

THE CITY OF HOLLAND BOARD OF PUBLIC WORKS (BPW)
SPECIFICATION
FOR
DUCTILE IRON PIPE WATER DISTRIBUTION SYSTEMS – 33 10 00

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PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes furnishing and installing pipe and appurtenances for ductile iron water distribution systems including hydrostatic pressure testing, disinfection, bacteriological sampling, testing and reporting and disposal of chlorinated water and the complete removal of abandoned pipe and appurtenances. All work shall conform to BPW Standards & Specifications, MDOT Standards & Specifications as modified by the BPW and AWWA C600 & C651. All non-itemized work will not be paid for separately.
- B. All pressure and leakage testing, flushing, disinfection, bacteriological testing and municipal water system shutdowns shall be scheduled with BPW personnel a minimum of 24 hours in advance. Only BPW personnel shall operate valves within the systems.

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

- A. Water Main, _ inch, DI, Tr Det G Ft
 - 1. Paid for by the unit foot as measured in place and includes hand trimming, excavation, pipe, joint restraint, underground utility conductivity and continuity, connection to service piping and municipal utility, restraint of existing pipe, polyethylene wrap, bedding, backfill, compaction, disinfection and testing.
- B. Water Reuse Main, _ inch, DI, Tr Det G Ft
 - 1. Paid for by the unit foot as measured in place and includes hand trimming, excavation, pipe, joint restraint, underground utility conductivity and continuity, connection to service piping and municipal utility, polyethylene wrap, bedding, backfill, compaction and testing.
- C. Bend, _ degree, _ inch Ea
 Cross, _ inch by _ inch by _ inch by _ inch Ea
 Plug, _ inch Ea
 Reducer, _ inch by _ inch Ea
 Tee, _ inch by _ inch by _ inch Ea
 - 1. Paid for by the unit installed and includes hand trimming, excavation, fitting, restraint, accessories, polyethylene wrap, bedding, backfill and compaction.
- D. Sleeve, _ inch Ea
 - 1. Paid for by the unit installed and includes hand trimming, excavation, fitting, restraint, accessories, polyethylene wrap, bedding, backfill and compaction. Any sleeves used at the convenience of the contractor will not be paid for separately but shall be paid for under Water Main, DI, _ inch, Tr Det G or Water Reuse Main, DI _ inch, Tr Det G.

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- E. Valve and Box, _ inch Ea
1. Paid for by the unit installed and includes hand trimming, excavation, valves, restraint, accessories, polyethylene wrapping, bedding backfill and compaction.
- F. Hydrant Assembly Ea
1. Paid for by the unit installed and includes hand trimming, excavation, gravel sump, hydrant, valve, connection, pipe, bends, restraint, accessories, bedding, backfill and compaction.
- G. Water Service, _ inch Ea
1. Paid for by the unit installed along the short side of the main and includes installing pipe and fittings, corporation stop, curb stop, curb box, all necessary connections, hand trimming, excavation, bedding, backfill, compaction and reconnection to existing service. Work will be limited to the ROW area and 7 feet from the ROW line. Closing existing corporation and removal of existing materials is also included.
- H. Water Service, Long, _ inch Ea
1. Paid for by the unit installed on the long side of the main and includes installing pipe and fittings, corporation stop, curb stop, curb box, all necessary connections, hand trimming, excavation, bedding, backfill, compaction and reconnection to existing service. Replacement work will be limited to the ROW area and 7 feet from the ROW line. Closing existing corporation and removal of existing material is also included.
- I. Water Service, Reconnect Ea
1. Paid for by the unit for each service reconnected, regardless of size, to the proposed main and includes cutting to length existing copper service, installing fittings, corporation stop, new curb stop, new curb box, all necessary connections, hand trimming, excavation, bedding, backfill and compaction. Removal of existing materials is also included.
- J. Water Service, Missile Ea
1. Paid for by the unit installed via trenchless technology. This pay item shall be in addition to Water Service, _ inch and Water Service, Long, _ inch and shall be used exclusively at the discretion of the Engineer.

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- K. Main, Remove Ft
1. Paid for by the unit removed and shall include hand trimming, excavation, disconnection and removal of mains, services and appurtenances, backfill and compaction. All hydrants shall remain the property of the BPW.
- L. Valve Box, Adjust Ea
1. Paid for by the unit installed and shall include hand trimming, excavation, removal and disposal of existing casting, installation of new casting, bedding, backfill and compaction.

1.3 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- B. Manufacturer's Certificate: The manufacturer shall furnish certified transcripts of the results of tensile tests, a listing of the length and weight of each piece, a list of the pieces rejected and the reason for the rejection. The manufacturer shall also furnish a sworn statement that the inspection and all of the specified tests have been made and that the results comply with the requirements of the applicable standard.
- C. Project Record Documents: Record actual locations of mains, valves, connections, bends, major fittings, hydrants, thrust restraints, and top of pipe elevations (to USGS datum). Identify and describe unexpected subsoil conditions and uncharted utilities.
- D. Disinfection and testing procedures, chemicals, treatment levels and equipment shall be made readily available for review.
- E. Disinfection Report including: Type and form of disinfectant used; Date and time of disinfectant injection start and time of completion; Test locations; Name of person collecting samples; Initial and 24 hour disinfectant residuals (ppm) of treated water for each outlet tested; Date and time of flushing start and completion; Disinfectant residual (ppm) after flushing for each outlet tested.

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PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND APPURTENANCES

- A. Ductile Iron Pipe: Conforming to ANSI/AWWA C151/A21.51, NSF 61 Certified, Class 52, sized as indicated.
1. Deliver and store per manufacturer's requirements.
 2. Pipes shall be furnished in 18' or 20' sections or as indicated.
 3. All pipes shall be double thickness cement lined in accordance with ANSI/AWWA C104/A21.3.
 4. Water mains and services installed within public easements or rights-of-way shall be encased in 8-mil polyethylene per ANSI/AWWA C105/A21.5, black in color.
 5. Water reuse mains and services installed within public easements or rights-of-way shall be encased in 8-mil polyethylene per ANSI/AWWA C105/A21.5, purple in color.
 6. Encased pipe shall be closed with 2" Poly Ken #900 and Scotchwrap #50.
 7. All dead ends shall be closed with ductile iron plugs or caps and equipped with suitable blow off facilities.
- B. Joints: 350 psi rated conforming to ANSI/AWWA C111/A21.11. In construction areas of suspected soil contamination, Nitrile or FKM gaskets shall be used.
1. Push-On: Deflection shall not exceed the limits shown in Table 2.
 - A. Joint Restraint: Shall consist of stainless steel locking segments vulcanized into the gasket and capable of being disassembled.
 2. Mechanical (**PREFERRED FOR JOINT RESTRAINT**): EBAA Iron, Inc. Series 1100 Mechanical Joint Restraints "MEGALUGS" or BPW approved equal shall be used. Deflection amounts shall not exceed the limits shown in Table 3.
 - A. Bolts: Bolts shall be Cor-Blue bolts conforming to ANSI/AWWA C111/A21.11. Manufacturer's certification of compliance must accompany each shipment. Bolts shall be polyethylene encased.
- C. Fittings: Ductile iron, push on or mechanical joint, 350 psi rated joints conforming to ANSI/AWWA C153/A21.53 up to 12" and ANSI/AWWA C110/A21.11 16" and larger.
1. Transition gaskets (for new construction) shall be used for all fittings up to 8" transitioning from iron pipes sizes (IPS) to ductile iron pipes sizes (DIPS) and meeting the ANSI/AWWA C111/A21.11 standard.

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2.2 VALVE BOXES

A. Boxes shall be cast iron, 3 sectional, screw-type adjustable to allow top to be set flush with final grade elevation of pavement or ground surface. Cast iron lids shall be provided with the word(s) “water” or “reuse” and an arrow indicating clockwise to open. The box shall be designed for highway loads and shall be Buffalo type.

1. EJIW 8560 Series or BPW approved equal

2.3 GATE VALVES – 3” AND LARGER

A. Resilient Seated Gate Valves: Conforming to AWWA C509 or AWWA C515, NSF 61 Certified, sized as indicated on the drawings, right-hand open (clockwise). The BPW reserves the right to approve or disapprove any valve for use in the water distribution systems.

1. EJIW or BPW approved equal
2. Deliver and store in shipping containers with labeling in place.
3. Valve body, bonnet and seal plate shall be ductile iron.
4. The rated working pressure of the valve shall be 250 psi.
5. The interior shall be free of pockets or ledges where debris can collect.
6. All gaskets shall be pressurized o-rings. Packing glands are not permitted.
7. The valve body and bonnet shall be coated on all exterior and interior surfaces with a fusion-bonded epoxy in conformance with AWWA C550.
8. Bolting materials shall be stainless steel and meet ASTM A307, Grade B
9. Gate valves 20” and larger shall have an enclosed spur gear.
10. The manufacturer’s name, valve size, year of manufacture, pressure rating, AWWA Standard, and “DI” shall be cast on the valve.
11. The valve shall be designed so that during operation or cycling of the valve, there is no friction or abrasion or rubbing together of the gate and body that can wear away any rubber or epoxy and expose bare iron. Gates shall be completely covered with rubber over all interior and exterior ferrous surfaces. The rubber shall be securely bonded to the gate body, including the part that houses the stem nut. The stem nut through the gate shall be fully opening top to bottom and shall be solid ductile iron.

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12. All valves shall be assembled solely of components manufactured within the continental United States to assure timely shipment and access to manufacturing facilities. All valves shall be assembled and tested within the continental United States to assure timely shipment and access to assembly and testing facilities.
13. All required Drawings, manuals, parts lists and certifications must be furnished. Manufacturer shall certify that the valves furnished meet this Specification and any materials found not conforming to this specification subsequent to acceptance and/or installation shall be rejected and replaced.

2.4 BALL TYPE CORPORATION STOPS

- A. All corps shall be manufactured and tested in accordance with ANSI/AWWA C800 with NSF 61 Certification. The corporation shall be packed joint with a lock-down nut for copper tubing as specified in this section. All corps shall conduct electrical current from the pipe it's connected to through the body of the valve to the pipe connected to it without exception. Equivalent flare connection valves may be accepted upon approval by the BPW.

1. Ford FB1000-x-K, McDonald 4701B-22, Mueller P-25008, BPW approved equal

2.5 SERVICE SADDLES

- A. Service Saddles are required for all 1.5" and 2" Service Connections. All saddles shall meet or exceed ANSI/AWWA C800 with NSF 61 Certification. The saddle shall consist of brass nuts and a brass body with an EPDM gasketed outlet tapped with an AWWA taper. Straps shall be double, flattened silicon bronze.

1. Ford 202B, McDonald 3825-4148, Mueller BR2B or BPW approved equal

2.6 SERVICE PIPE, LESS THAN 3" IN DIAMETER

- A. Services shall be seamless and manufactured in conformance with ASTM B88, type "K" copper with NSF 61 Certification. Minimum size used shall be 1" standard Copper Tubing Size (CTS).

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2.7 BALL TYPE CURB STOPS AND CURB BOXES

- A. All curb stops shall be manufactured and tested in accordance with ANSI/AWWA C800 with NSF 61 Certification. The curb stop shall be packed joint with a lock-down nut for copper tubing as specified in this section. All curb stops shall conduct electrical current from the pipe it's connected to through the body of the valve to the pipe connected to it without exception. Equivalent flare connection valves may be accepted upon approval by the BPW.
 - 1. Ford B55-XXX, McDonald 6100-22, Mueller P-25209, BPW approved equal
- B. Cast iron Buffalo Box with arch pattern screw adjustment and 2¼" minimum shaft ID.
 - 1. Tyler / Union 6500 Series Box 95-E or BPW approved equal.

2.8 TAPPING SLEEVES AND VALVES

- A. Tapping valves shall conform to the requirements of gate valves as specified above, be made with conformance to the shape required to allow a tapping machine to tap directly through the open valve, and have a mechanical joint to connect to the tapping sleeve and a flanged joint to connect to the main, unless otherwise indicated. Flange bolts shall be type 304 stainless steel.
- B. Tapping sleeves shall be stainless steel split sleeves with flanged outlet. All flange nuts and bolts shall be stainless steel and conform to ASTM A307, Grade B.

2.9 HYDRANTS

- A. The BPW W/WW Services Department reserves the right to approve or disapprove any hydrant for use in the water distribution system.
 - 1. EJIW WaterMaster 5BR250 or BPW approved equal
 - 2. Manufactured / tested in accordance with UL 246, FM 510 and AWWA C502.
 - 3. Designed so that one person can replace any or all of the working parts without removing the main valve seat and, in case of accident or breaking of the hydrant barrel, valve will remain closed by mechanical design.
 - 4. 5¼" valve opening, minimum
 - 5. Inlet shall be 6" mechanical joint and NSF 61 Certified.
 - 6. Hydrant shall be of proper length for installation in a trench of 5.5'
 - 7. Two, 2½" national standard thread hose nozzles
 - 8. One factory installed 5" Harrington Storz pumper / steamer connection

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9. Square 15/16" operating nut
10. Shall be right-hand open (clockwise)
11. Designed for a minimum working pressure of 150-psi and tested at 300-psi
12. Drain orifice shall be plugged.
13. The upper barrel of the hydrant shall be "Safety Yellow"
14. Two coats of asphalt varnish shall be applied to the section below ground.
15. All nozzles shall be on a removable head, not on the hydrant barrel, so that they may be rotated by changing the position of the top flange, without removing the barrel.

2.10 PRESSURE TEST GAUGE

- A. The pressure test gauge shall be liquid filled, have a maximum reading of 300 psi, have hash marks in increments of 5 psi and have certification of calibration within the past 12 calendar months prior to use.

2.11 STAND PIPES

- A. All standpipes shall be a minimum of 4" in diameter.

2.12 BACKFLOW PREVENTION DEVICES

- A. When flushing or filling mains under construction from an existing municipal water main, a BPW approved reduced pressure zone (RPZ) backflow prevention device shall be utilized.

2.13 DISINFECTION CHEMICALS

- A. Liquid Chlorine or Sodium Hypochlorite (liquid) per AWWA B300.

2.14 BEDDING MATERIAL

- A. Class I granular material conforming to MDOT Specifications.

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PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that the minimum cover of 5' is provided over mains and services.
- B. All surface structures outside paved areas shall be set to the plan elevation of 0.20' above the adjacent ground.

3.2 STORAGE

- A. The interiors of pipes, fittings, valves and hydrants shall be protected from contamination, dirt and foreign material at all times. Pipe delivered to the site shall be strung to minimize the entrance of foreign material, dirt and other contaminants.

3.3 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.

3.4 INSTALLATION - PIPE

- A. The Contractor shall not disturb any mains or valves that are in service.
- B. Route pipe in straight line or in accordance with allowable deflection in Tables 2 and 3.
- C. Unless otherwise indicated in a profile, mains shall be installed with a minimum cover of 5' as measured from the permanent centerline elevation (or existing road elevation if the permanent pavement elevation is not known) or existing ground at main, whichever results in a lower elevation. Where the main crosses ditches, a minimum cover of 5' shall be maintained.
- D. A minimum horizontal separation of 10' from water main and all sewers (including reuse main) and a minimum vertical separation of 18" from water main and all utilities shall be maintained. Where pipe deflection is not possible, 22.5 ° vertical bends shall be used to obtain the required separation.
- E. All polyethylene wrapping installed on the pipe shall be overlapped and secured with tape wrap as specified above. Any damaged polyethylene wrapping shall be immediately repaired prior to backfilling. Installation Method 'C' as described in ANSI/AWWA C105/A21.5 shall be used.
- F. The bell holes shall be excavated to sufficient width and depth to permit proper joining of pipe and thorough examination of joints.

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- G. Every precaution shall be taken to prevent any foreign materials from entering the pipe while it is being placed. When pipe installation is not in progress, the open ends of the pipe shall be closed by a cover or a plug. If water is in the trench, the seal shall be a watertight seal and shall remain in place until the trench is completely dry. Pipe shall not be laid in water nor laid when, in the opinion of the Engineer or his representative, trench conditions are unsuitable.
- H. Rubber gaskets for mechanical joints shall be carefully placed and bolts drawn up evenly and progressively.
- I. When joining push on type joint pipes, the gasket will be wiped clean, flexed and then placed in the socket. A thin film of lubricant will be applied to the inside surface of the gasket that will come into contact with the entering pipe. Only manufacturer's recommended lubricant will be allowed. When installing gaskets in freezing weather, the gaskets will be kept warm and pliable prior to their use.
- J. When the pipe has been cut in the field, the cut end will be reconditioned. The outside of the cut end will be tapered back about $\frac{1}{8}$ " at an angle of about 30 degrees in order to remove any sharp, rough edges which might injure the gasket.
- K. For pipe 8" or smaller, joint assemblies may be manually done. For pipe larger than 8", a jack-type tool will be used for the joint assemblies.
- L. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- M. Slope water pipe and position drains at low points.
- N. Thrust blocks may not be used in lieu of restrained joints. Restrained joints shall be installed in accordance with Table 1.
- O. Mechanical joint restraints are required on all tie-ins.
- P. Building services shall be marked with 2"x2"x12' hardwood markers, placed vertically at the end of the pipe, painted a fluorescent color and 2"x3/8" diameter rebar placed 1' below grade.
- Q. Upon receipt of satisfactory bacteriological results, the contractor shall connect the new water main to the existing water system under the inspection of the BPW. The interiors of all pipes and fittings shall be swabbed with a 1% - 5% chlorine solution. Before backfilling, the system shall be brought to full pressure, air removed and the joints inspected for leaks.
- R. When new pipe is connected to non-restrained pipe using 45 degree (or greater) bends or tees, thrust blocks set against or piling driven into solid bearing shall be constructed as pipe restraint. All such restraint shall be approved by the Engineer prior to backfill operations.

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3.5 INSTALLATION - VALVES

- A. Set valves on solid bearing
- B. Valves shall only be installed on sections of mains that are horizontally level.
- C. Center and plumb valve box over valve.
- D. Without exception, service curb valve and box shall be installed on a portion of the water service that is perpendicular to the face of the building it services.
- E. Water service corporation valve shall be inserted directly into the main or BPW approved service clamp, saddle or coupling. Insertion must be at an angle less than 45 degrees from the horizontal and on the same side of the main as the customer being served.

3.6 INSTALLATION – HYDRANTS

- A. Set hydrants plumb; locate Storz connection perpendicular to and facing roadway with the center of the connection 18" above the finished grade at the hydrant.
- B. Thrust blocks may not be used in lieu of restrained joints. Restrained joints shall be installed in accordance with Table 1.
- C. As indicated, locate hydrants and control valves on solid bearing to grade.
- D. Breakable portion of the stem coupling shall be placed at or just above finish grade.
- E. Verify that all hydrant drains and weep holes are plugged.
- F. All hydrant barrels shall be wrapped in polyethylene and taped from the hydrant valve to 3" below grade. The polywrap under the hydrant flange shall not be exposed once restoration has been completed.
- G. Hydrants not yet in service, or taken out of service shall be covered with a black garbage bag to easily indicate that they are not in service.
- H. Prior to the BPW's final acceptance of the water system, it is the Contractor's responsibility pump all hydrants dry and verify that they remain dry no earlier than 30 days following the initial pumping.
- I. The Contractor shall replace, at no charge to the BPW, any hydrant damaged beyond repair by the Contractor or his assigns. This shall include hydrants stripped, to any degree, of factory applied primer.

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3.7 HYDROSTATIC PRESSURE TESTING

- A. After completion of the pipeline installation, including partial backfill, but prior to final connection to the existing system, conduct, in the presence of the BPW, concurrent hydrostatic pressure and leakage tests in accordance with AWWA C600.
- B. Provide all personnel, equipment, corporation stops, gauges, pumps, standpipes, temporary blocking and other necessary apparatus requested by BPW personnel to perform the leakage and hydrostatic pressure tests. Standpipes shall be a minimum of 4" in diameter.
- C. Before applying test pressure, air shall be expelled completely from the section of piping under test. If air cannot be expelled from existing hydrants, corporation cocks shall be installed. After the air has been expelled, the hydrants or corporation cocks shall be closed and test pressure applied. If installed, the corporation cocks shall be removed and plugged after successful completion of the test.
- D. Tests shall be made on sections not exceeding 1,200' in length. Dead ends, bends at hydrants and other fittings shall be properly restrained before testing.
- E. Tests shall not be made against closed valves.
- F. Slowly bring the piping to test pressure and allow the system to stabilize prior to conducting the leakage test. Valves shall not be operated at pressures above the rated valve pressure.
- G. Pressure test the system at 150 psi for a minimum of 2 hours or longer as needed for the BPW to examine the line. Repair leaks and re-test.
- H. No pipeline installation will be approved if the pressure varies by more than 5 psi during the duration of the test.
- I. All exposed piping, fittings, valves, hydrants, and joints shall be examined carefully during the hydrostatic pressure test. Any damaged or defective materials discovered following the pressure test shall be repaired or replaced with sound material at no cost to the Owner, and test shall be repeated to the satisfaction of the BPW.
- J. The "testing allowance" is defined as the quantity of water necessary to return post-test pipe pressure to the specified test pressure. The testing allowance shall not be measured by a drop in pressure over a period of time.

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- K. No pipeline installation shall be approved if the testing allowance is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148,000} \quad (\text{Equation 1})$$

Where:

- L = testing allowance, in gallons per hour
- S = length of pipe tested, in feet
- D = nominal diameter of the pipe, in inches
- P = test pressure during hydrostatic test, in pounds per square inch

- L. If the testing allowance exceeds the amount as determined in Equation 1, locate the source of the failure and make repairs as necessary to the satisfaction of the BPW.
- M. One complete hydrostatic pressure test will be witnessed by the BPW and considered normal service. If the first test does not fulfill all requirements of these hydrostatic pressure testing procedures, the BPW reserves the right to recoup any and all expenses for subsequent witnessing of hydrostatic pressure tests from the Contractor.

3.8 WATER MAIN DISINFECTION, BACTERIOLOGICAL SAMPLING AND TESTING:

- A. Disinfection, bacteriological sampling and testing shall be performed in accordance with AWWA C651.
- B. The BPW and/or its authorized representative shall act as the testing firm and shall witness and confirm test results. Maintain one copy of each test result on site.
- C. At least 1 set of samples shall be collected from every 1,200 LF of water main, at least 1 from each end and at least 1 from each branch that is 10 LF in length or longer.
- D. Inject disinfectant to achieve a free chlorine concentration of 25 – 500 ppm not more than 10 LF downstream from the beginning of the new main and maintain the disinfectant in the system, including all hydrant branches and standpipes, for at least 24 hours. BPW personnel may test the treated water for conformance to this specification.
- E. Flush and circulate the water in the system, including hydrant branches and standpipes, until the required cleanliness is achieved. Maintain the water in the system for at least 24 hours. At the end of the 24 hour period, BPW personnel will collect the first set of bacteriological test samples.
- F. Samples shall be collected from a spigot located on the vertical portion of a standpipe assembly. The BPW will describe the standpipe assembly as needed. Samples shall not be collected from fire hydrants.

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- G. Immediately prior to sampling, the Contractor, at no cost to the BPW, shall apply dust palliative to all exposed aggregate within the project limits.
- H. BPW Sampling Procedure:
1. Spray bleach onto the sampling point and open the valve completely.
 2. Working towards the existing water system, open all necessary valves until the new water system is being fed by the existing water system. Open the valves appropriately to draw a sample of water from the new system. DO NOT sample water from the existing system.
 3. Collect a sample of water in a 10 mL vial and check the free chlorine concentration. A sample cannot be taken until the water contains less than 1.30 ppm free chlorine for at least 24 hours.
 4. Once water has run freely from each sampling point for at least 5 minutes, throttle the valve until there is a constant stream about the thickness of a pencil. Allow the water to run for 1 additional minute.
 5. Hold the sample bottle near the bottom with one hand and unscrew the cap with the other. DO NOT rinse out the powder in the sample bottle. DO NOT allow the interior of the cap to come into contact with anything other than the sample bottle.
 6. Hold the sample bottle under the stream of water and fill it to the shoulder of the 100 mL line. DO NOT adjust the flow once you have started filling the sample bottle. DO NOT allow the sample bottle to overflow. After the sample bottle is filled to the correct level remove it from the flow, immediately replace the cap and secure it tightly.
 7. Throttle down the sampling point valve then reverse the opening order to close the remaining valves.
 8. Complete a sample form to include: date issued, project name, time and date of water sample collection, name of person collecting samples, test locations, disinfectant residuals for each outlet tested (ppm), bacteria test results for each outlet tested and certification that water conforms to bacterial standards. Using permanent marker, transcribe the 5-digit number from the sample form to the bottle cap.
 9. Deliver the sample(s) to the lab immediately. No more than 2 hours may pass between the collection time and the delivery time.
- I. 24 hours after the first set of bacteriological test samples has been collected, BPW personnel will collect a second set of samples.

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- J. At the discretion of the BPW Water Treatment Plant, a third set of bacteriological test samples may be required 24 hours after the second set has been collected.
- K. In order to pass bacteriological testing, 2 or 3 consecutive samples, at least 24 hours apart, must display negative bacteriological results. Results from bacteriological testing will be available approximately 30 hours after the last sample is taken.
- L. Should the water not pass a bacteriological test, repeat the disinfection and flushing procedure as outlined above and in AWWA C651. Additionally, the BPW reserves the right to require the contractor to perform pipeline pigging operations at no cost to the Owner.
- M. The BPW reserves the right to recover all costs associated with additional flushing, sampling and testing.

3.9 DISPOSING OF CHLORINATED WATER

- A. Prior to disposal, chlorinated water shall be treated as necessary with Vita-D-Chlor or BPW approved equal to obtain a residual chlorine value < 0.1 ppm. BPW personnel shall test the treated water for conformance to this specification.

3.10 MUNICIPAL WATER SYSTEM SHUTDOWNS

- A. Municipal water valves shall only be operated by BPW personnel.
- B. Unless otherwise stated, shutdowns shall be limited to 0800 - 1500, Monday through Friday, excluding BPW holidays.
- C. The BPW requires at least 24 hours of prior notice in order to schedule a shutdown with affected customers. As part of the notice, the contractor shall indicate the amount of shutdown time required.
- D. The BPW reserves the right to recover all costs associated with a shutdown that exceeds the allotted time. Also, after the allotted time, the contractor shall reimburse the BPW for damages at the rate of \$20.00 per minute.

3.11 SERVICE RELOCATIONS

- A. As directed by the BPW, the existing service shall be relocated in one continuous operation. Sleeves are not permitted under paved surfaces. Unless otherwise approved, at least 24-hours of advance notice shall be given to the affected customer.
- B. Broken services shall be turned off at the corporation, cut and disconnected. The new service shall be installed and the original water service shall be removed.

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3.12 MAIN RELOCATIONS

- A. The Contractor shall verify the existing main depth, composition, diameter and location at the proposed relocations to permit adjustment prior to construction. Adjustments to unit prices will not be considered.
- B. Relocations shall extend to the first undisturbed joint beyond the trench. Solid sleeve couplings shall only be used in reconstruction projects.
- C. Mains may be relocated over a conflicting utility only when 6' of cover will be maintained over the relocated main and a minimum vertical separation of 18" will be maintained between the two utilities.

3.13 METAL PIPE AND APPURTENANCE RECYCLING

- A. All removal work shall be scheduled to maintain service.
- B. Remove all main, service pipe and appurtenances and salvage, recycle or dispose of as directed.
- C. The contractor shall transport all removed metal pipe and appurtenances to a metal recycler where they shall be weighed and credited to the BPW. Weight tickets shall be submitted for record.

TABLE 1: PIPE RESTRAINT LENGTH REQUIRED, FEET

Pipe Size (in)	Tees, 90° Bends	45° Bends	22½° Bends	11¼° Bends	Dead Ends	Reducers One Size	**
4	33	13	7	3	82		
6	46	19	9	4	117	61	90
8	59	24	11	6	149	61	79
12	83	34	17	9	213	114	172
16	106	44	21	10	275	117	157
20	127	53	26	13	333	117	149
24	149	61	30	14	389	117	142
30	176	73	36	17	469	164	212
36	202	83	40	20	542	164	200

**If length of pipe on small side of reducer exceeds this value, restrained joints are unnecessary.

Tees: Tees shall be restrained in the branch direction as required in the table above. Also, to augment the above, in the straight through direction, the minimum length of the first pipe on either side of the tee shall be 10'. In those cases where a valve is placed at the tee, the valve shall be restrained to the tee as noted below, and the next pipe shall be a minimum length of 10'.

Bends: Bends shall be restrained in both directions as required in the table above.

Valves: All mainline valves shall be restrained.

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Plugs/Caps: All dead ends on mains shall be plugged or capped with standard plugs or caps. The main, including the plug or cap shall be restrained back from the plug or cap as required in the table above. In those cases where a plug/cap is located at or adjacent to a tee or cross, the pipe shall be restrained as a dead end, per the table above.

Casing Pipe: Restrain all joints within a casing pipe or within 20' of a casing pipe.

All joints lying within the above minimum distances shall be restrained and shall not be included as a separate pay item. The length of restrained joints is based on trench backfill being compacted to 95% of maximum unit weight in accordance with MDOT procedures. If, at the discretion of the BPW, the pipe is not encased in polyethylene wrap, a multiplier of 0.70 may be used.

TABLE 2: PERMISSIBLE DEFLECTIONS IN PUSH-ON JOINT PIPE

Pipe Size (in)	Maximum Permissible Deflection per Length of Pipe (in)		Approximate Radius of Curve Produced by Succession of Joints (ft)	
	18'	20'	18'	20'
4	19	21	205	230
6	19	21	205	230
8	19	21	205	230
12	19	21	205	230
16	11	12	340	380
20	11	12	340	380
24	11	12	340	380
30	11	12	340	380
36	11	12	340	380

TABLE 3: PERMISSIBLE DEFLECTIONS IN MECHANICAL JOINT PIPE

Pipe Size (in)	Maximum Permissible Deflection per Length of Pipe (in)		Approximate Radius of Curve Produced by Succession of Joints (ft)	
	18'	20'	18'	20'
4	31	35	125	140
6	27	30	145	160
8	20	22	195	220
12	20	22	195	220
16	13	15	285	320
20	11	12	340	380
24	9	10	450	500