SECTION 02660 - WATER MAINS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Scope: Furnish and install pipe, fittings, valves, hydrant and appurtenances necessary to complete work shown or specified.

B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.

C. Definitions

1. Abbreviations

a. ANSI - American National Standards Institute
b. ASTM - American Society for Testing & Materials
c. AWWA - American Water Works Association

2. All pipe, fitting and valve sizes and references to pipe diameter on the drawings or in the specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.2 MINIMUM STANDARDS FOR WATERMAINS

A. All new development; commercial or residential subdivision must extend water across their road frontage if none exists.

B. The minimum water main size for fire protection is a 6-inch line. Additionally, the developer must submit hydraulic calculations demonstrating that the fire hydrant can deliver 1000 gpm and maintain a 20 psi residual pressure.

C. Water main supply system for subdivisions and industrial/business parks shall be "looped" to allow for both a primary and secondary water supply into the site.

D. Wherever possible, water main systems along streets shall be located on the opposite side of the street from sanitary sewer lines.

E. Lateral connections should be installed in conjunction with installation of water mains. If laterals are not installed at time of water main placement, particularly at cul-de-sac streets, the water main system shall be designed to wrap around not less than 75% of the outside turning circle of cul-de-sac.

F. As the water main system is installed, water lines shall be marked with a 2" x 4" or other acceptable stake, with a height allowing a minimum of 6'-0" above grade. Stake shall have the uppermost section painted blue, and marked with the letter "W" to indicate water line placement.

1.3 QUALITY ASSURANCE

A. Mark pipe, fittings, valves and hydrants according to the applicable specification or standard.

B. The Contractor shall test and disinfect water mains constructed under this Contract as specified in this Section.

C. The Contractor shall collect samples of water from water mains constructed under this Contract, after the piping has been disinfected. The samples shall be collected in the presence of the Town Representative who will submit the samples to the applicable regulatory agency for bacteriological analysis at the Contractor's expense. Collection and submittal of these samples shall meet the requirements of the applicable regulatory agency. If samples do not pass the requirements of the bacteriological analysis, the water main will be disinfected and sampled again. This procedure will be followed until the samples pass the analysis.

D. A performance test may be required by the Town Superintendent, at any time, for each crew installing water mains. The Contractor shall perform these tests at no additional cost to the Town. When requested by the Town Superintendent, the Contractor shall test a given section of water main installed by a given crew. The section shall be a continuous section of water main which can be isolated by valves shown on the drawings. The Contractor shall not install water mains in other sections until the first section has been successfully tested.

PART 2 - PRODUCTS

2.1 GENERAL

All pipe, fittings, valves, hydrants and appurtenances shall be as shown on the drawings or as required by the manufacturer's and ANSI/AWWA specifications. All pipe, fittings, valves, hydrants and appurtenances shall be new and unused.

2.2 BURIED WATER MAIN PIPE AND FITTINGS

A. Ductile Iron Water Mains

1. Pipe

a. Ductile iron pipe shall meet the requirements of ANSI/AWWA C151/A21.51. Design and manufacture pipe for the pressure class

listed plus 100 psi surge pressure. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the drawings or as required by the manufacturer's and ANSI/AWWA specifications, shall be included. Minimum thickness class shall be as follows:

Size Range	Pressure Class
4" - 12"	350
14" - 20"	250

b. Pipe joints shall be push-on type. Joints shall meet the requirements of ANSI/AWWA C11/A21.11. Restrained joints shall be Lok-Ring, Lok-Fast, Lok Tyte, or equal.

2. Fittings

a. Fittings shall be ductile iron. Fittings for standard size pipe shall meet the requirements of ANSI/AWWA C110/A21.10. Compact or short body fittings 3 inches through 16 inches shall meet the requirements of ANSI/AWWA C153/A21.53. Design and manufacture fittings for a pressure rating or at least 150 psi.

b. Fitting joints shall be mechanical joints or restrained push-on joints. Joints shall meet the requirements of ANSI/AWWA C111/A21.11. Thrust block all mechanical joints as indicated on the drawings or as required by the manufacturer's and ANSI/AWWA specifications. Pipe connecting to restrained joint fittings shall be restrained as indicated on the drawings or as required by the manufacturer's and ANSI/AWWA specifications.

3. Adapters

a. Adapters from ductile iron water mains to flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure class rating of 150 psi.

b. Adapter ends connecting to ductile iron water mains shall be one of the following: plain end, push-on joint, mechanical joint or restrained push-on joint. Adapters with plain ends, push-on joints or mechanical joints my be used where restrained joints are not required. Adapters shall have restrained push-on joints where restrained joints piping is required, as indicated on the drawings. Mechanical joints and restrained push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11. Restrained joints

shall be Lok-Ring, Lok-Fast, Lok-Tyte or as approved by the Utilities Superintendent.

c. Adapter ends connecting to flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

4. Line the inside surfaces of all pipe, fittings and adapters with single layer cement mortar lining. Cement mortar lining and seal coating shall meet the requirements of ANSI/AWWA C104. Coat the outside surfaces of all pipe, fittings and adapters with a bituminous coating, complying with ANSI/AWWA C151.

5. Gaskets for mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11.

6. Nuts and Bolts

a. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C11/A21.11.

b. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.

7. Polyethylene encasement for ductile iron water mains shall meet the requirements of ANSI/AWWA C105/A21.5. Install polyethylene encasement only when indicated on the drawings.

B. Polyvinyl Chloride Water Mains

1. Pipe

a. Polyvinyl chloride pipe shall meet the requirements of ANSI/AWWA C900, Class 150/DR18. Design and manufacture pipe for a working pressure of 150 psi plus surge pressure. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the drawings or as required by the manufacturer’s and NSI/AWWA specifications, shall be included.

b. Polyvinyl chloride pipe shall have ductile-iron-pipe-equivalent outside diameter.

c. Pipe joints shall be push-on type and meet the requirements of ANSI/AWWA C900. Do not use solvent-cement joints.

2. Fittings

   a. Fittings shall be ductile iron and meet the requirements of ANSI/AWWA C110. Design and manufacture fittings for a pressure rating of 150 psi.

   b. Line the inside surfaces of fittings with cement mortar lining and bituminous seal coasting shall meet the requirements of ANSI/AWWA C104/A21.4. Coat outside surfaces of fittings with bituminous coating. Outside coating shall meet the requirements of ANSI/AWWA C110.

   c. Fitting joints shall be mechanical joints. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.

   d. Mark each fitting. Marking shall meet the requirements of ANSI/AWWA C110.

3. Adapters

   a. Adapters from polyvinyl chloride water mains to victaulic, flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.
   b. Line the inside surfaces of adapters with a single cement mortar lining. Cement mortar lining and seal coating shall meet the requirements of ANSI/AWWA C104/A21.4. Coat outside surfaces of adapters with bituminous coating, complying with ANSI/AWWA C110.

   d. Adapter ends connecting to polyvinyl chloride water mains shall have plain ends or mechanical joints. Mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11.

   e. Adapter ends connecting to victaulic, flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

4. Gaskets

   a. Gaskets for polyvinyl chloride push-on joints shall meet the requirements for ANSI/AWWA C900.

   b. Gaskets for mechanical joints shall meet the requirements of ANSI/AWWA C111/A21.11 and ASTM F477.

5. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, and bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C11/A21.11.

2.3 PIPE AND FITTING SMALLER THAN 4-INCH

A. Pipe shall be Type K drawn copper and shall meet the requirements of ASTM B88.

B. Fittings and couplings shall be cast bronze and shall meet the requirements of ASTM B16.18. Construct and manufacture fittings and couplings for a pressure rating of 150 psi.

C. Unions shall be bronze and shall meet the requirements of ASTM B16.18. Design and manufacture unions for a pressure rating of 150 psi.

D. Flanges for connection of screwed joint pipe to flange joint valves or fittings shall be 125-16 cast iron, screwed companion flanges, complying with both ASTM A126 and ANSI B16.1.

E. Tape for screwed joints shall be teflon.

F. Gaskets for flange joints shall be 1/16-inch thick, full face and conform to ANSI/AWWA C111/A21.11. Gaskets shall be rubber or as approved by the Utilities Superintendent.

G. Bolts for flange joints shall be steel, heavy hexagon head machine bolts. Nuts shall be steel, semi-finished, heavy hexagon nuts. Nuts and bolts shall meet the requirements of ASTM A307 for Grade B and be zinc-coated alloy steel.

2.4 VALVES

A. Shall be manufactured in accordance to AWWA C-509 and shall be AFC-2500 ductile iron resilient wedge valve. Valves have a full ten-year published money back warranty.

B. All ferrous parts shall be made of ductile iron, ASTM A526, minimum 65,000 psi tensile.

C. Valve Stems shall be stainless steel.

D. Bonnet and body metal thickness shall meet or exceed the minimum thickness permitted by ANSI/AWWA C153/A2153-88, and shall be coated inside and out with fusion-bonded epoxy. Bonnet and body and stuffing box bolts and nuts shall be type 18-8 stainless steel and must be installed and tested by the manufacturer.

E. Wedge shall be ductile iron, one-piece, fully encapsulated in synthetic rubber except for guide and wedge nut areas.

F. Synthetic rubber shall be molded in place and bonded to the wedge. Mechanical fasteners are not allowed.

G. Valves shall be provided with two (2) "O" rings above and one (1) "O" ring below the thrust collar.

H. All stem seals shall be replaceable with the valve wide open and while subjected to full rated pressure. Stem shall be removable.

I. Buried valves 2-inch and smaller shall be curb stops. Curb stops shall meet the applicable requirements of ANSI/AWWA C800, ASTM B-62 for 85-5-5-5 composition bronze, and USAS B21. Curb stops shall be Mueller H-10283, Ford B11 Series, or as approved by the Town Superintendent.

J. Air and Vacuum Valves shall be as follows:

Size	Specification
1/2"	Apco No. 141WD, Val-Matic 100DWS, or equal
1"	Apco No. 142WD, Val-Matic 101DWS, or equal
2"	Apco No. 144WD, Val-Matic 102DWS, or equal
3"	Apco No. 146WD, Val-Matic 103DWS, or equal
4"	Apco No. 1604/152, Val-Matic 104DWS, or equal
6"	Apco No. 1606/153, Val-Matic 106DWS, or equal

2.5 VALVE BOXES

A. Valve boxes for gate valves shall be cast iron. Valve boxes shall be two piece or screw type with an inside shaft diameter of 5-1/4".. Each box shall be complete with bottom section, top section and cover. Valve boxes shall be extension type with slide or screw type adjustment. Each base and bottom section shall be the proper size for the valve served. Each valve box assembly shall be the proper length for the valve served. The minimum thickness of metal shall be 3/16-inch. Cast the word "WATER" in each valve box cover.

B. Valve boxes for curb stops shall be cast iron. Curb boxes shall be the extension type. Each curb box shall be complete with foot piece, curb box and lid or as approved by the Town Superintendent:

2.6 FIRE HYDRANTS

A. Fire hydrants shall be dry-barrel, compression shutoff, traffic model design and shall comply with ANSI/AWWA C502 "Standard for Dry-Barrel Fire Hydrants".

Main valve size shall be 5-1/4 inch and shall open left. Inlets shall be 6-inch mechanical joint. Each hydrant shall have two 2-1/2-inch nozzles and one 4-1/2-inch pumper nozzle equipped with Storz fittings. Nozzle threads and hydrant opening direction shall be consistent with the existing fire hydrants in the waterworks in which the fire hydrant is installed, unless otherwise directed by the Town Superintendent. Each hydrant shall be proper length for the water main to which the hydrant is connected. Fire hydrant coating shall meet the requirements of ANSI/AWWA C502. Paint color yellow, factory applied. Hydrants shall be Waterous Pacer Hydrant WB67, or an approved equal.

B. The bronze valve seat shall thread into a bronze sub-seat. The drain plunger shall be bronze and shall be positively operated by a main operating rod. A top stop nut shall be used to provide a positive limit to the travel of the main rod. Two-piece operating nuts shall be used. The nozzle section shall have a 360^{o} rotation capability by loosening four bolts. Nozzles shall be mechanically attached with a ductile iron retainer and sealed with an "O" ring. The barrel shall be of ductile iron with a minimum inside diameter of 7-1/4". The shoe and lower valve washer shall be coated inside and out with fusion-bonded epoxy. The shoe shall be attached to the lower barrel with factory-installed stainless steel bolts and nuts, and shall have a flat bottom, ribbed back, and strapping lugs. The hydrant design shall allow for plugging of drains without excavating.

C. Fire Hydrant Placement - Fire Hydrants shall be placed no farther apart than 300 feet in all residential subdivisions, subdivision sections, and other residential areas in which dwelling density meets or exceeds three dwelling units per gross acre. Fire hydrants shall be placed no further apart than 300 feet in all Industrial, Business, and Commercial areas, and all Industrial, Business, and Commercial uses. Such requirement shall be in full force and effect unless explicitly exempted by the Chief of the Fortville Volunteer Fire Department. For residential uses with densities less than three dwelling units per gross acre, the requirements as established in Table No. III-B-A of the Uniform Fire Code shall apply. Where there is any ambiguity or dispute concerning the interpretation of this requirement, the decision of the Chief of the Fortville Volunteer Fire Department shall prevail, subject to appeal

2.7 SPRINKLER SYSTEMS

Multi-family developments, duplexes, and hotel/motels shall be required to have sprinkler systems installed in the attics of said structure as approved by the Chief of the Fortville Volunteer Fire Department. Such requirement shall be in full force and effect unless explicitly exempted by the Chief of the Fortville Volunteer Fire Department. Where there is any ambiguity or dispute concerning the interpretation of this requirement, the decision of the Chief of the Fortville Volunteer Fire Department shall prevail subject to approval.

2.8 BACKFLOW PREVENTION AND CROSS CONNECTIONS

All water services must comply with 327 IAC 8-10 regarding back flow and cross connections.

2.9 RESIDENTIAL METER SETTINGS

Pits shall be white interior or Fratco ribbed type made of white plastic 20" ID for single meter setting. Cover shall be locking type single lid with 4" rise and small operating nut. Lid must have hole for toughread meter. Meter setting shall be set up with 5/8" x 3/4" meter bar with prongs to support the meter. A yoke valve shall be installed on one end of the bar and a check valve on the side going to the house. Service lines shall be type K soft copper or polyethylene tubing, 200 psi. Bury tracing wire with all plastic lines.

Corporation stop and saddles shall be installed on all taps at a 22 ½ angle. Service lines shall have compression fittings for 3/4" CTS or equivalent on all connections. Pits shall be set at no more than 3' inside the sidewalk. Pits are to be at a depth of 36". Contractor must furnish submittals on all materials to be installed. The Town must approve any substitutions.

2.10 NON-RESIDENTIAL METER SETTINGS

Vault shall be reinforced concrete. Access hatch shall be Bilco-J-2AL and shall be flush with top of vault. A yoke valve shall be installed on one end of the bar and a check valve on the side going to the house. Service lines shall be type K soft copper or ductile iron inside and within three (3) feet of the vault. Vault shall be 8" concrete reinforced with #4 rebars at 12" on center each way. The top of the vault shall be a minimum of 4" reinforced concrete. Vaults constructed in paved areas, shall be level with the pavement. The top shall be sufficiently reinforced to support the expected traffic loads. Vault construction in other areas shall correspond to the finished grade level of the surrounding area. Vault drainage shall be provided by a sump pump or other Town approved alternate. The vault shall be equipped with an access ladder and hatch, Bilco-J-2AL or approved equal, which shall be installed directly above the meter(s). Contractor shall be responsible for installing the meter and service into the vault in accordance with these standards and Details 2660I and 2660J. Meter shall be a compound meter as manufactured by Invensys and shall be installed in accordance with manufactured recommendations and these standards. Duplex reduced pressure backflow prevents shall be installed on all service connections. Backflow preventors installed in the vault shall be suitable for installation in an enclosure. Contractor must furnish submittals on all materials to be installed. The Town must approve any substitutions.

PART 3 - EXECUTION

3.1 INSPECTION

Inspect water main pipe, fittings, valves, hydrants, and appurtenances prior to installation. Promptly remove damaged or unsuitable products from the job site. Replace damaged or unsuitable products with undamaged and suitable products.

3.2 LAYING OF WATER MAINS

A. Proper tools and facilities shall be provided and used by the Contractor for safe working conditions.

B. Lay and maintain pipe to lines and grades shown on the drawings or to the minimum depth specified in this Article. Install fittings, valves and hydrants in the locations shown on the drawings.

C. When the exact location of buried utilities is unknown and piping is to be constructed parallel and close to said utilities, adjust the alignment of the piping to least interfere with these utilities. This applies unless otherwise shown on the drawings or specified by the Town Superintendent.

D. Water mains shall be laid at least 10 feet horizontally from any existing sanitary sewer or sewage force main. The distance shall be measured from edge to edge of the pipe. Water mains crossing sanitary sewer or sewage force mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer or force main. The 18-inch separation shall apply whether the water main is over or under the sewer or force main. Lay water mains at crossings of sewers and force mains so a full length of water main pipe is centered on the sewer or force main whenever possible. No water main shall pass through or come in contact with any part of a sanitary sewer manhole.

E. For pipe 10 inches and smaller, pressure piping shall be laid at a depth that provides at least 4’-6” of cover. At least 4’-0” of cover shall be provided for pipes 12 inches or larger. Cover shall be measured as the vertical distance from the top of the pipe to the finish grade elevation.

F. Laying of water mains shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section.

G. Shape the bottom of the trench to give uniform circumferential support of the lower quarter of each pipe.

H. Do not lay pipe in water or when the trench or weather conditions are unsuitable for proper installation.

I. As each length of pipe is placed in a trench, joint the pipe being laid to the previously laid pipe. Bring the pipe to correct line and grade. Secure the pipe in place with bedding tamped under the pipe. Tamp bedding up to the centerline of the pipe.

J. Deflection from a straight line or grade shall not exceed the limits specified in this Section. If the alignment requires joint deflections in excess of the allowable deflection per joint, furnish and install fittings or a sufficient number of shorter lengths of pipe.

K. Provide thrust restraint at horizontal and vertical deflection fittings and at tees, plugs, tapping sleeves and tapping saddles. Restraint shall be restrained joint piping or concrete thrust blocking.

L. Where concrete thrust blocking is used, cover the fitting to be blocked with visqueen or a heavy duty grease to prevent adherence of the concrete to the fitting.

M. Block the open end of the pipe at the close of each day's work to prevent contamination from dirt or rain water and entry of any animal or foreign material.

N. Lower pipe, fittings, valves and hydrants into the trench by hand, hoists or ropes or other suitable tools or equipment that will not damage products, coatings or linings. Do not drop or dump pipe, fittings, valves, or hydrants into the trench.

O. Water main designs that require crossing a county legal drain shall be approved and constructed per the latest standards of the Hancock County Surveyor's Office.

3.3 SETTING VALVES, VALVE BOXES AND FIRE HYDRANTS

A. Clean the interiors of valves and hydrants of foreign matter before installation. Tighten stuffing boxes. Inspect valves and hydrants in opened and closed positions to ensure all parts are in working condition.

B. Set valves and valve boxes plumb. Center valve boxes on the valves with posi-cap aligner. Locate valves outside the area of roads and streets where feasible. Tamp backfill around each valve box to a distance of 4 feet on all sides of the box or to be undisturbed trench face if less than 4 feet. The maximum distance between valves shall be 1,000 feet.

C. Set hydrants plumb with the pumper nozzle facing the street. The centerline of the outlet nozzles shall be at least 18 inches or at most 30 inches above finished grade at a hydrant. Install hydrant extensions where required to bring hydrant to proper elevation. Set each hydrant upon a slab of stone or concrete not less than 4 inches thick and 15 inches square. Wedge the side of each hydrant opposite the pipe connection against the undisturbed trench face to prevent the hydrant from blowing off the branch connection. Compact the backfill around each hydrant to

finish grade. Furnish and install a gate valve and valve box in each hydrant branch connection. Fire hydrants are to be yellow.

3.4 CONNECTING TO EXISTING MAINS

A. The Contractor shall locate and verify exact size of all existing mains, both horizontally and vertically. Additionally, allow adequate time, after location and prior to making new connections, for changes in the connection location and size. Backfill excavation immediately after main is located and measured.

B. Make each wet connection with a tapping valve and tapping sleeve. Install and hydrostatically test each tapping valve and tapping sleeve assembly prior to tapping existing water main. Inspect each tapping valve prior to tapping existing water main. Open and close tapping valves, and inspect in opened and closed positions to ensure all parts are in working condition. Inspect each tapping valve immediately before connecting tapping machine to ensure the tapping valve is open. Install watertight plug on the tapping valve outlet and backfill excavation if existing water main is not tapped within 48 hours after installing tapping valve and tapping sleeve or tapping saddle assembly. Install watertight plug on the tapping valve outlet and backfill excavation if new water main is not connected to tapping valve within 48 hours after making tap in existing water main.

C. Make each dry connection with fittings and valves indicated on the drawings. Furnish and install sleeves required to complete connections. All required pipe, fittings valves, tools, and equipment shall be at the connection site prior to starting connection. Wash interior of new pipe, fittings, and valves with a solution containing 50 mg/l of chlorine prior to making connection. Make connections at night and on weekends when required. The Town will operate existing valves. Install sufficient water main and restraint joints so existing water mains can be in service immediately after the connection is completed. Inspect joints and eliminate leaks immediately after the connection is completed and the existing mains are put in service. Install watertight plugs on open ends of pipe and valves, and backfill excavation if new water main is not connected to dry connection with 48 hours after completing dry connection.

3.5 JOINTING

A. Ductile Iron Push-on Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. For restrained push-on joints, move the loose retainer ring into position against the retainer bar on the spigot end of the pipe being installed.

Loosely assemble the joint bolts and nuts.

3. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-Foot Pipe Length
4”	5º	18-1/2”
6”	5º	18-1/2”
8”	5º	18-1/2”
10”	5º	18-1/2”
12”	5º	18-1/2”

4. For restrained push-on joints, pull the nuts to a uniform tightness by hand or with a short wrench. Do not pull the spigot of the pipe being installed against the back of the bell of the receiving pipe. Engage at least a full nut on each bolt when joint deflection is required.

B. Polyvinyl Chloride Push-on Joints

1. Pipe must be cleaned and installed as specified by the manufacturer’s requirements. Additionally, all joints must be free of all foreign material.
2. Deflect the pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the pipe manufacturer.

C. Mechanical Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

Pipe Size	Bolt Size	Torque Range
4” thru 24”	3/4”	75 to 90 ft.-lb.

2. Deflect pipe, fittings or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:
3.

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-Foot Pipe Length
4”	8º - 18’	31”
6”	7º - 7’	27”
8”	5º - 21’	20”
10”	5º - 21”	20”
12”	5º - 21’	20”
14”	3º - 35’	13-1/2”
16”	3º - 35’	13-1/2”
18”	3º - 0’	11”
20”	3º - 0’	11”
24”	2º - 23’	9”

D. Shoulder Type Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. The tightening torque shall not exceed the limits recommended by the joint manufacturer.

3. Deflect pipe, fittings, adapters or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits recommended by the manufacturer.

E. Threaded Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. Do not overtighten joints.

3. Backing off made-up threaded joints to facilitate fit-up or alignment will not be permitted.

F. Flange Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess

bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. Do not overtorque nuts and bolts.

3.6 RESTRAINING AND SUPPORTS

A. Thrust Blocking

1. Construct thrust blocks of concrete having a 28-day compressive strength of at least 2,000 psi.

2. Lubricate fitting surfaces to prevent bonding between fittings and thrust blocks.

3. Construct thrust blocks between fittings and undisturbed soil. The area of thrust blocking bearing on undisturbed soil shall be at least the area indicated on the drawings. Construct thrust blocking so pipe and joints are accessible for repair and joint flexibility is not impaired.

B. Restrained joint piping shall be as specified in this Section. Distance from fitting to end of restraint shall not be less than that indicated on the drawings (Town of Fortville Detail 2660-K).

C. Mechanical Joint Rod Restraint

1. Mechanical joint rod restraint shall be from fitting to fitting.

2. The number of rods shall conform to the following table:

Pipe Size	Rod Size	Minimum No. of Rods
4”	3/4”	2
6”	3/4”	2
8”	3/4”	4
10”	3/4”	4
12”	3/4”	6
14”	3/4”	6
16”	3/4”	8
18”	3/4”	8
20”	3/4”	10
24”	3/4”	16

D. Pipe supports

1. Furnish and install supports required to hold pipe, fittings and valves at the lines and grades indicated on the drawings, without causing strain upon pipe, fittings and valves.

2. Support piping by suitable saddle stands, concrete piers or hangers.

3. Locate supports where necessary, at least 8 feet on center.

3.7 HYDROSTATIC TEST

A. Hydrostatic tests shall be performed on all water mains installed. The Contractor shall make arrangements with the Town Superintendent and/or Town Representative for scheduling each test. Each test shall be performed on the day mutually agreed upon and in the presence of the Town Superintendent and/or Town Representative.

B. The Contractor shall furnish equipment, temporary piping, pumps, fittings, gauges, and operating personnel necessary to conduct the tests. Water for testing may be obtained from the Town.

C. The water mains may be tested in sections between valves when there is one or more intermediary valves in a water main.

D. Test procedures shall meet the requirements of AWWA Standard C600.

E. Each section of water main shall be complete, and thrust blocks shall have been in place for not less than 10 days prior to being tested.

F. Test pressure shall not be less than 1.5 times the working pressure at the lowest point along the test section, or 120 psi, whichever is greater, but shall not exceed the pipe, fitting or thrust-restraint design pressures at any point. Test pressure shall not vary by more than $\pm$5 psi for the duration of the test.

G. Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests at these pressures, the test setup should include provisions, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or opened fully if desired.

H. Test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section included closed, resilient-seated gate valves, or

butterfly valves. No test sections shall exceed 5 miles in length without prior approval from the Town Superintendent.

I. All newly laid pipe or any newly valved section shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure at the point of testing. Each valved section of pipe shall be slowly filled with water. The specified test pressure, which is based on the elevation of the lowest point of the line or section being tested as corrected to the elevation of the test gauge, shall be applied by means of a pump connection to the pipe in a manner satisfactory to the Town Superintendent. Valves shall not be operated in either the open or closed direction at differential pressures above the rated pressure. Allow the system to stabilize at the test pressure before conduction the leakage test.

J. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at high points, the Contractor shall install corporation cocks at such points so that air can be expelled as the line is filled with water. After the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged, or left in place if approved by the Town Superintendent.

K. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged components during or after the pressure test shall be repaired at the contractors expense. The test shall be repeated until the results are satisfactory to the Town.

L. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe or any valved section to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$\frac{L = SD \sqrt{P}}{133{,}200}$$

Where:
L = Allowable leakage, in gallons per hour
S = Length of pipe tested, in feet
D = Nominal diameter of the pipe, in inches
P = Average test pressure during leakage test, in pounds per square inch (gauge)

ALLOWABLE LEAKAGE PER 1000 FT. OF PIPELINE*

Nominal Pipe Diameter. In.

Avg. Test Pressure Psi	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54
450	0.48	0.64	0.95	1.27	1.50	1.91	2.23	2.56	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60
400	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.60	5.41	6.31	7.21	8.11
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.50	3.12	3.90	4.68	5.46	6.24	7.02
275	0.37	0.50	0.75	1.00	1.24	1.42	1.74	1.99	2.24	2.40	2.99	3.73	4.48	5.23	5.98	6.72
250	0.36	0.47	0.71	0.95	1.19	1.40	1.58	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41
225	0.34	0.45	0.68	0.90	1.13	1.35	1.56	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.48	5.09	5.73
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.50	1.79	1.98	2.38	2.98	3.68	4.17	4.77	5.36
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.56	1.84	2.21	2.76	3.31	3.86	4.41	4.97
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53
100	0.23	0.30	0.45	0.50	0.75	0.90	1.05	1.20	1.35	1.60	1.80	2.25	2.70	3.15	3.60	4.05

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gph/in. of nominal valve size shall be allowed.

When hydrants are in test section, the test shall be made against closed hydrant valves.

M. If test results disclose leakage greater than allowable limits, the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. Additional tests performed after the repairs will be at the Contractors expense. All visible leaks are to be repaired, regardless of the amount of leakage.

3.8 FLUSHING

A. Flush water mains and fire hydrants prior to disinfection. Flushing shall continue until the water is clear. The flushing velocity shall be at least 2.5 feet per second. The following are the flows required to provide required flushing velocities.

Pipe Size	Inside Diameter	Flow velocity of 2.5 feet per Second
½”	0.622”	2.4 gpm
¾”	0.824”	4.2 gpm
1”	1.05”	6.8 gpm
1-1/4”	1.38”	12 gpm
1-1/2”	1.61”	16 gpm
2”	2.07”	27 gpm
2-1/2”	2.47”	38 gpm
3”	3.07”	58 gpm
4”	4”	98 gpm
6”	6”	220 gpm
8”	8”	390 gpm
10”	10”	620 gpm
12”	12”	880 gpm
14”	14”	1,200 gpm
16”	16’	1,600 gpm
18”	18”	2000 gpm

20”	20”	2,500 gpm
24”	24”	3,600 gpm

3.9 DISINFECTION

A. Disinfect all new and repaired water mains prior to placing them in service. Disinfection procedures shall be in accordance with AWWA 651-92. Disinfect pipe, fittings, valves, and hydrants with a chlorine solution containing 50 mg/l ± 5 mg/l of available chlorine.

B. Water shall be supplied to the new system at a constant, measured rate. In the absence of a meter, the rate may be approximated by methods such as placing a Pitot gauge in the discharge and measuring the time to fill a container of known volume.

C. At a point not more than 10 ft. downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will have not less than 50 mg/L free chlorine. To assure that the correct concentration is provided, measure units shall be taken at regular intervals in accordance with the procedures described in the current edition of Standard Methods for the Examination of Water or Wastewater, AWWA Manual M12, or by using an appropriate chlorine test.

D. The chlorinating material shall be chlorine gas, calcium hypochlorite or sodium hypochlorite. Calcium hypochlorite shall have 70% available chlorine by weight, and sodium hypochlorite shall have 5.25% to 14.7% available chlorine. Placing chlorine tablets in the mains during construction is not an acceptable method of disinfection. The following table shows the quantity of chlorine or hypochlorite required to produce 50 mg/l of available chlorine per 100 feet of pipe.

			Pounds		Ounces		Quarts	
Pipe Size	Inside Diameter	Chlorine Gas	Cal. Hycl. (70%)	Cal. Hycl.	Sod. Hycl.	Sod Hycl.	Sod Hycl	Sod Hycl
½”	0.622”	0.00066	0.00094	0.015	0.072	0.20	0.0022	0.0063
¾”	0.824”	0.0012	0.0017	0.026	0.13	0.35	0.0039	0.011
1”	1.05”	0.0019	0.0027	0.043	0.20	0.57	0.064	0.018
1-1/4”	1.38”	0.0032	0.0046	0.074	0.35	0.99	0.011	0.031
1-1/2”	1.61”	0.0044	0.0063	0.10	0.48	1.3	0.015	0.042
2”	2.07	0.0073	0.010	0.17	0.79	2.2	0.025	0.069
2-1/2”	2.47	0.010	0.015	0.24	1.1	3.2	0.035	0.099
3”	3.07	0.016	0.023	.37	1.7	4.9	0.055	0.15
4”	4”	0.027	0.039	0.62	3.0	8.3	0.093	0.26
6”	6”	0.061	0.087	1.4	6.7	19	0.21	0.58

Pipe Size	Inside Diameter	Chlorine Gas	Pounds Cal. Hycl. (70%)	Ounces Cal. Hycl.	Quarts Sod. Hycl.	Sod Hycl.	Sod Hycl	Sod Hycl
8”	8”	0.11	0.16	2.5	12	33	0.37	1.0
10”	10”	0.17	0.24	3.9	19	52	0.58	1.6
12”	12”	0.24	0.35	5.6	27	75	0.83	2.3
14”	14”	0.33	0.48	7.6	36	100	1.1	3.2
16”	16”	0.44	0.62	10	47	130	1.5	4.1
18”	18”	0.55	0.79	13	60	170	1.9	5.2
20”	20”	0.68	0.97	16	74	210	2.3	6.5
24”	24”	0.98	1.4	22	110	300	3.3	9.3

E. While chlorine is being applied, valves shall be positioned so that the strong chlorine solution will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall be retained in the main for at least 24 hours. During this time, all valves and hydrants in the section being treated shall be operated to ensure disinfection of all appurtenances. At the end of this period, the treated water in all portions of the main shall have a residual of not than 10 mg/L free chlorine.

3.10 POST DISINFECTION FLUSHING

A. After the applicable testing period, heavily chlorinated water shall be removed in order to prevent damage to the pipe. The chlorinated water shall be flushed from the main until chlorine measurements show that the concentration in the water leaving the main is greater than 0.5 mg/L but less than 2.0 mg/L.

B. Chlorinated water shall be properly discharge to an approved sanitary sewer. If no sanitary sewer is available a reducing agent shall be applied to the water to be waste in order to thoroughly neutralize residual. The following table shows the amount of neutralizing chemicals required. Where necessary, federal, state and local regulatory agencies should be contacted to determine if there are special provisions for the disposal of heavily chlorinated water.

POUNDS OF CHEMICALS REQUIRED TO NEUTRALIZE VARIOUS RESIDUAL CHLORINE CONCENTRATIONS IN 100,000 GALLONS OF WATER*

Residual Chlorine Concentration mg/L	Sulfer Dioxide (SO_2)	Sodium Bisulfate ($NaHSO_3$)	Sodium Sulfite (Na_2SO_3)	Sodium Trisulfate ($Na_2S_2O_35H_2O$)
1	0.8	1.2	1.4	1.2
2	1.7	2.5	2.9	2.4
10	8.3	12.5	14.6	12.0
50	41.7	62.6	73.3	60.0

*Except for residual chlorine concentration, all amounts are in pounds.

3.11 BACTERIOLOGICAL TEST

A. Satisfactory bacteriological test results approved by the Indiana State Board of Health shall be produced for two (2) successive sets of samples, collected at twenty-four (24) hour intervals, before the new mains are accepted for use.

B. Contractor shall notify the Town when the system and disinfection is complete and the water is ready for bacteriological testing. The Town will then collect the sample with the Contractor present. Town will submit the sample to an independent certified laboratory for bacteriological analysis at the Contractor's expense.

C. Samples shall be collected from the end of the line, and tested for bacteriological quality in accordance with Standard Methods for the Examination of Water and Wastewater. At least one set of samples shall be collected from the new main and one from each branch. In case of long mains, samples shall be collected along the length of the line, at reasonable intervals, as well as at its end. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate. No hose or fire hydrant shall be used in the collection of samples.

3.12 RE-TESTING AND DISINFECTION

If test results are unsatisfactory, Contractor shall repeat the disinfection. Testing shall be repeated as noted above until the testing results are satisfactory and the mains are approved for service

PART 4 - FIGURES

4.1 INDEX

FIGURE	DESCRIPTION
2660A	Trench and Bedding Detail
2660B	Thrust Block Details
2660C	Joint Restraining Details
2660C.1	Pressure Pipe Joints Restraints Table
2660D	Steel Casing Detail
2660E	Connection to Existing Main
2660F	Gate Valve and Box
2660G	Fire Hydrant Details
2660H	Water Meter and Pit Detail
2660I	Non-residential Water Service
2660J	Non-residential Fire Service and Meter Vault Detail

END OF SECTION 02660