

METROPOLITAN UTILITIES DISTRICT	Construction Standard	No: 1.15.1
Prepared by: Rich Baird	Installation of Water Mains	Page: 1 of 12
Approved by: James Bartels		<u>Supersedes:</u> New
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GENERAL

Water mains shall be installed using only piping and fittings approved by the District's Engineering Design Department. Acceptable methods of installation are open cutting, horizontal directional drilling (HDD) and pipe bursting. The type of pipeline material will dictate which installation method may be used.

PIPE INSTALLATION REQUIREMENTS

Pipe Handling

Pipes, valves, hydrants and fittings shall be lowered from trucks and into trenches with ropes, wide belt slings or other suitable tools and equipment that will not damage the material. Dropping or dumping material from trucks and into the trenches is not permitted. Any item that is dropped or dumped is automatically rejected and shall not be used. The contractor shall pay the District the full cost of any District provided item that is dropped or dumped into the trench. In addition, the contractor shall return said item(s) to the District's Stores Yard.

Pipe Cleanliness

All dirt and other foreign material shall be removed from the inside of all pipe and fittings before installation. Care shall be taken to prevent foreign material (dirt, debris, tools, clothing, animals, etc.) from getting in the pipe before, during and after installation. Pipe ends shall be effectively covered if foreign material can't be prevented from entering the pipe until the pipe is installed.

Whenever pipe installation is not in progress, the open ends of the installed pipe shall be closed by a watertight plug or cap. In addition, the open end of the pipe shall be closed by a watertight plug or cap when being pushed through a bore hole or casing.

Cutting Metal Pipe

Pipe shall be cut perpendicular to the pipe axis with power cutting tools driven either by hydraulic, electric or air motors, or by gasoline engines. Tools which can damage the pipe will not be permitted. The use of cutting torches is not permitted, except on steel pipe. When a contractor requests the use of a cutting torch, they shall submit cutting materials and procedures to the Engineer for approval.

Direction of Bells

Pipe shall be laid with bells in the direction of laying (bells ahead).

Unsuitable Laying Conditions

Pipe shall not be laid in water or when either trench conditions or weather conditions are adverse to the laying of pipe unless permitted by the Senior Design Engineer - Water.

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Pipe Embedment

Unless otherwise shown on the drawings, pipe embedment shall be per C.S. [1.11.2](#).

General Laying Procedure

After a length of pipe is lowered into the trench, its spigot end shall be centered in the bell of the preceding pipe and brought home. The pipe shall be brought to correct line and grade and secured in place with approved embedment material.

Joint Lubricant

All spigot ends shall be given a thin film of joint lubricant before the joint is made. Use only lubricant that is supplied by the pipe supplier unless otherwise directed by the Senior Design Engineer - Water.

Cleaning Joint Surfaces

The last 12" of the internal and external surface of the pipe ends (ex. spigot and/or bell) shall be thoroughly cleaned to remove oil, grit, tar, and all other foreign material. For metal and concrete piping, this shall be done by wire brushing and wiping. For plastic piping, this shall be done with a clean, dry, non-dyed, lint-free cloth or paper towel to remove dust and light soil. Heavier soil may be washed off with soap and water, followed by a thorough rinse with clean water, and dried with a clean, dry, non-dyed, lint-free cloth or paper towel. Solvents, other than soap and water, shall not be used to clean joint surfaces.

Separation from Sanitary and Storm Sewers

Installation of water mains parallel to sewers as well as sanitary and storm sewer crossings shall be done in accordance with the C.S. [1.13.1](#).

Flanged Joint Assembly

The following procedure shall be used for assembling flanged joints:

1. Thoroughly clean the mating surfaces of both flanges. The flanges shall be free of oil, grit, tar and other foreign material.
2. Coat each mating surface with gasket sealant.
3. Place a full-faced gasket on one flange. Align the bolt holes in the gasket with the bolt holes in the flange.
4. Bring both flanges together and insert the bolts through the bolt holes.
5. Tighten bolts in pairs with each member of the pair on opposite sides of the flange assembly. Each pair shall be drawn up a little at a time until all bolts are uniformly tight.

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Bentomat CL Geosynthetic Clay Liner

Install Bentomat CL Geosynthetic clay liner around pipe and fittings as shown on the drawings or as directed by Engineer per C.S. [1.11.3](#).

INSTALLATION OF DUCTILE IRON PUSH JOINT (DIPJ) PIPE

General Joint Assembly

1. Clean the bell and spigot.
2. Insert a single rubber gasket with the small bulb of the gasket to the outside of the bell (in the event organic chemicals, e.g. gasoline, diesel, oil, etc., are encountered in the soil during construction, the gasket shall be Nitrile [NBR]).
3. Lubricate the spigot, insert spigot in the bell, and push home to complete the joint.

Checking the Gasket

After the joint is assembled, use a feeler gauge to verify the gasket is in its retaining groove. If the gasket is out of the groove, the pipes shall be pulled apart, the gasket removed and disposed of, a new gasket inserted, and the pipes reassembled as directed above. Cut used and rejected gaskets into at least two pieces to prevent reuse.

Preparing Cut Pipe Ends

When cut pipe ends are to be used in place of manufactured spigot ends, the cut end shall be filed or ground to produce a slight bevel of about 30 degrees from the vertical face. **CAUTION:** *Ensure there are no sharp edges that could cut the gasket during assembly.*

Pipe Deflection

If a deflection is required, the pipe shall be deflected after the pipe spigot is pushed home. At all times, the spigot shall be pushed home with no deflection.

The maximum permissible deflection per length of pipe shall not exceed the recommendations listed in Table 1.

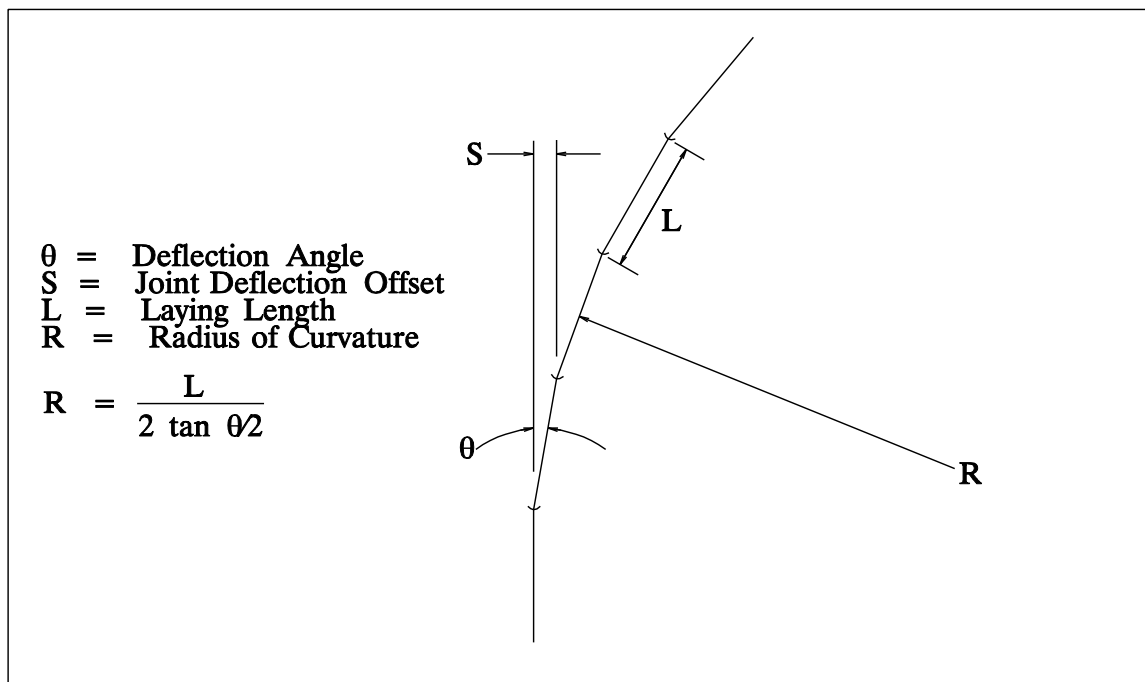
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Table 1 - Maximum joint deflection for full-length push joint pipe

Nominal Pipe Size (in.)	*Deflection Angle - θ (degrees)	Maximum Offset – S (in.)		Produced by Succession of Joints (ft.)	
		Length = 18'	Length = 20'	Length = 18'	Length = 20'
3	5	19	21	205	230
4	5	19	21	205	230
6	5	19	21	205	230
8	5	19	21	205	230
10	5	19	21	205	230
12	5	19	21	205	230
14	3*	11	12	340	380
16	3*	11	12	340	380
18	3*	11	12	340	380
20	3*	11	12	340	380
24	3*	11	12	340	380
30	3*	11	12	340	380
36	3*	11	12	340	380
42	3*	11	12	340	380
48	3*		12		380
54	3*		12		380
60	3*		12		380
64	3*		12		380

* For 14" and larger push joint pipe, maximum deflection angle may be larger than shown above. Consult pipe manufacturer.



Pipeline Curve Geometry

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INSTALLATION OF DUCTILE IRON MECHANICAL JOINT (DIMJ) PIPE

General Joint Assembly

Mechanical joints shall be assembled as follows:

1. Clean the bell and spigot.
2. Lightly coat both the bell and spigot with joint lubricant.
3. Slip the cast iron (CI)/ductile iron (DI) gland over the spigot. The lip extension of the gland shall extend toward the end of the spigot.
4. Slip a rubber gasket over the spigot with the thick edge of the gasket toward the gland (in the event organic chemicals, e.g.: gasoline, diesel, oil, etc., are encountered in the soil during construction, the gasket shall be Nitrile [NBR]).
5. Insert the spigot into the bell.
6. Press the gasket into place into the bell. When installed properly, the gasket will be evenly located around the entire joint.
7. Slide the gland into position for bolting. Align the bolt holes in the gland and the bell.
8. Insert the bolts and screw on the nuts finger tight.
9. Tighten bolts in pairs with each member of the pair on opposite sides of the pipe. This will draw the gland into the joint. Tighten the bolts with a torque limiting wrench to the values listed in Table 2.

Table 2 – Permissible Bolt Torque

Bolt Diameter	Torque (ft-lbs.)
5/8"	45-60
3/4"	75-90
1"	85-100
1-1/4"	105-120

Retainer Glands

Retainer glands for use with mechanical joint pipe shall be used and installed in accordance with C.S. [5.5.3](#). **All mechanical joint pipe to be retained shall use wedge action retainer glands. Set screw retainer glands shall not be used except for retaining plain end fittings. Do not use wedge action retainer glands on plain end fittings.**

Preparing Cut Pipe Ends

When cut pipe ends are to be used in place of manufactured spigot ends, the cut end shall be filed or ground to produce a slight bevel of about 30 degrees from the vertical face. **CAUTION:** *Ensure there are no sharp edges that could cut the gasket during assembly.*

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Pipe Deflection

If a deflection is required, the pipe shall be deflected after [step 8](#) and before [step 9](#) of the assembly procedure. The maximum permissible deflection per length of pipe shall not exceed the recommendations listed in Table 3.

Table 3 - Maximum joint deflection for full-length M.J. pipe without retainer glands

Nominal Pipe Size (in.)	Deflection Angle - θ (degrees & minutes)	Approx. Radius of Curve – R Produced by Succession of Joints (ft.)			
		Maximum Offset – S (in.)		Length = 18'	Length = 20'
3	8-18	Length = 18'	Length = 20'	Length = 18'	Length = 20'
4	8-18	31	35	125	140
6	7-07	27	30	145	160
8	5-21	20	22	195	220
10	5-21	20	22	195	220
12	5-21	20	22	195	220
14	3-35	13.5	15	285	320
16	3-35	13.5	15	285	320
18	3-00	11	12	340	380
20	3-00	11	12	340	380
24	2-23	9	10	450	500

Joint deflection with retainer glands shall not exceed the above table or the gland manufacturer's specifications.

INSTALLATION OF DUCTILE IRON RESTRAINED JOINT(DIRJ) PIPE

General Joint Assembly

Restrained joint pipe is unique between manufacturers. The crew or contractor installing the pipe shall be responsible for knowing the manufacturer's assembly procedure for the restrained joint pipe that is being installed and for installing the pipe per the pipe manufacturer's procedure. The following is a general assembly procedure for DIRJ pipe:

1. Clean the bell and spigot.
2. Clean and insert the rubber gasket into the appropriate seat in the pipe bell (in the event organic chemicals, e.g. gasoline, diesel, oil, etc., are encountered in the soil during construction, the gasket shall be Nitrile (NBR)).
3. Lubricate the gasket and the companion spigot end.
4. Insert the spigot end into the companion bell.
5. Install the restraint mechanism.
6. Pull the leading pipe (pipe just installed) axially to engage the restraint mechanism.
CAUTION: *Pulling more than required to engage the restraint mechanism may separate adjoining non-restrained joints (push or mechanical joints).*

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Pipe Deflection

If a deflection is required, the pipe shall be deflected after the joint has been completely assembled. The maximum permissible deflection per length of pipe shall not exceed the recommendations listed in Table 4.

Table 4 - Maximum joint deflection for full-length R.J. pipe

Nominal Pipe Size (in.)	Deflection Angle – θ (degrees-minutes)	Maximum Offset – S (20' Pipe Length) (in.)	Approx. Radius of Curve – R Produced by Succession of Joints (20' Pipe Length) (ft.)
4	5-0	21	230
6	4-0	17	285
8	4-0	17	285
10	4-0	17	285
12	4-0	17	285
14	3-0	12	380
16	3-0	12	380
18	3-0	12	380
20	2-30	10	460
24	2-15	9	510
30	1-45	7	655
36	1-30	6	765
42	0-30	2	2295
48	0-30	2	2295
54	0-30	2	2295

INSTALLATION OF POLYVINYL CHLORIDE (PVC) PIPE

PVC pipe shall not be installed in soils contaminated with organic chemicals (e.g.: gasoline, diesel, oil, etc.). If organic chemicals are encountered in the soil during construction, cease construction activities immediately and notify the Design Engineer for the project or the Senior Design Engineer. The construction of the pipeline shall not continue in the contaminated area until authorized and notified, in writing, by the Engineer.

Assembling Push-On Pipe Joint

Only pipes with factory installed gaskets shall be used. **CAUTION:** *Do not remove the gasket from the pipe bell end as this may damage the pipe.*

- Clean the joint surfaces. Apply lubricant per the manufacturer's specifications. **CAUTION:** *Do not use any other lubricant than that supplied by the pipe manufacturer.*
- Brace the bell so that it doesn't move during the joint assembly process.
- Insert the spigot into the mating bell assuring straight alignment. Once the spigot evenly contacts the gasket, apply firm pressure either by hand or bar and block assembly. Larger pipe may require the use of mechanical assistance.
- Push the pipe until the "reference mark" on the spigot end is flush and visible with the lip of the mating bell. **CAUTION:** *Do not over insert the spigot and do not use excessive force which may over insert previously assembled pipe joints.*

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Assembling PVC Pipe to Valves, Fittings and other Mechanical Joint Appurtenances (mechanical joint DI fittings shall be used in PVC water main construction)

Pipe ends that will be inserted into a mechanical joint fitting or valve shall have all but 1/4” of the factory bevel removed. A cut pipe end shall have a 1/4” bevel constructed on the end of the pipe. The angle and depth of the bevel shall match that of the first 1/4” of bevel, closest to the bell end, on a factory beveled pipe end. The end may be beveled using a wood rasp, a pipe beveling tool, sander or abrasive disk. All burrs and sharp edges shall be removed prior to joint construction.

The PVC pipe end shall be pushed fully home (bottomed out) within the mechanical-joint bell. The joint shall be assembled per the [Installation of Ductile Iron Mechanical Joint \(DIMJ\) Pipe – General Joint Assembly](#) section of this standard.

Preparing Cut Pipe Ends

Pipe shall be cut perpendicular to the pipe axis using a steel blade hand or power saw or a power saw with an abrasive blade.

Cut pipe ends that will be inserted into a PVC bell shall be beveled to match a factory beveled spigot end and an insertion reference mark shall be drawn around the circumference of the pipe an appropriate distance back from the cut end. A factory beveled spigot end shall be used as a guide for proper bevel angle and depth; furthermore, the end shall be used to determine the distance of the insertion reference mark from the end of the pipe. The end may be beveled using a wood rasp, a pipe beveling tool, sander or abrasive disk. All burrs and sharp edges shall be removed to avoid cutting the gasket during joint construction.

Pipe Joint Deflection and Pipe Bending

WARNING: Under no circumstances shall it be permitted to bend pipe to achieve a change in horizontal and/or vertical alignment. Each pipe segment shall be straight from pipe end to pipe end. Bending PVC pipe can induce stresses within the pipe that may cause pipeline failure during tapping operations.

Pipe joints may be deflected to achieve **minor changes** in alignment. Pipe joints shall not be deflected more than 4" (1°) per 20' length of PVC pipe manufactured by Diamond Plastics Corporation or as recommended by the pipe manufacturer. If a required change in alignment exceeds that of joint deflection, fittings (bends) shall be used.

Pipe Surface Damage

Pipe segments that have scratches, gouges, cuts, etc. that are 10% or greater of the pipe wall thickness shall not be used in the construction of the pipeline.

INSTALLATION OF PVC RJ PIPE VIA PIPE BURSTING

Integral bell Certa-Lok PVC RJ pipe should be used when installing PVC via pipe bursting. A similar restrained joint system may be considered if the bells are deemed enough to not be scarred during pull-back. Certa-Lok splines shall be trimmed flush prior to pipe being pulled in.

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INSTALLATION OF HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PE pipe shall not be installed in soils contaminated with organic chemicals (e.g.: gasoline, diesel, oil, etc.). If organic chemicals are encountered in the soil during construction, cease construction activities immediately and notify the Design Engineer for the project or the Senior Design Engineer. The construction of the pipeline shall not continue in the contaminated area until authorized and notified, in writing, by the Engineer.

Joints

Unless otherwise specified, all polyethylene joints on HDPE pipe shall be thermally butt fused.

Joining Methods

The pipe and fittings shall be joined by butt fusion, electrofusion, or mechanical joint adapters, or acceptable DI restrained joint fittings with stainless steel stiffeners in accordance with the District's Construction Standards.

Butt Fused Joints For HDPE Pipe

See C.S. [11.2.3](#).

Installation of Electrofusion Couplings on HDPE Pipe

See C.S. [11.7.0](#).

Installation of Sidewall Fusion-Corp. Saddles

See C.S. [11.7.1](#).

Bead Removal

Melt beads shall not be removed from the inside or outside of the butt fused joint.

Pipe Surface Damage

For pipe segments that have scratches, gouges, cuts, etc., see C.S. [1.2.6](#) for repair or replacement instructions.

Assembling HDPE Pipe to Valves, Fittings and other Mechanical Joint Appurtenances (mechanical joint DI fittings shall be used in HDPE water main construction)

Connections to DI pipe, fittings and valves as shown on the drawings shall use mechanical joint adapters or wedge action retainer glands with stainless steel insert stiffeners. Mechanical joint adapters shall incorporate a factory installed stiffener and shall be butt fused to the plain end of the HDPE pipe per manufacturer's recommended joining procedure.

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INSTALLATION OF PRESTRESSED CONCRETE CYLINDER PIPE (PCCP)

General Joint Assembly

The following procedure shall be used to assemble joints:

1. Clean the bell and spigot rings.
2. Check the bell and spigot rings for any nicks or burrs. Any nicks or burrs which are discovered shall be carefully filed smooth.
3. Coat the gasket with lubricant and install it on the spigot.
4. Exercise the gasket by inserting a smooth round rod between the gasket and the spigot and running the rod around the spigot for a complete turn in one direction and then for a complete turn in the opposite direction.
5. Lubricate the bell.
6. Insert the spigot in the bell and push the pipe home.
7. Check the position of the gasket in the joint with steel feeler gauges before the pipe reaches final position.

Joint Grouting

Inside Joint Recess

Fill the inside joint recess with a mortar consisting of one part Portland cement and three parts sand and having a consistency such that it will stay in the recess without sagging, slumping, or falling out. Clean and saturate the recess with clean water before applying the mortar. Trowel the surface of the mortar flush with the adjacent pipe surfaces.

Outside Joint Recess

Enclose the outside joint recess using a diaper furnished by the pipe manufacturer, which acts as a form for the grout. Mix the grout to a pouring consistency, which shall consist of one part Portland cement and three parts sand. Pour the grout into the space formed by the diaper and the pipe, allow the grout to run to the bottom of the pipe, and rod until the joint is completely filled.

The grouting of the joints shall comply with the pipe manufacturer's recommendations and procedures.

Joint Harnesses

Joint harnesses shall be installed as shown on the drawings. Grout all harness joints as described above.

Temporary Supports

Temporary support may be required for previously laid pipe to maintain the correct grade where pipe is being installed in concave transitions between grades.

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Pipe Deflection

Joint deflections for straight concrete pipe or joint breaks with bevels shall not exceed the pipe manufacturer's published recommendations.

INSTALLATION OF STEEL PIPE

At all times during construction and installation of the pipeline, use every precaution to prevent damage to the protective coating on the pipe. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workers will be permitted to walk upon the coating only when necessary, in which case they shall wear shoes with rubber or composition soles and heels. (Any damage to the pipe or protective coating from any cause during the installation of the pipeline and before final acceptance by the District shall be repaired as directed by the Engineer at the expense of the contractor).

During welding the coating shall be protected by draping any 18" wide strip of heat-resistant material over the top half of the pipe on each side of the coating holdback to avoid damage to the coating by hot weld spatter. No welding ground shall be made on the coated part of the pipe.

Pipe shall be handled with wide belt slings. Chains, cables and other equipment likely to cause damage to the pipe or coating shall not be used.

Field joints shall be wrapped in accordance with C.S. [8.5.2](#).

CORROSION PROTECTION OF METALLIC PIPELINES AND APPURTENANCES

Polyethylene Encasement of Ductile Iron

All buried ductile iron pipe and fittings shall be encased in polyethylene in accordance with C.S. [1.12.1](#).

Wrapping of Couplings on Ductile Iron Mains

All mechanical couplings shall be wrapped in polyethylene in accordance with C.S. [1.12.1](#).

Coating of Couplings on Concrete Mains

Buried steel couplings installed on concrete pipe and any adjacent bare steel shall be fully encased in 2" to 6" of cement mortar coating.

Material in Vaults

Uncoated gate valves (other than bronze), steel piping, mechanical couplings, mechanical joints, flanges including bolts, nuts and washers and any other uncoated ferrous material in vaults shall be wrapped per C.S. [8.5.2](#).

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Protection of Buried Steel

All steel flanged outlets, steel mechanical couplings and any other uncoated steel appurtenances which are buried and not located in vaults shall be primed and double wrapped with cold applied pipe wrap conforming to C.S. [8.5.2](#).

Insulated Flange Sets

All flanges specified as insulated flanges shall be assembled with double insulating flange sets, which shall be installed per C.S. [8.2.2](#).

Cathodi-Clamps and Anode Installation

All Cathodi-Clamps and anodes shall be installed per C.S. [8.3.3](#).