.3 Continuous Feed Method

a) Place calcium hypochlorite granules in the main during construction, completely fill the main to remove all air pockets, flush the completed main to remove particulates, and fill the main with potable water. Calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main, and at 500-foot intervals. The potable water shall be chlorinated so that after a 24-hour holding period in the main there will be a free chlorine residual of not less than 10 mg/l. The quantity of granules to be placed is shown in Table 3 below which is based on AWWA C-651 Section 4.4 Table 14.1:

***Table 14.1** Calcium Hypochlorite Granule Quantities for Water Main Disinfection*

Pipe Diameter		Calcium Hypochlorite	
In.	mm.	Oz	g
4	100	1.7	57
6	150	3.8	113
8	200	6.7	200
10	250	10.5	300
12	300	15.1	400
16	350 and larger	D x 15.1	D x427.9

14.4 Tablet Method

a) Place 5-g calcium hypochlorite tablets in each section of pipe as it is being installed. Also, place one tablet in each hydrant, hydrant branch, and other appurtenances. The main shall be filled with potable water when installation is complete at a velocity no greater than 1 ft/s. Air shall be eliminated from the line. Water shall remain in the pipe for at least 24-hours. If the temperature of the water is less than 41°F, the water shall remain in the pipe for at least 48-hours. A detectable chlorine residual should be found at each sampling point after the 24-hour period. Table 4 below, which is based on AWWA C-651 Section 4.4 Table 2, shows the number of tablets required.

***Table 14.2** Number of 5-Gram Calcium Hypochlorite Tablets to Obtain 25 mg/l*

Pipe Diameter		Pipe Length, ft (m)	
In.	mm.	18 (5.5)	20 (6.1)
4	100	1	1
6	150	1	1
8	200	2	2
10	250	3	3
12	300	4	4
16	400	6	7
24	610	13	14
30	762	20	22
36	915	28	31

($0.0012d^2L$, where d is the diameter in inches and L is the length of pipe section in feet.)

15) Bacteriological Sampling

15.1 Step 1: Flushing

a) Water main shall be disinfected for a period of not less than 24-hours before flushing.

b) Contractor shall provide all fire hose, taps, flushing plugs, pipe, and fittings as needed for flushing. Contractor shall obtain a water meter from the Kenosha Water Utility and install in the flushing discharge line to measure the flushing water used.

c) Flushing velocities shall not be less than 2.5 feet per second.

d) Water main shall be flushed by opening each hydrant on the main, progressing from the hydrant closest to the connection of the existing distribution system unless drainage from the hydrant requires otherwise. Flushing time and procedure shall be determined by Engineer.

e) If required by the Engineer, a temporary blow-off valve may be needed to complete flushing. All material shall be furnished by the Contractor and the cost of any required blow-off devices are considered incidental to the contract. The size of the stand pipe shall be governed by the table below (per AWWA):

Table 15.2 *Standpipe Size by Main Size*

Pipe Diameter	Flow Rate	Size and # of Stand-Pipe Outlet(s)		# of Hydrant Outlet(s)	
		1.5" Outlet	2" Outlet	2.5" Outlet	4.5" Outlet
8"	470 gpm	2	-	1	1
12"	1,060 gpm	3	3	2	1
16"	1,880 gpm	-	5	2	1

With a 40 psi pressure in the main with the fire hydrant flowing to atmosphere, a 2 1/2 inch fire hydrant outlet will discharge approximately 1,000 gpm; and a 4 1/2 inch fire hydrant outlet will discharge approximately 2,500 gpm. 2 Number of taps on pipe based on discharge through 5 feet of galvanized iron pipe with one 90° elbow.

15.2 Step 2: Sampling

a) Water samples shall be collected and tested by Kenosha Water Utility personnel. All mains and water services larger than two inches (2") require two consecutive "safe" samples, taken at least 24-hours apart. At least one set of samples shall be collected from every 1,200-feet of the new water main, plus one set from the end of the line, and at least one set from each branch. If more than two samples from the same location are unsafe, the contractor may be charged for additional sampling and flushing.

b) As an alternative, the Contractor may follow Option B for testing under AWWA 651. This allows for 2 sets of samples to be obtained 15 minutes apart after a 16 hour resting period of the water inside the main.

16) Hydrostatic Pressure Test

16.1 Materials

a) The pressure test gauge shall have a pressure valve range of 0-300 psi, with a four inch (4”) dial, and be liquid filled.

16.2 Construction Methods

a) Hydrostatic tests will be required in accordance with AWWA C-600 and C-605 for ductile iron and PVC pipe, respectively. When the new pipe is connected to the existing Kenosha Water Utility system, hydrostatic testing shall be done after flushing and obtaining bacteriological “safe” test results.

b) The Engineer shall be present during the hydrostatic testing conducted by Contractor. A minimum 48-hour notice to the Engineer is required prior to test. Contractor shall supply all testing equipment. Equipment must be adequate and appropriate for application at Engineer's discretion.

c) All hydrostatic testing shall be considered incidental to the water main installation.

d) All pipe shall be subjected to a hydrostatic pressure of a minimum of 150-psi at the highest point along the test section. The test pressure shall not be less than 1.25 times the stated working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section. In no case shall the test pressure exceed the design pressure limit for any pipe, thrust restraint, valve, fitting, or other appurtenance. The pressure shall be held for a minimum of two (2) hours.

e) Contractor shall expel all air from the pipe before applying test pressure. This shall be done through hydrants, blow-offs, or special taps at high points in the line.

f) Once all air has been expelled, the section of main to be tested shall be pumped up to the test pressure using chlorinated water. Pumps, gauges, and all necessary apparatus shall be supplied by Contractor.

g) After test pressure has been attained, the pump or pumpline valve shall be closed and disconnected from the water main. The system shall be allowed to stabilize at the test pressure before conducting the hydrostatic test. The test pressure gauge shall be monitored for a minimum of two (2) hours. Any loss in pressure in excess of 5-psi indicates a failure of the pressure test.

h) Any section of pipe not passing the pressure test shall have all leaks located and repaired by the contractor. That section of pipe will then be retested until it passes the pressure test.