

THE MUNICIPAL AUTHORITY OF THE TOWNSHIP OF WASHINGTON

Fayette County, Pennsylvania

STANDARD SPECIFICATIONS AND REQUIREMENTS FOR WATER LINE EXTENSIONS AND RELOCATIONS

JANUARY, 2010



BANKSON ENGINEERS, INC.

267 Blue Run Road
P.O. Box 200
Indianola, PA 15051
(412) 767-5100
banksonengineers.com

**THE MUNICIPAL AUTHORITY OF
THE TOWNSHIP OF WASHINGTON**

**STANDARD SPECIFICATIONS AND REQUIREMENTS
FOR
WATER LINE EXTENSIONS AND RELOCATIONS**

TABLE OF CONTENTS

		<u>PAGE</u>
1.	USE OF THESE SPECIFICATIONS	1
2.	PIPE	1
	A. Large Diameter Pipe (3" Diameter and Larger)	1
	1) PVC Pipe	1
	2) Ductile Iron Pipe	2
	B. Small Diameter Pipe (Smaller than 3" Diameter)	2
3.	FITTINGS	2
	A. Large Diameter Fittings (3" Diameter and Larger)	2
	B. Small Diameter Fittings (Smaller than 3" Diameter)	3
4.	JOINTS FOR LARGE DIAMETER (3" and Larger) PIPE, FITTINGS AND VALVES	3
	A. Unrestrained Joints To Be Installed Underground	3
	B. Restrained Joints To Be Installed Underground	3
	1) General	3
	2) Megalugs	4
	3) Field-Lok or Fast-Grip Gaskets	4
	C. Joints To Be Installed Above Ground or in Underground Vaults .	4
5.	JOINTS FOR SMALL DIAMETER (Smaller than 3" Diameter) PIPE, FITTINGS AND VALVES	4
6.	VALVES	4
	A. Direction of Opening	4
	B. Large Diameter Valves (3" and Larger)	5
	C. Valve Stem Extensions	5
	D. Tapping Sleeves and Valves	6
	E. 2-Inch Blow-Off Valves (requirement for permanent valves only)	7
	F. Curb Stops	7
	G. Corporation Stops	7
	H. Other Small Diameter Valves (Smaller than 3" Diameter)	7
	I. Air Relief Valves	7
7.	FIRE HYDRANTS	7
8.	POLYETHYLENE ENCASEMENT	8
9.	DETECTABLE IDENTIFICATION TAPE	8
10.	LOCATING WIRE AND ASSOCIATED TERMINATION STATIONS	9
11.	UTILITY LINE MARKER	9
12.	VALVE BOXES	9
13.	CURB BOXES	9
14.	SERVICE SADDLES	10
15.	STEEL CASING PIPE	10
16.	TEMPORARY MATERIALS	11
17.	HANDLING OF MATERIALS	11
18.	INSTALLATION	12
	A. General	12

Table of Contents - continued

	<u>PAGE</u>
B. Excavation to Grade	12
C. Excavation in Rock	13
D. Excavation in Poor Soil	13
E. Drainage	14
F. Pipeline Bedding Conditions	14
1) Standard Laying Conditions - Drawing	14
2) Definition of Bedding and Backfill Materials	14
G. Laying of Pipe and Fittings	15
H. Jointing of Pipe and Fittings	16
1) Push-On Joints	16
2) Mechanical Joints	17
I. Flanged Pipe and Fittings	17
J. Plugging or Capping Dead Ends	17
K. Anchoring and Blocking of Pipe and Fittings	18
L. Concrete Encasement	18
M. Installation of Pipe Inside Steel Casing Pipe	18
N. Installation of Valves, Fittings and Appurtenances	19
1) General	19
2) Valve Boxes	19
3) Sleeves	19
O. Installation of Fire Hydrants	19
1) Location	19
2) Position	20
3) Connection to Main	20
4) General Installation Requirements	20
P. Installation - Polyethylene Encasement	21
Q. Trench Backfill	22
1) General	22
2) Steep Berm Backfill	23
3) Backfill in Rock Excavation	23
4) Compaction	24
R. Installation of Detectable Identification Tape and Locating Wire	24
S. Connections to the Existing System	24
T. Installation of Service Lines	24
U. Tapping PVC Pipe	25
19. HYDROSTATIC TESTS	25
20. OPERATIONAL TESTS	27
21. DISINFECTION OF PIPELINES	27
22. DISPOSING OF HEAVILY CHLORINATED WATER	29

Attachments

- Drawing Number 1-514-78-1 - Miscellaneous Water Line Details
- Drawing Number 1-514-78-2 - Bedding, Backfill and Surface Restoration Details

**THE MUNICIPAL AUTHORITY OF
THE TOWNSHIP OF WASHINGTON**

**STANDARD SPECIFICATIONS AND REQUIREMENTS
FOR
WATER LINE EXTENSIONS AND RELOCATIONS**

1. USE OF THESE SPECIFICATIONS

This document has been prepared exclusively for the use of developers or developers' agents engaged in the installation of extensions to the water distribution system of The Municipal Authority of the Township of Washington (MATW or Authority) under the terms of Developers' Agreements, or for the use of PennDOT and PennDOT's agents engaged in the replacement or relocation of MATW water mains to accommodate highway improvements.

Throughout these Specifications, the term "Developer/Contractor" is used. For the purposes of these Specifications, the term "Developer/Contractor" is to apply as follows:

- A. Where a developer is either installing a water line or has employed a contractor to install a water line under the terms of a Developer's Agreement, the term "Developer/Contractor" is to apply to the developer.
- B. Where PennDOT has engaged a contractor to perform water line relocation/replacement work as part of a highway improvement project and these Specifications have been included as part of the PennDOT Contract Specifications, the term "Developer/Contractor" is to apply to the contractor engaged by PennDOT.

2. PIPE

A. Large Diameter Pipe (3" Diameter and Larger)

1) PVC Pipe

PVC pipe shall be NSF approved and manufactured in accordance with either A.W.W.A. Standard C900, or A.W.W.A. Standard C909, and shall conform to either Class 150 or Class 200 and shall have push-on joints. Solvent weld joints will not be permitted. Pipe conforming to A.S.T.M. D2241 will NOT be accepted. The outside diameter of all PVC pipe furnished shall conform to the outside diameter requirements for ductile iron pipe given in A.W.W.A. C151.

For any test section of pipeline which includes any PVC pipe, both detectable identification tape and locating wire, complete with termination stations, are to be installed. The requirements for both are presented later in these Specifications.

Copyright Bankson Engineers, Inc., January 2010

This document has been prepared exclusively for the use of developers or developers' agents engaged in the installation of extensions to the water distribution system of The Municipal Authority of the Township of Washington (MATW or Authority) under the terms of Developer's Agreements, or for the use of PennDOT and PennDOT's agents engaged in the replacement or relocation of MATW water mains to accommodate highway improvements. The use of this document by others or by anyone for any purpose other than for extensions, replacements or relocations to the MATW water distribution system is forbidden. The use of this document for any purpose is permitted only with the express permission of both Bankson Engineers, Inc. and MATW. This document may be reproduced only by Bankson Engineers, Inc. and MATW, or by PennDOT or PennDOT's agents, but only for MATW water system related projects.

2) Ductile Iron Pipe

Ductile Iron pipe is to be used only in special circumstances and for specific locations as designated by the Authority.

Ductile iron pipe shall be designed and manufactured in accordance with A.W.W.A. C151. Ductile iron pipe shall, unless specifically noted otherwise on the contract drawings, either prepared by or accepted by the Authority, have a thickness of no less than Special Thickness Class 52. Flanged end pipe shall be Special Thickness Class 53. Ductile iron pipe shall be cement lined as per A.W.W.A. C104, except that the thickness of the lining shall be twice the amount required in A.W.W.A. C104 (commonly referred to as "double cement lining").

All ductile iron pipe is to be encased in polyethylene wrap. The requirements for the polyethylene encasement are presented later in these Specifications.

The exterior surfaces of all flanged end pipe are to be prepared and painted by the manufacturer. Exterior surfaces shall be prepared as per SSPC-SP-7, Brush-Off Blast Cleaning, no more than four hours before the application of the first coat of paint. An NSF approved two coat high solids epoxy paint system is then to be applied in strict conformance with the paint manufacturer's recommendations. Alternatively, the exterior surfaces flanged end materials may have a fusion-bonded epoxy coating as per A.W.W.A. C116.

B. Small Diameter Pipe (Smaller than 3" Diameter)

Except where noted otherwise on the Standard Drawings, which are a part of these Specifications, small diameter pipe installed underground shall be Type K copper tubing. Small diameter pipe installed in pits or above ground shall be either rigid Type K copper pipe or brass. Where so indicated on the Standard Drawings, certain small diameter piping shall be either brass or 304 stainless steel.

3. FITTINGS

A. Large Diameter Fittings (3" Diameter and Larger)

All fittings for ductile iron pipelines shall be ductile iron and shall conform to either A.W.W.A. C110 (Standard) or A.W.W.A. C153 (Compact). All fittings, except plugs, caps and sleeves, shall be double cement lined (twice the thickness specified in A.W.W.A. C104). In lieu of double cement lining, the fittings furnished may have a protective, fusion-bonded epoxy coating as per A.W.W.A. C116.

For piping 4-inch diameter and larger, sleeves shall be the long pattern solid body type with standard mechanical joint bell ends. The Developer/Contractor shall furnish a filler piece ("dutchman") to minimize movement under changing thrust conditions.

The exterior surfaces of all flanged end fittings are to be prepared and painted by the manufacturer. Exterior surfaces shall be prepared as per SSPC-SP-7, Brush-Off Blast Cleaning, no more than four hours before the application of the first coat of paint. An NSF approved two coat high solids epoxy paint system is then to be applied in strict conformance with the paint manufacturer's recommendations. Alternatively, the exterior surfaces flanged end materials may have a fusion-bonded epoxy coating as per A.W.W.A. C116.

B. Small Diameter Fittings (Smaller than 3" Diameter)

Fittings for small diameter pipelines shall be brass, suitable for the required test pressure.

4. JOINTS FOR LARGE DIAMETER (3" and Larger) PIPE, FITTINGS AND VALVES

A. Unrestrained Joints To Be Installed Underground

All underground ductile iron fittings shall have either push-on or mechanical joint ends.

B. Restrained Joints To Be Installed Underground

1) General

Restrained joints shall be designed to provide a positive means to prevent joint separation without the use of tie-rods, friction clamps or similar devices. Restrained joints shall be designed to withstand normal working pressures of at least 250 psi. Also, each joint restraining assembly shall be designed to ensure that no joint separation will occur should the joint provide the only means of restraint for a dead-end cap subjected to a hydrostatic test pressure of 350 psi.

At certain locations specifically noted on the contract drawings, either prepared by or accepted by the Authority, or at other locations where the Developer/Contractor elects to use restrained joints, restrained mechanical joints are to be used. Each restrained mechanical joint shall employ a mechanical joint bell end fitting or valve in conjunction with a Megalug and a plain end ductile iron pipe.

At certain locations specifically noted on the contract drawings, either prepared by or accepted by the Authority, where restrained push-on joints are indicated, each restrained joint system shall employ a push-on bell end ductile iron pipe, fitting or valve in conjunction with either a Field-Lok or a Fast-Grip gasket, and a plain end ductile iron pipe.

2) Megalugs

Where the term "Megalug" is used on the contract drawings, either prepared by or accepted by the Authority, the mechanical joint system shall be a Megalug 1100 Series ductile iron mechanical joint restraint system for ductile iron pipe and 2000 Series for PVC and PVCO pipe, manufactured by EBAA Iron Sales, Inc. Use of Megalugs shall be **IN ADDITION** to conventional concrete blocking.

3) Field-Lok or Fast-Grip Gaskets

Where restrained joints other than restrained mechanical joints are indicated, the Developer/Contractor shall furnish either Field-Lok gaskets manufactured by U.S. Pipe or Fast-Grip gaskets manufactured by American Cast Iron Pipe Company. The special gaskets furnished, however, must be compatible with the pipe, valve or fitting bell ends being furnished. Field-Lok gaskets shall not be used with bells designed to accommodate Fastite or Fast-Grip gaskets. Fast-Grip gaskets shall not be used with bells designed to accommodate TYTON or Field-Lok gaskets. Use of push-on restrained joints shall be **IN ADDITION** to conventional concrete blocking.

C. Joints To Be Installed Above Ground or in Underground Vaults

Joints to be installed either above ground or in underground vaults shall be flanged conforming to A.W.W.A. C110/A21.10 or A.W.W.A. C115/A21.53. Bolt circle and bolt circle holes shall conform to A.N.S.I. B16.1, Class 125.

5. JOINTS FOR SMALL DIAMETER (Smaller than 3" Diameter) PIPE, FITTINGS AND VALVES

Joints for pipe 1-inch diameter and smaller installed (buried) underground shall be flared joints. Small diameter pipe installed in pits or above ground shall have either soldered joints (copper pipe) or threaded joints (brass pipe).

6. VALVES

A. Direction of Opening

All valves installed on the Washington County portion of the Authority's water distribution system shall open COUNTER-CLOCKWISE (commonly referred to as "open left"). All valves installed on the Fayette County portion of the Authority's water distribution system shall open CLOCKWISE (commonly referred to as "open right").

B. Large Diameter Valves (3" and Larger)

All large water valves shall be resilient seated gate valves. All exposed bolts, nuts and washers on the valves shall be 316 stainless steel. All valves shall conform to either one the following:

- 1) Valves shall be manufactured in conformance with A.W.W.A. C515, or
- 2) Valves shall be manufactured in conformance with A.W.W.A. C509, and shall conform to additional provisions as follows:
 - a. Valve design and testing shall conform to a 250 psi working pressure standard, and
 - b. Valve design and shell testing shall accommodate a 500 psi standard, and
 - c. Valves shall have ductile iron bodies. Cast iron bodies will not be accepted.

Large diameter valves to be installed (buried) underground shall have non-rising stems and 2-inch operating nuts.

Large diameter valves to be installed in pits or above ground shall be furnished with position indicators and with handwheels having the direction of opening cast into the handwheel.

For all valves which are installed at depths such that the top of the operating nut is more than 42-inches below the finished grade, the Contractor shall furnish and install valve stem extensions with an approved paint system as shown on the Contract Drawings.

C. Valve Stem Extensions

Valve stem extensions shall be furnished and installed on valves are buried underground and the operating nut is more than three feet below the top of the valve box.

Valve stem extensions shall be epoxy-coated solid carbon steel. The length of each valve stem extension furnished shall be such that the top of the operating nut is located between three and nine inches below the top of the valve box. Extension shaft diameters shall be not less than 1-1/4 inches.

Surface preparation for application of the epoxy coating shall be white metal blast cleaning in accordance with the Steel Structures Painting Council (SSPC-SP-5). Epoxy coating system shall be equivalent to the following:

First Coat - Tnemec 91-H2O-Hydro-Zinc, 2.5 to 3.5 mils (DFT)
Second Coat - Tnemec 140 Pota-Pox Plus, 7.0 to 9.0 mils (DFT)

After the stem extensions are coated they shall be stored in a manner so they are not exposed to direct sunlight. The Contractor shall house the stem extensions or wrap them and otherwise protect them from exposure until ready to install.

Each valve stem extension shall have a positive means to secure the stem extension to the valve nut to prevent the extension from being lifted or dislodged. One or more friction screws will not be considered adequate. The Contractor may furnish stem extensions with any one of the following securing arrangements:

- a. Drill and tap the sides of the valve nut to accept two small pins of 316 stainless steel with threaded ends. Drill holes in corresponding locations on the sides of the stem extension bottom. The holes should be oversized so that no torsional loads are applied to the two pins. The pins would be secured into the valve nut after the stem extension is in place.
- b. Provide stem extension with bottom sides drilled and tapped with small screws of 316 stainless steel. At the two corresponding locations on the valve nut sides, drill oversized holes. The drilled holes must be oversized so that torsional loads are not applied to the two small screws.

Where valves are located in severe slope areas that do not permit the proper vertical installation of a valve box, a special lower end of the valve stem extension shall be provided. The lower end of the valve stem extension, in this case, shall have a universal joint suitable for permitting vertical installation of the valve box. Securing arrangement requirements between valve stem extension and valve nut for these special extensions shall be the same as for all other stem extensions.

Shop drawings showing the details of the stem extension securing system and the universal joint stem extension shall be furnished to the Engineer for review and acceptance.

D. Tapping Sleeves and Valves

Tapping sleeves shall be designed for the type and size of pipe being tapped and shall provide a watertight seal on the pipe by means of mechanical joints, caulked joints or an O-ring. Tapping sleeves shall incorporate a test plug so that the integrity of the sleeve seals can be verified prior to the actual tapping of the pipe. Tapping valves shall have sufficient internal diameter to accept the tapping machine cutting tool and shall have ends to match the sleeve on one side and the machine/lateral pipe on the other. Tapping valves shall, in all other respects, meet the valve specifications for the project.

E. 2-Inch Blow-Off Valves (requirement for permanent valves only)

Permanent 2-inch blow-off unit valves shall be ball valves manufactured by Ford Meter Box Company, Inc., Watts Regulator Company or equivalent.

All 2-inch blow-off valves shall have 2-inch square operating nuts.

F. Curb Stops

Curb stops shall be ball valve curb stops rated for a 300 psi working pressure. Curb stops shall have inlet and outlet connections designed for the type of service line to be used. Only flared-type joints will be accepted for copper service lines.

G. Corporation Stops

The corporation stops designed for insertion into water mains under pressure shall be of bronze construction and shall meet A.W.W.A. C800. Corporation stops shall be ball type corporation stops rated for a 300 psi working pressure. A flared-type joint shall be provided to connect to Type K soft copper tubing. A service insulator shall be provided, as shown on the Contract Drawings.

H. Other Small Diameter Valves (Smaller than 3" Diameter)

All small diameter valves other than blow-off valves, corporation stops and curb stops shall be ball valves rated for a 300 psi working pressure.

I. Air Relief Valves

All air relief valves shall be combination air release and air/vacuum relief valves. Each valve shall have a cast iron body, cover and baffle. The valve seats and gaskets shall be constructed of a synthetic material such as Buna-N. The pipe plug in the cover of the valve shall be malleable iron. All other material in the valve shall be stainless steel. Air relief valves shall be designed for a working pressure of at least 125 psi. All air relief valves shall be as manufactured by Val-Matic, Crispin or equivalent.

7. FIRE HYDRANTS

All fire hydrants shall be The Municipal Authority of the Township of Washington's standard hydrant which is the American Flow Control B-62-B-5 fire hydrant. All hydrants shall be rated for a 200 psi working pressure. Hydrants shall be furnished with two 2-1/2-inch hose nozzles, one 4-1/2-inch streamer nozzle, and a 5-1/4-inch main valve opening. Hydrants shall be furnished with the Authority's standard threads, paint system and color scheme.

The depth of cover at the hydrant will vary depending upon the main line depth. The minimum depth of cover will be four feet (minimum depth of bury 4-1/2 feet). The clearance of two inches to four inches, as shown on the typical installation detail, between the surrounding natural ground surface and the traffic flange shall be provided at all hydrant installations.

The hydrants shall be installed entirely within public highway rights of way even though the Drawings may indicate that the hydrant is beyond the right-of-way line.

Following installation, the fire hydrant shall be painted by the Contractor in accordance with the Authority's color scheme. A single coat of MAB/Pennsbury Hydrant hide, or equivalent, paint shall be applied to all exterior hydrant surfaces.

8. POLYETHYLENE ENCASEMENT

All ductile iron or cast iron materials installed underground, including ductile iron pipe, ductile iron fittings and ductile or cast iron bodied valves, shall be wrapped with an 8-mil thickness polyethylene film. This requirement shall apply equally to all ductile iron pipelines, as well as to ductile iron fittings and ductile/cast iron valves. The polyethylene film shall be made of virgin polyethylene and shall be manufactured in accordance with A.W.W.A. C105.

The polyethylene tube seams and overlaps shall be wrapped and held in place by means of a 2-inch wide, plastic backed, adhesive tape. The tape shall be either Polyken Number 900 (polyethylene), Scotchwrap Number 50 (polyvinyl), or equivalent. The tape shall be such that the adhesive shall bond securely to both metal surfaces and polyethylene film. Torn or damaged polyethylene film shall not be used.

9. DETECTABLE IDENTIFICATION TAPE

The Developer/Contractor shall furnish and install detectable identification tape for each test section of pipeline which includes any PVC pipe. For the purposes of this provision, a test section shall be defined as any section of pipeline which has two valves on either end or which has a valve on one end and a connection with an existing main on the other end.

No detectable identification tape needs to be furnished or installed for test sections which contain no PVC pipe.

The tape shall be constructed of a non-degradable plastic at least two inches wide, shall be blue in color and shall be imprinted in a contrasting color with the words "CAUTION BURIED WATER LINE BELOW." The tape shall include a metallic foil or wire designed to allow easy detection with an inductive type pipe locator. The tape shall be installed in continuous lengths in the pipeline trench at a depth of 12" to 18" below the surface.

10. LOCATING WIRE AND ASSOCIATED TERMINATION STATIONS

Where detectable identification tape is required, as per the preceding section of these Specifications, the Developer/Contractor shall furnish and install a Number 14 insulated copper wire along the entire length of the PVC or composite PVC/ductile iron pipeline test section. Locating Wire Termination Stations shall be provided in conformance with the Locating Wire Termination Detail, one of the Standard Drawings provided in these Specifications.

The copper wire is to be located directly above the centerline of the pipeline and is to be positioned between 12" and 18" below the final ground surface elevation. The locating wire is to be continuous and, to the extent practical, without splices between termination stations.

11. UTILITY LINE MARKER

A utility line marker shall be furnished and installed at each location indicated on the Drawings and where directed by the Authority. The marker shall be a Model CUM-375, 5 feet 6 inches long, blue in color, as manufactured by Carsonite International, or equivalent. Each marker shall be furnished with a decal which includes the following information:

- A. Either "Water Valve" or "Water Main" as applicable.
- B. "The Municipal Authority of the Township of Washington"
- C. "Telephone Number (724) 929-3370"

12. VALVE BOXES

Valve boxes shall be provided for all valves 2-inch diameter and larger. Valve Box shall be injection molded and commercially manufactured utilizing a proprietary PENTEK® compound known as SUPERFLEXON per ASTM D-2853-70, Class 1212. Material shall be a rigid combination of polyolefin with fibrous inorganic component reinforcing and U.V. stabilizer additives to assure resistance to material degradation from ultraviolet light. The entire upper section of the box shall be made of a POLYIRON® magnetically locatable material. The use of magnets will not be permitted. Box shall have a cast iron ring and a cast iron 4-pronged traffic lid. Cast iron shall have a minimum weight of 18 lbs. and must conform to ASTM-A-48, Class 20 specifications. Box to be Buffalo type (screw) and have a shaft diameter of 5¼". The bottom part of the box shall have a bell measuring 7⅞" high by 10-1/16" wide and have a knock out as standard equipment.

The length of the shaft shall vary depending upon the depth of the pipe at each valve installation. The base section of the valve box shall be large enough to surround the valve bonnet with proper clearance at all points. Each valve box shall be provided with a cover with the word "WATER" cast thereon.

13. CURB BOXES

Curb boxes shall be provided for all curb stops less than 2-inch diameter.

Curb Service Box shall be injection molded and commercially manufactured utilizing a proprietary PENTEK®/Pentair Filtration, Inc. compound known as SUPERFLEXON per ASTM D-2853-70, Class 1212. Material shall be a rigid combination of polyolefin with fibrous inorganic component reinforcing and UV stabilizer additives to assure resistance to material degradation from ultraviolet light. The box shall be telescoping two-piece (screw style) with polycarbonate ring, pentagon bolt and Superflexon cover. Upper section shall be locatable electronically and magnetically with ring riveted to the top piece. Lower section shall be a full threaded shaft 9f 2.35" ID over a Buffalo style arch, 4" wide by 7" high and saddle, 3 1/3" wide by 4" high. Curb boxes shall have cast iron cover and ring, with brass pentagon nut.

The curb box lid shall be furnished with the word "WATER" cast thereon.

14. SERVICE SADDLES

Service saddles shall be provided for all taps onto PVC or PVCO pipe. Similarly, service saddles shall be provided for all taps onto ductile iron pipe where direct taps using the corporation stop inlet threads specified would have less than three (3) full threads of embedded contact with the ductile iron pipe wall.

Service saddles will have at least two construction straps and be of bronze and/or stainless steel construction. Saddles will be specially designed for the main line pipe being used. Wrap around 360 degree saddles will be used on PVC pipe.

Saddles shall provide full support around the circumference of the pipe. Saddles shall have a bearing area of sufficient width along the axis of the pipe so that the pipe will not be distorted when the saddle is made tight.

15. STEEL CASING PIPE

Unless otherwise indicated, the inside diameter of casing pipe shall be at least four inches larger than the maximum pipeline outside diameter. The casing shall have, unless otherwise shown on the Contract Plans or indicated in the Detail Specifications, minimum wall thicknesses according to the following schedule:

<u>Casing Diameter</u>	<u>Minimum Wall Thickness</u>	<u>Casing Diameter</u>	<u>Minimum Wall Thickness</u>
16-Inch and Smaller	5/16-Inch	42-Inch	9/16-Inch
18-Inch	7/16-Inch	48-Inch	5/8-Inch
20-Inch	7/16-Inch	54-Inch	11/16-Inch
24-Inch	7/16-Inch		
30-Inch	1/2-Inch		
36-Inch	9/16-Inch		

The casing shall be black steel material and all joints shall be welded. The pipe shall have a yield strength of thirty-five thousand (35,000) psi. The lines placed in the casing shall have the type of joint as indicated on the Plans.

16. TEMPORARY MATERIALS

Temporary materials for temporary blow-offs, test ports, etc., may be required. The type of temporary materials used shall be at the Developer/Contractor's discretion, however, the materials used shall fulfill the required function and must be completely removed following successful hydrostatic and bacteriological testing of the new water main.

17. HANDLING OF MATERIALS

All material furnished by the CONTRACTOR or OWNER shall be delivered and distributed to the site by the CONTRACTOR.

Except as modified by these Contract Documents, unloading, handling and storage shall conform to Section 6.1 of A.W.W.A. C600 for ductile iron pipe, fittings and appurtenances and shall conform to Section 2 of A.W.W.A. C605 for PVC and PVC0 pipe and fittings.

Cast and ductile iron pipe, fittings, valves, hydrants and accessories shall be loaded and unloaded by lifting with hoists or skidding, so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

During the process of unloading, all pipe, fittings and other such materials shall be inspected by the CONTRACTOR for loss or damage in transit. No shipment of materials shall be accepted by the CONTRACTOR until or unless notation of any lost or damaged material shall have been made on the bill of lading by the agent of the carrier.

The pipe, fittings, valves, hydrants and other accessories shall, unless otherwise directed, be unloaded at the point of delivery or storage, hauled to and distributed at the site of the project by the CONTRACTOR, and shall at all times be handled with care or avoid damage. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. The pipe shall be placed on the site of the work parallel with trench alignment with bell ends facing in the direction in which the work will proceed, unless otherwise specified.

The pipe shall be handled so as to prevent damage to the exterior coating and interior cement lining, and in a manner to prevent damage to the machined and mechanical joint ends. All pipe with damaged ends shall be replaced by the CONTRACTOR at his expense. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

The CONTRACTOR shall be responsible for the safe storage of material furnished by or to him and accepted by him and intended for the work until it has been incorporated in the completed project.

18. INSTALLATION

A. General

Except as modified by these Contract Documents, installation shall conform to A.W.W.A. C600 for ductile iron pipe, fittings and appurtenances and shall conform to A.W.W.A. C605 for PVC and PVCO pipe and fittings.

The trench for the water line shall be excavated so that the pipe can be laid to the proper alignment to avoid obstacles and to the depth required, and it shall be excavated only so far in advance of pipe laying as permitted by public officials, where subject to such control, or by the OWNER. The trenches shall be excavated to a depth sufficient to provide a minimum cover of four feet, except as otherwise noted on the Contract Plans.

The CONTRACTOR shall excavate by hand in areas where necessary or where called for by the Contract Documents, and where available space is too limited to permit the use of equipment.

Equipment having rubber runners or tires shall be utilized exclusively on permanent pavement.

B. Excavation to Grade

The pipe trench shall be excavated to the depth required, so as to provide uniform and continuous bearing and support for the pipe on solid and undisturbed ground at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18 inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. Any part of the bottom of the trench excavated below the specified grade shall be corrected with approved material, thoroughly compacted. The finished subgrade shall be prepared accurately by means of hand tools.

The subgrade beneath the centerline of the pipe shall be finished to within 0.03-foot of a straight line between pipe joints and all tolerances shall be above the specified grade.

Alternatively, for ductile iron pipe only, the trench may be excavated to two inches below the bottom of the pipe and earth mounds used to support the pipe. Where earth mounds are used to support the pipe, they shall be tamped and shall be adequate to maintain alignment and to maintain a 2-inch clearance between the pipe and trench bottom at all points. Two earth mounds shall be used for each joint of pipe and shall be placed one-fifth of the pipe length from each end.

C. Excavation in Rock

The word "rock" whenever used in this section as the name of an excavated material shall be interpreted to include solid ledge rock, concrete or masonry structures, any other material which requires drilling and blasting for its removal, and all boulders exceeding one-third cubic yard in volume. Rock shall be removed to such an extent that in no place will it come closer than 6 inches to the finished pipeline. Following completion of the excavation, a bed of sand or earth, free from stones or clods, at least 6 inches deep, shall be made on the bottom of the trench, and the pipe shall be placed on this cushion. Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 6 inches around each side of all pipe, valves and fittings for pipes 24 inches or less in diameter and 9 inches for pipe larger than 24 inches in diameter.

The subgrade, where excavation is made in rock, shall be made by backfilling with an acceptable material and in 4-inch layers. The layers shall be thoroughly tamped so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18 inches near the middle of each pipe length by the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately with hand tools.

The subgrade beneath the centerline of the pipe shall be finished to within 0.03-foot of a straight line between pipe joints and all tolerances shall be above the specified grade.

D. Excavation in Poor Soil

Where the bottom of the trench at subgrade is found to be unstable or to include ashes, cinders, all types of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material, the unsuitable material shall be excavated and removed to the width and depth required to properly bed the pipe. Before the pipe is laid, the subgrade shall be made uniform by backfilling with an approved material in 3-inch uncompacted layers. The layers shall be thoroughly tamped so as to provide a uniform and continuous bearing and support for the pipe at every point between bell holes, except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 18 inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle. The finished subgrade shall be prepared accurately by means of hand tools.

The subgrade beneath the centerline of the pipe shall be finished to within 0.03-foot of a straight line between pipe joints and all tolerances shall be above the specified grade.

Where the bottom of the trench at subgrade is found to consist of material which is unstable to such a degree that it cannot be removed and replaced with an approved material to support the pipe properly. A foundation for the pipe consisting of materials satisfactory to the Authority shall be constructed.

E. Drainage

Any water which may accumulate or be found in trenches or other excavations shall be removed. Dams, flumes or other works necessary to keep excavations entirely clear of water during the installation of the pipeline shall be created. The excavation shall be maintained reasonably dry throughout the pipeline installation. Sufficient pumping machinery and equipment shall be available at all times on the site and ready for immediate use.

F. Pipeline Bedding Conditions

1) Standard Laying Conditions - Drawing

The drawing showing Standard Laying Conditions, which is a part of these Specifications, governs the bedding requirements for the different types of pipeline for various conditions:

- a. Ductile iron pipeline which is 24-inch diameter or less, and which is not installed in rock, shall be installed in conformance with the Type 1 Standard Laying Condition.
- b. Ductile iron pipeline which is installed in rock shall be installed in conformance with the Type 3 Standard Laying Condition, provided selected earth is available in sufficient quantity. If not, either Type 4 or Type 5 Standard Laying Condition, as determined by the quantity of selected earth available, shall apply.
- c. PVC pipeline shall be installed in conformance with the Type 3 Standard Laying Condition, provided selected earth is available in sufficient quantity. If not, either Type 4 or Type 5 Standard Laying Condition, as determined by the quantity of selected earth available, shall apply.

2) Definition of Bedding and Backfill Materials

- a. Selected Earth - Retained excavated material suitable for backfill in critical areas. Selected earth shall be free of rocks or stones larger than 2 inches in size, organic matter, coal, coal blossom, cinders, slag or other objectionable matter.
- b. Suitable Earth - Retained excavated material suitable for backfill in less critical areas. Suitable earth shall be free of rocks or stones larger than 6 inches in size, brush, roots or any perishable materials which might cause subsequent settlement. Suitable earth shall be largely free of coal, coal blossom, cinders, slag or other objectionable matter.

Copyright Bankson Engineers, Inc., January 2010

- c. Number 2A Stone - Coarse aggregate conforming to PennDOT Publication 408, Section 703.2, except that only limestone or gravel shall be used. Slag shall not be used. Gradation shall conform to PennDOT Number 2A as per Table C. Quality shall conform to Type B as per Table B. Unless specifically noted otherwise, wherever the word "stone" appears in the Contract Documents, it is hereby defined to conform to the description of Number 2A stone.
- d. Fine Aggregate - Natural sand or manufactured sand conforming in all respects to PennDOT Publication 408, Section 703.1, except that slag or slag by-products will not be permitted. Gradation and quality shall conform to Type B #1 given in Table A.

G. Laying of Pipe and Fittings

Proper implements, tools and facilities shall be provided and used for the prosecution of the work. All pipe, fittings, valves and hydrants shall be carefully lowered into the trench, piece by piece, by means of a crane, ropes or other suitable tools or equipment, in such a manner as to prevent damage to water main materials and protective coatings and linings. Under no circumstances shall water main materials be dropped or dumped into the trench.

The pipe and fittings shall be subject to inspection for defects before being laid.

All lumps, blisters and excess coal tar coating shall be removed from the bell and spigot ends of each pipe, and the outside of the spigot and the inside of the bell shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

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, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be 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 around it, except at the bells.

At times when the pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other approved means. If water is in the trench, the seal shall remain in place until the trench is pumped completely dry. At the conclusion of work each day, the Contractor shall install a watertight plug.

The pipe shall be laid with bell ends facing in the direction of laying and, for lines on an appreciable slope, bells shall face upgrade. The degree of deflection from the straight line in either the vertical or horizontal plane for all types of pipe, including mechanical joint and push-on joint, shall not exceed that required for making satisfactory joints.

Maximum deflection for push-on joint pipe shall be limited to 80% of the pipe manufacturer's recommendations.

No pipe shall be laid in water, except at stream crossings or when trench conditions or weather conditions are unsuitable for such work. During the time the pipe laying is not in progress, the open ends of the pipe shall be closed by approved means, and no trench water shall be permitted to enter into the pipe.

No vertical bend in excess of 1¼ degrees shall be incorporated in the water line unless indicated. If such construction is necessary or indicated, the bends or fittings shall be blocked and rods anchored in the concrete shall be placed around the pipe.

The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner, without damage to the pipe or cement lining, and so as to leave a smooth end at right angles to the axis of the pipe.

H. Jointing of Pipe and Fittings

The joints between the lengths of pipe ends shall be made as follows:

1) Push-On Joints

The inside of the bell and the outside of the spigot end shall be thoroughly cleaned to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket.

A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot end of the pipe, or both. Gasket lubricant shall be as supplied by the pipe manufacturer and acceptable to the Authority.

The spigot end of the pipe shall be entered into the socket with care to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool, jack-type tool or other device acceptable to the Authority. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field cut pipe lengths shall be filed or ground to resemble the spigot end of such pipe as manufactured. Complete assembly instructions are available from the pipe manufacturer.

Copyright Bankson Engineers, Inc., January 2010

2) Mechanical Joints

The joints on mechanical joint pipe shall be made in accordance with the following procedure:

- a. The socket and plain end shall be washed with an approved lubricant and the gland and gasket shall be slipped over the plain end of the pipe. The small side of the gasket and lip side of the gland shall be placed facing the bell.
- b. The gasket shall be painted with the lubricant.
- c. The gasket shall be pushed into position so that it is evenly seated in the socket.
- d. The gland shall be slid into position, the bolts inserted and the nuts made finger tight.
- e. The bolts shall be brought to a uniform tightness with a ratchet wrench. The bolts 180 degrees apart shall be tightened alternately in order to bring the gland up evenly all around, the bolt at the bottom of the joint to be tightened first and then continued in this manner.

I. Flanged Pipe and Fittings

The flanged piping shall be installed to the alignment indicated. Every precaution shall be employed in this work so that where a number of lines enter headers, exact elevations are maintained to permit exact alignment. Approved rubber gaskets 1/16-inch thick shall be installed between flanges to ensure watertight joints, and the flange surfaces shall be painted with red lead prior to insertion of the gaskets. The gaskets shall be full cut with pre-stamped bolt holes. The gasket material shall be free from corrosive alkali or acid ingredients. The bolts shall have hexagonal heads and nuts, all in accordance with the American National Standards Institute. If flanged pipe is to be buried or is exposed in a wet location, the bolts and nuts shall be painted with a bitumastic paint after installation and encased in polyethylene.

J. Plugging or Capping Dead Ends

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees and crosses, and all spigot ends shall be capped. Concrete reaction blocking shall be installed at all plugs and caps.

K. Anchoring and Blocking of Pipe and Fittings

The Developer/Contractor shall furnish and install concrete reaction blocking for ALL water main bends, tees, dead ends, reducers and hydrants unless specifically noted otherwise on the contract drawings, either prepared by or accepted by the Authority. The note regarding "RESPONSIBILITY AND MINIMUM PROVISIONS" shown on the Guide to Thrust Blocking Requirements, on the Miscellaneous Water Line Details Drawing, is extremely important.

The Developer/Contractor shall note that in many instances where restrained joints may be used in the project, those restrained joint provisions may be insufficient by themselves to properly accommodate all thrust forces.

Concrete reaction blocking shall be mixed in the proportions of 1:2-3/4:4 and have a compressive strength of not less than 2,000 pounds at 28 days. Concrete shall not be poured adjacent to bolts and nuts and shall be kept at a distance far enough away to facilitate bolt removal. Anchors and supports shall be installed where required.

The blocking shall be placed between the fitting to be anchored and a solid bearing and so placed as to permit access for repair to the pipe and fittings. All other piping shall be laid so that a uniform bearing is obtained, or so that the piping is properly supported.

All vertical bends shall be restrained or blocked with concrete. Where a section of pipeline must be installed at an angle greater than $11\frac{1}{4}^{\circ}$ from horizontal, both ends of the section and all intermediate joints must be properly restrained using restrained joint fittings.

Where the pipe is installed on slopes greater than 15%, concrete anchors shall be installed to firmly hold the pipe and to prevent erosion of the trench backfill material.

L. Concrete Encasement

Where the pipeline crosses under streams, concrete encasement will be installed. Encasement will be constructed to encase the pipe to a minimum 6-inch thickness, measured at the widest point of the pipe bells, for a longitudinal distance at least 10 feet on each side of the stream, or to a point where the top of the pipe is at least 2 inches above the normal stream level.

M. Installation of Pipe Inside Steel Casing Pipe

All pipe installed in the casing shall be fitted with Wolmanized wooden skids extending for the full length of the pipe, with the exception of the bell and spigot end. The skids shall be separated by 90° , being off-set from the horizontal and vertical axis by 45° for pipe up to 14 inches in diameter. Six evenly spaced skids shall be used on pipe diameters 16 inches through 36 inches and 7 skids shall be used on pipe diameters larger than 36 inches.

The skids shall provide sufficient height to permit clearance between the bell joint and casing wall. The skids shall be fastened securely to the pipe with strapping or clamps.

No petroleum products will be permitted for use as a lubricant during the installation of the water pipe into the casing.

Stainless steel annular skids may be used instead of wooden skids, provided the design of the skids is acceptable to MATW.

In all cases where a Developer/Contractor chooses to use a casing to facilitate his work, the casing materials and installation shall be in accordance with these requirements and the casing shall be left in place at no expense to MATW.

N. Installation of Valves, Fittings and Appurtenances

1) General

All valves, fittings, plugs, caps and other similar appurtenances shall be set and jointed to the pipe in the same manner specified for cleaning, laying and jointing of pipe. All bolts, nuts and plugs will be painted with bitumastic paint after installation, unless the pipeline is encased in polyethylene for at least 10 feet on either side of the appurtenance.

2) Valve Boxes

A valve box shall be provided for every valve installed underground.

The valve box shall not transmit shock or stress to the valve and shall be centered and plumb over the wrench nut of the valve. The box cover shall be flush with the surface of the finished pavement or with the ground surface. A reinforced concrete slab 18"x18"x6" shall be installed in a neat, workmanlike manner around each valve box lid located outside any paved surface.

3) Sleeves

Care shall be taken to ensure that the space between the pipe ends is as small as practical. A filler piece shall be installed to prevent any movement.

O. Installation of Fire Hydrants

1) Location

Fire hydrants shall be located in a manner to provide complete accessibility and also in such a manner that the possibility of damage from vehicles or injury to pedestrians will be minimized.

When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap shall be less than 6 inches and no more than 12 inches from the gutter face of the curb.

When set in the lawn space between the curb and the sidewalk or between the sidewalk and the property line, no portion of the hydrant or nozzle cap shall be within 6 inches of the sidewalk.

2) Position

All hydrants shall stand plumb and shall have their nozzles parallel with or at right angles to the curb with the pumper nozzle facing the curb. Hydrants shall be set to the established grade with nozzles at least 12 inches above the ground. The hydrant safety flange shall be above grade not less than 2 inches and no more than 4 inches.

3) Connection to Main

Each hydrant shall be controlled by an independent 6-inch gate valve. Each hydrant control valve shall be fastened to the main and to the hydrant with restrained joint fittings and ductile iron pipe nipples.

4) General Installation Requirements

This work will include all excavation, setting and connecting the hydrant branch with the main line, backfill, supporting and bracing, testing and other related work.

The hydrant base shall be restrained and blocked, as indicated on the Standard Drawing. All nut and bolts which will be underground shall be painted with bitumastic paint prior to backfilling. It is of utmost importance that solid bearing be obtained for the blocking and that such blocking be completely adequate. The space around the blocking and above the base of the hydrant to a height of at least 18 inches and a distance of at least 18 inches from outside the hydrant around the entire circumference shall be filled with broken stone or gravel absolutely clean, not less than 3/4-inch in size. At least 10 cubic feet of broken stone or gravel shall be placed around the hydrant.

The gravel or broken stone shall extend at least 6 inches above the waste opening in the hydrant. Hydrant drains which are located below the normal ground water elevation shall be plugged prior to the hydrant installation. In a location where the hydrant is to be placed in a sloping area, a clear area shall be provided behind and along the sides of the fire hydrants, and the earth shall be supported by an adequate stone wall on three sides.

Following installation, all damaged painting, including rust spots, chipped or abraded areas and all faded or discolored areas shall be wire brushed and touched up or, if ordered, completely repainted to the satisfaction of the Authority.

In all instances where the water lines are installed lower than the normal depth, due to topography and other physical facilities, extensions shall be provided on the hydrant so that the hydrant will be at the required height. The area around the hydrant shall be level, and sloped areas behind the hydrant shall be graded so the toe of the slope is sufficient distance from the hydrant to permit access on all sides and so that no earth material will be in close proximity to the section of the hydrant located above ground.

The depth of bury set forth in the Material Specifications is for an average or normal condition, and the hydrant must be adjusted for all conditions that are not normal.

P. Installation - Polyethylene Encasement

The polyethylene encasement, when required, shall be installed in accordance with the following:

- 1) Pick up the pipe by a crane at the side of the trench using either a sling or pipe tongs, and raise the pipe about three feet off the ground. Slip a section of undamaged polyethylene tube over the spigot end of the pipe and bunch up the tube, accordion fashion, between the end of the pipe and the sling. The tube should be cut approximately 2 feet longer than the length of the pipe.
- 2) Lower the pipe into the trench, seat the spigot end in the bell of the adjacent installed pipe and then lower the pipe to the trench bottom. A shallow bell hole shall be provided in the trench bottom to facilitate the wrapping of the joint.
- 3) Make up the pipe joint in the normal fashion.
- 4) Remove the sling from the center of the pipe and hook into the bell cavity. Raise the bell end 3 or 4 inches to permit the tube of polyethylene film to be slipped along the full length of the barrel. Enough of the film should be left bunched up, accordion fashion, at each end of the pipe to overlap the adjoining pipe about 1 foot.
- 5) To make the overlap joint, pull the film over the bell of the pipe, fold the film around the adjacent spigot and wrap with about three circumferential turns of the 2-inch wide plastic adhesive tape to seal the tube of film to the pipe.

The tube on the adjacent pipe shall then be pulled over the first wrap on the pipe bell and sealed in place behind the bell using about three circumferential turns of the 2-inch plastic adhesive tape.

- 6) The resulting wrap on the barrel of the pipe will be loose, and it should be pulled snugly around the barrel of the pipe and the excess material folded over at the top. The fold shall be held in place by 6-inch strips of the 2-inch wide plastic adhesive tape at intervals of about 3 feet along the pipe barrel.
- 7) Fittings, valves, hydrants, etc., except push-on joint fittings, shall be hand wrapped using polyethylene film that is held in place with the plastic adhesive tape. This will be required even though the pipeline itself may not require encasement.

Bends, reducers and offsets can be wrapped with the polyethylene tube in the same manner as pipe.

Valves can be wrapped by bringing the tube wrap on the adjacent pipe over the bells or flanges of the valve and sealing with the adhesive tape. The valve bodies are then wrapped with a flat sheet of the film passed under the valve bottom and brought up around the body to the stem and fastened in place with the adhesive tape.

Hydrants can be wrapped with polyethylene tube slipped over the hydrant to encase the hydrant from the lead-in valve to the ground level of the hydrant. To provide drainage of the hydrant, it is necessary to cut a small hole in the film and insert short brass pipe nipples to drain the water to the soil outside the film wrap.

All fittings that require concrete backing should be completely wrapped prior to pouring the concrete backing block.

- 8) If the polyethylene wrap is damaged during installation, damaged areas shall be re-wrapped with flat film and secured with tape.

Q. Trench Backfill

1) General

Final placement of all bedding and backfill materials from the bottom of the trench to the top of the pipe shall be BY HAND in lifts of no more than 4 inches. Special care shall be taken to ensure that material completely fills all voids around the bottom and sides of the pipe. Compaction of bedding and backfill materials from the trench bottom to the top of the pipe shall conform to the designated Standard Laying Condition.

Placement of backfill materials above the top of the pipe may be by machine, provided care is taken to ensure no voids will be present.

No bedding or backfill materials from the trench bottom to an elevation 1 foot above the top of the pipe shall be installed in a frozen condition. In sensitive areas, (such as under pavement, under shoulders, within three horizontal feet of a paved surface, etc.) absolutely no backfill materials will be permitted to be installed in a frozen condition. In less sensitive areas, up to 5% of the backfill material, to be placed in the trench zone located at least 1 foot above the top of the pipe, may be frozen PROVIDED that such frozen materials are broken up into particles no larger than 6 inches in size.

Backfill shall not be placed above any frozen materials which have already been placed in the trench unless the percentage and composition of the frozen material meets the limitations described in the preceding paragraph. Any permission to use backfill which contains limited amounts of frozen material will not limit the Developer/Contractor's responsibility to provide against trench settlement. It shall be the Developer/Contractor's responsibility to correct any trench settlement problem regardless of the cause of that problem.

All trenches which have been completely backfilled shall be maintained in good condition by the Developer/Contractor's for a period of two years after completion of the water line installation. The final grade of the trench shall be even with the grade of the roadway and shall be so maintained during construction and for two years thereafter.

The Developer/Contractor shall comply fully with the requirements of the Pennsylvania Department of Transportation or other municipal body having jurisdiction over the road along which work is in progress relative to backfill and restoration. All requirements in excess of these Specifications must be met.

2) Steep Berm Backfill

Where the excavation for the water main, service connections and appurtenances is made along or across a berm or shoulder sloping at a grade of 10% or greater, the top 12 inches of the trench shall be backfilled with AASHTO Number 1 (PennDOT Number 4) stone and choked with PennDOT Number 2A stone.

3) Backfill in Rock Excavation

Unless Type 4 or Type 5 standard laying conditions are indicated when rock is encountered at the proposed water line elevation, the trench shall be excavated an additional 4 inches and a 4-inch thick layer of fine aggregate, Number 2A stone, or selected earth material, as designated shall be installed as a cushion. In rock, either Type 3, Type 4 or Type 5 standard laying conditions shall be employed. Type 1 or Type 2 standard laying conditions shall not be used in rock areas.

4) Compaction

Normally all backfill shall be compacted by mechanical means in layers not to exceed 4 inches in thickness for tampers or wackers, or in layers not to exceed 8 inches for vibratory rollers.

R. Installation of Detectable Identification Tape and Locating Wire

All installations of nonmetallic pipeline shall include the furnishing and installation of detectable identification tape and locating wire. Both the detectable identification tape and the locating wire are to be located directly above the centerline of the pipeline and are to be positioned between 12" and 18" below the final ground surface elevation.

The locating wire is to be continuous and, to the extent practical, without splices between termination stations.

Prior to acceptance by the Authority, the Developer/Contractor shall electrically test the locating wire for its entire length to verify continuity.

S. Connections to the Existing System

All connections to the existing system will be completed with a minimum of down-time and at a time satisfactory to the Authority. It is anticipated that it will be possible to make the connections during normal working hours, however, if such scheduling becomes impossible, the work shall be completed at a time selected by the Authority.

Prior to starting any work, the exact depth and orientation of the existing line to which connections are to be made shall be established in order that the new line will be properly installed, thus permitting connections to be made as scheduled. Prior to making any connection, the Authority shall be given 48 hours notice (72 hours if the connection is to occur on a Monday). Once an existing line is removed from service for a connection, the work shall progress continuously until service is restored.

T. Installation of Service Lines

The curb stop and box will be placed near the property line of each property.

The tap for the corporation stop shall be placed at an angle of about $22\frac{1}{2}^{\circ}$ above horizontal, except that at high points the tap shall be near the top of the pipe and the stop firmly inserted. The copper pipe shall be connected to the stop, placed with a slight curvature to allow for settlement of the main line, and extended to the curb stop with a minimum depth of cover of 48 inches.

The curb box shall be placed in a perpendicular position directly over the curb stop, shall be properly supported beneath and shall be supported with properly tamped material extending to the surface of the ground.

U. Tapping PVC Pipe

All service connections on PVC pipe will utilize a wrap-around pipe saddle. Drilling the PVC pipe will be done slowly and cautiously, using only equipment and cutters designed specifically for PVC pipe and in accordance with equipment manufacturer's recommendations. Pipe temperature during tapping shall be in the range of 32° - 90° Fahrenheit.

19. HYDROSTATIC TESTS

After completion of the pipeline, or any portion of it, the installation shall be subjected to a hydrostatic test of 100 psi in excess of the normal working pressure as measured in the section of line to be tested. The section of line being tested shall not exceed 1,500 feet unless otherwise agreed to by the Authority.

The Developer/Contractor shall be responsible for isolating the new pipeline from all existing pipelines prior to the performance of hydrostatic tests. If this isolation is obtained by a physical separation, the final connection shall be visually inspected for leakage prior to backfilling.

Each section of pipe to be tested shall be slowly filled with water with the specified test pressure applied by means of a pump connected to the pipe in a satisfactory manner.

Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants or blow-offs are not available at high points, the Developer/Contractor shall make the necessary taps at points of highest elevation before the test is made using approved corporation stops, Type K copper, curb stops and boxes. This installation shall be left in place upon completion of the line.

The Developer/Contractor shall furnish the pump, connections, gauges and all other equipment required for proper execution of the hydrostatic test. All gauges shall be subject to testing and acceptance by the Authority.

After the test pressure has been applied, a leakage test shall be conducted to determine the exact quantity of leakage. The Developer/Contractor shall furnish all measuring devices, pumps, connections, gauges and all other required equipment for the proper execution of the leakage test. The gauges and measuring devices shall be subject to testing and acceptance by the Authority. During each test, the line shall be continuously subjected to the pressure previously specified for a duration not less than 2 hours.

Leakage is defined as the quantity of water to be supplied into the section of pipe being tested necessary to maintain the specified leakage test pressure after the pipe has been filled with water and air expelled.

The allowable leakage for 1,000 feet of 18-foot lengths of mechanical joint or push-on joint pipe at various pressures and diameters is shown in the table set forth below. If a line contains fittings or pipe lengths other than 18-foot nominal, the table should not be used and the allowable leakage should be computed by multiplying the leakage indicated in the table by a factor obtained by dividing 18 feet by the average length of pipe (including fittings) between joints. No pipe installation will be accepted if the leakage is greater than indicated in the following table.

The Authority shall be furnished with a written report of the results of the leakage test that identifies the specific length of pipe tested, the pressure, the duration of the test and the amount of leakage.

If any test of pipe discloses leakage greater than that specified in this Section, the Developer/Contractor shall locate the leak and repair the pipeline until the leakage is within the specified allowance.

Leaks shall be corrected by removing defective pipe lengths and installing new pipe and, if necessary, approved sleeves. Repair clamps will not be permitted.

Mechanical joint pipe or push-on joint pipe may, at the option of the Authority, be subjected to hydrostatic pressure, inspected and tested for leakage at any convenient time after the trench has been partially or completely backfilled.

Where concrete thrust blocks are provided on any section of the main line, the hydrostatic pressure test shall not be made until at least 5 days have elapsed after the concrete thrust blocks were installed. If high early strength concrete is used in the construction of the thrust block, the hydrostatic pressure test shall not be made until at least 2 days have elapsed.

Avg Test Pres psi	Allowable Leakage per 1,000 Linear Feet [Gallons per Hour]								
	PIPELINE DIAMETER [Inches]								
	2"	3"	4"	6"	8"	10"	12"	14"	16"
450	0.16	0.24	0.32	0.48	0.64	0.80	0.96	1.12	1.25
400	0.15	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20
350	0.14	0.21	0.28	0.42	0.56	0.70	0.85	0.99	1.13
300	0.13	0.20	0.26	0.39	0.52	0.65	0.75	0.91	1.04

Copyright Bankson Engineers, Inc., January 2010

This document has been prepared exclusively for the use of developers or developers' agents engaged in the installation of extensions to the water distribution system of The Municipal Authority of the Township of Washington (MATW or Authority) under the terms of Developer's Agreements, or for the use of PennDOT and PennDOT's agents engaged in the replacement or relocation of MATW water mains to accommodate highway improvements. The use of this document by others or by anyone for any purpose other than for extensions, replacements or relocations to the MATW water distribution system is forbidden. The use of this document for any purpose is permitted only with the express permission of both Bankson Engineers, Inc. and MATW. This document may be reproduced only by Bankson Engineers, Inc. and MATW, or by PennDOT or PennDOT's agents, but only for MATW water system related projects.

Avg Test Pres psi	Allowable Leakage per 1,000 Linear Feet [Gallons per Hour]								
	PIPELINE DIAMETER [Inches]								
	2"	3"	4"	6"	8"	10"	12"	14"	16"
275	0.13	0.19	0.25	0.38	0.50	0.62	0.75	0.87	1.00
250	0.12	0.18	0.24	0.36	0.48	0.60	0.71	0.83	0.95
225	0.12	0.17	0.23	0.34	0.45	0.57	0.68	0.79	0.90
200	0.11	0.16	0.22	0.32	0.43	0.53	0.64	0.74	0.85
175	0.10	0.15	0.20	0.30	0.40	0.50	0.60	0.70	0.80
150	0.10	0.14	0.19	0.28	0.37	0.46	0.55	0.65	0.74
125	0.09	0.13	0.17	0.25	0.34	0.42	0.51	0.59	0.67
100	0.08	0.12	0.15	0.23	0.30	0.38	0.45	0.53	0.61

The allowable leakage values presented in this table equal ½ the values presented in Table 7 of A.W.W.A. C600.

Note: For pipe with 18-foot nominal lengths. To obtain the allowable leakage for pipe with 20-foot nominal lengths, multiply the leakage calculated from the table by 0.90. If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakages for each size.

20. OPERATIONAL TESTS

After completion of the hydrostatic tests, all valves, hydrants and other operating appurtenances will be operated throughout their range and checked for proper operation. At the completion of this test, all valves will be open and all hydrants will be closed, unless otherwise required by the Authority.

21. DISINFECTION OF PIPELINES

Prior to being placed into service, all new mains and repaired portions of, or extensions to, existing mains shall be thoroughly disinfected through the use of liquid chlorine or chlorine compound. The quantity of chlorine used shall be such an amount that a chlorine residual of not less than 10 parts per million remains in the water after 24 hours standing in the pipe.

The disinfection procedure shall be executed in accordance with the Specifications of the American Water Works Association Designation C651 - Standard for Disinfecting Water Mains.

All dirt and foreign matter shall be removed prior to chlorination by flushing the line. Any available outlets may be used, and additional outlets or blow-offs shall be installed as necessary under the Lump Sum Price, to provide sufficient flow to obtain a water velocity in the pipeline of not less than 5 feet per second, unless this velocity is unobtainable from the source. Flushing shall be done after the pressure test has been made. It must be understood that flushing removes only the lighter solids and cannot be relied upon to remove heavy material allowed into the main during laying.

The chlorine to be applied to the water shall be in the form of liquid chlorine, high test calcium hypochlorite or sodium hypochlorite. The use of chloride of lime is not permitted.

The preferred point of application of the chlorine material is at the beginning of the pipeline extension or any valved section in the extension, and through a corporation stop inserted by the Developer/Contractor in the top of the newly laid pipe. The water injection for delivering the chlorine-bearing water into the pipe should be supplied from a tap on the pressure side of the gate valve controlling the flow into the pipeline extension.

Water from the existing distribution system or other source of supply shall be controlled so as to flow slowly into the newly laid pipeline during the application of chlorine. The rate of chlorine mixture flow shall be in such proportion to the rate of water entering the pipe that the chlorine dose applied to the water entering the newly laid pipe shall produce at least 10 parts per million after 24 hours standing.

If circumstances are such that a short retention period must be used, the chlorine concentration shall be increased accordingly.

Tablet disinfection shall be limited to short extensions (up to 2,500 feet), and small diameter mains (up to 12 inches). Because the preliminary flushing step must be eliminated, this method shall be used only when scrupulous cleanliness has been exercised. Tablet disinfection shall not be used if trench water or foreign material has entered the main, or if the water is below 5° Centigrade (41° Fahrenheit).

The number of tablets required to provide a dose of 50 mg/l of chlorine is provided in the table below.

Tablets shall be placed in each section of pipe, hydrants, hydrant branches and other appurtenances. The tablets shall be attached by a food grade adhesive. All the tablets within the main must be at the top of the main. If the tablets are fastened before the pipe section is placed in the trench, their position should be marked on the section to assure that there will be no rotation. This is particularly important if PVC, PVCO, or other plastic pipe material is being used.

Copyright Bankson Engineers, Inc., January 2010

The adhesive may be Permatex Forma-a-Gasket No. 2* or any alternative acceptable to the Authority. There shall be no adhesive on the tablet except on the broad side next to the surface to which the tablet is attached.

- * A product of the Permatex Company, Brooklyn, New York, and Kansas City, Kansas.

When installation has been completed, the main shall be filled with water at a velocity of less than 1 foot per second. This water shall remain in the pipe for at least 24 hours.

Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back to the line supplying the water.

Number of Hypochlorite Tablets of 5-G
 Required for Dose of 50 Mg/l**

Length of Section [Feet]	Diameter of Pipe [Inches]					
	2	4	6	8	10	12
13 feet or less	1	1	2	2	3	5
18	1	1	2	3	5	6
20	1	1	2	3	5	7
30	1	2	3	5	7	10
40	1	2	4	6	9	14

**Based on 3-3/4 grams available chlorine per tablet.

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/l. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline.

22. DISPOSING OF HEAVILY CHLORINATED WATER

The environment to which the chlorinated water is to be discharged shall be inspected. If there is any question that the chlorinated discharge will cause damage to the environment, then a reducing agent, such as sodium thiosulphate, shall be applied to the water to be wasted to thoroughly neutralize the chlorine residual remaining in the water. Where necessary, federal, state, and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water.

In Pennsylvania, the Fish Commission must be notified before discharging heavily chlorinated water to a stream.

Following chlorination, all treated water shall be thoroughly flushed from the newly laid pipeline at all its extremities until the replacement water throughout its entire length shall, upon test, be proved comparable in quality to the water served to the public from the existing water supply system.

No sooner than 48 hours after the pipeline flushing has been completed, and during which 48 hour period the new pipeline has remained full of water, but inactive, a sample shall be collected at each dead end. On continuous lengths exceeding 2,000 feet, at least one sample shall be obtained for every 2,000 linear feet. No substantive flushing of the new main should occur for the 48 hours prior to the collection of the sample(s).

Tests shall be performed by a laboratory, independent of the Developer/Contractor, certified by the EPA. The water samples for the bacteriological analyses shall be obtained by the Developer/Contractor only when a representative of the Authority is present. The water samples shall be collected in bottles provided by a laboratory certified by the Department of Environmental Protection to perform bacteriological testing. Once collected, the samples shall be turned over to the Authority's representative for delivery to the laboratory. The laboratory's charges for the bacteriological analyses shall be borne by the Developer/Contractor. The costs for delivering the water samples to the laboratory shall be borne by the Authority. The tests shall show that either (a) the water quality is comparable to that in the rest of the system, or (b) the total coliform count is no higher than 1.0 coliform bacteria per 100 milliliter sample and a standard plate count does not exceed 500 bacteria per 1 milliliter sample after 48 hours incubation. This satisfactory quality of water delivered by the new main should continue for a period of at least two full days, as demonstrated by laboratory examination of samples taken from a tap located and installed in such a way as to prevent outside contamination.

Should the initial treatment fail to result in the conditions specified, additional flushing and/or the original chlorine procedure shall be repeated until satisfactory results are obtained. The timing and responsibilities regarding any additional sampling and testing shall be as stipulated for the original sampling and testing.